ANVESHANA'S INTERNATIONAL JOURNAL RESEARCH IN ENGINEERING AND APPLIED SCIENCES.

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NATIONAL LEVEL CONFERENCE ON INNOVATIVE COMPUTATIONAL MATHEMATICS AND MECHANICAL APPLICATIONS
NLCECMA-2017

23rd December 2017

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Messages

NATIONAL LEVEL CONFERENCE ON INNOVATIVE COMPUTATIONAL MATHEMATICS AND MECHANICAL APPLICATIONS NLCECMA-2017 23rd December 2017 addresses these issues through the seminar and exhibitions, bringing together representatives of all those involved at every fields of business, industry, academic, government and civil.

The National Conference facilitates ideas, information and program possibly to solve. his conference is going to address many issues. I am confident that your deliberations and the outcome of your efforts will raise public awareness about the role and value technology as a tool to promote economic, social and cultural development while addressing the complex issues on your agenda.

I wish all the delegates a successful techno career and take the privilege to welcome you all to this National Conference NLCECMA-2017.

We look forward for your participation.

With best wishes.

Dr. S. Chakradhar Goud
Sana Engineering College

Message

I am indeed honored to be invited to the **NATIONAL LEVEL CONFERENCE ON INNOVATIVE COMPUTATIONAL MATHEMATICS AND MECHANICAL APPLICATIONS NLCECMA-2017** being organized under the aegis of the Anveshana Education and Research Foundation (AERF). I wish to compliment the vision of AERF aimed at keeping the younger generation abreast of the latest multi-disciplinary trends in technology. We are all aware of the 'future shock 'syndrome where what is current today is rendered obsolescent tomorrow. This underpins the paramount need to move in synch with the latest trends in research and technology. Today innovation constitutes the cornerstone of technological advancement. The talent and skills of Indians are being recognized globally. It is conferences like **NLCECMA-2017** that would offer a veritable platform for the dissemination and exchange of ideas. I would appeal to all the participants to make the best use of this opportunity and derive the maximum benefit.

B. Pavan Goud
Director-AERF

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Message

I am glad to know now that AERF (Anveshana Educational and Research foundation) is organising a conference on "Multi-Disciplinary Academic Studies" on 2nd July 2016 at NSIC, ECIL.

This conference would understand the people of INDIA to conquer the Knowledge in different domains of Academic Studies. This Conference will go a long way in establishing concept and disseminating the knowledge about the Multi-Disciplinary Academic Studies.
I wish the team a very best of luck in their endeavour

Dr. D. Sucharitha, Director-AERF

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ANVESHANA'S INTERNATIONAL JOURNAL RESEARCH IN ENGINEERING AND APPLIED SCIENCES.

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SOME INTEGRAL REPRESENTATIONS OF TWO VARIABLE GENERALIZED HYPERGEOMETRIC POLYNOMIALS

Paper ID -1001

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Abstract

The main aim of this paper is to derive some integral representations of two variable generalized hyper geometric polynomial set $I_n(\alpha;\beta;x,y)$ such as contour integral, real integral representation, infinite single integral representation, finite single integral representation , finite double integral representation. Moreover, we also derive addition and multiplication formulae. It is interesting to note that these results can suitably be applied to yield numerous further applications involving known as well as unknown hypergeometric functions.

Keywords: Hypergeometric polynomial, integral representation, generating functions, Hypergeometric functions.

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HEAT AND MASS TRANSFER ANALYSIS OF STEADY MHD FREE CONVECTIVE FLUID FLOW PAST AN INCLINED STRETCHING POROUS SHEET WITH VISCOUS DISSIPATION AND RADIATION

Paper ID -1002

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Abstract

The present paper describes MHD free convection flow past inclined porous stretching sheet under the influence of viscous dissipation and Radiation effects. Similarity transformations are used to reduce non linear partial differential equations to ordinary differential equations. Approximate solutions have been derived for velocity, temperature and concentration, using R-k method of fourth order along with shooting technique. Graphical analysis has been done to identify influences of different physical parameters on velocity, temperature and concentration.

Keywords: Angle of inclination, Chemical reaction parameter, Eckert number, Magnetic field, Porosity, Radiation parameter.

HEAT TRANSFER ANALYSIS OF SECOND GRADE FLUID OVER A STRETCHING SHEET THROUGH POROUS MEDIUM UNDER THE INFLUENCE OF CHEMICAL REACTION PARAMETER

Paper ID -1003

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Abstract

Evaluation has been done to study heat transfer of a second grade fluid through a porous medium under the influence of chemical reaction parameter over a linear impermeable stretching sheet. Similarity transformations are being used to reduce the governing differential equations to ordinary ones which are solved numerically. Effects of different parameters were studied on the fluid flow. The results of stream and heat transfer were shown graphically.

Keywords: Porous medium, Stretching sheet, viscous dissipation, chemical reaction parameter.

GENERATING FUNCTIONS FOR HYPERGEOMETRIC POLYNOMIALS OF TWO VARIABLES RN (Β;Γ; X, Y) USING WEISNER GROUP THEORETIC METHOD

Paper ID -1004

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Abstract

In this paper, an attempt has been made to obtain the generating relations for the hypergeometric polynomial set R n (β;γ; X, Y) by the Weisner's method. To be exact, the condition for a given set of functions to have generating relations by Weisner's method is that it must have ascending and descending recurrence relations. From these recurrence relations the raising and lowering first order linear differential operators derived, which generate a 3-dimensional Lie algebra. Moreover, these operators have also been used to obtain the extended form of the group generated by raising and lowering operators. In the entire investigation, a set of six generating relations have been obtained for the polynomial set R n (β;γ; X, Y) and followed by its applications.

Keywords: Chebyshev polynomials, Generating relations, Special functions.

GENERATING FUNCTIONS FOR HYPERGEOMETRIC POLYNOMIALS OF TWO VARIABLES RN (Β; Γ; X, Y) BY TRUESDELL METHOD

Paper ID -1005

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Abstract

In this paper, the Truesdell method is utilized to derive the generating functions for the generalized hypergeometric polynomial set R_n (β; γ; x, y) by giving suitable interpretation to the index n. Further, it is interesting to note that these generating functions can be suitably applied to yield numerous applications to various classical orthogonal polynomials of mathematical physics namely the Laguerre, Meixner, Gottlieb and Krawtchouk polynomials. Many of these applications are known but some of them are believed to be new in the theory of special functions.

Keywords: Generalized Hypergeometric Polynomials, Generating Functions, Special Functions.

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GENERALIZED (α,β) - RATIONAL CONTRACTIONS IN ORDERED S_b-METRIC SPACES WITH APPLICATIONS

Paper ID -1006

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Abstract

In this paper, we define generalized (α,β)-rational contraction based on this, we have to prove some fixed point theorems, applications related to integral equations and Homotopy theory. Also we gave an example which supported our main results.

Keywords: Fixed point, Generalized (α,β)-rational contraction, Homotopy theory, Sb-metric spaces.

MHD SLIP FLOW OF CASSON FLUID OVER AN EXPONENTIALLY STRETCHING INCLINED PERMEABLE SHEET WITH SORET-DUFOUR EFFECTS

Paper ID -1007

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Abstract

The present paper describes the heat and mass transfer analysis of MHD mixed convection flow of Casson fluid over an inclined permeable stretching sheet under the influence of Soret and Dufour effects. The governing partial differential equations are converted into ordinary ones applying similarity transformations. These equations then solved numerically by using R-K Method of fourth order along with shooting method. The influence of various parameters on velocity, temperature and species concentration are presented graphically.

Keywords: Casson fluid, Dufour effects, Inclined stretching sheet, MHD, Slip flow Soret.

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JOINT AND NET EFFECT ON LIFE EXPECTANCY AT BIRTH THROUGH THE LITERACY RATE AND INFANT MORTALITY RATE OF INDIA AND STATE-WISE_BY PATH ANALYSIS

Paper ID -1008

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Abstract

The main focus of this paper is to draw the interaction and direct effects on longevity at birth through the Vital indicators of India and its States. Observed that few demographic and Socio-economic factors which have been influencing growth of the country. This research paper is mainly designed to bring readers attention on demographic and economic status of India as well as Kerala compared to other Indian states. Through this paper author put an attempt to on contribution or impact of demographic and socio-economic factors on growth rate of India. The information about Vital Statistics has been collected from the sources of Government Offices and previous research articles of Economic Reviews. Conclusion have been drawn the rate of demographic indicators of Kerala has been drastically increased. Although it has been better in social, economic, cultural and Health factors; thus, well-being of Kerala as compared to other developing and developed countries also. Employed descriptive methods, multiple correlations, Regression and Fitted Trend lines; Utilised R software for the Statistical analysis. © 2006-2018 Asian Research Publishing Network (ARPN).

Keywords: Demography, India, Kerala, Path analysis.

A STUDY ON Γ-NEUTROSOPHIC SOFT SET IN DECISION MAKING PROBLEM

Paper ID -1009

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Abstract

Soft set theory was proposed by Molodtsov, it has been regarded as an effective Mathematical tool to deal with uncertainties. In our regular life we frequently faced some realistic problems which needs right decision making, to get the best solution of these problems we need to consider various parameters relating to the best solution. In this paper we study some basic definitions, prepositions and tabular representation of Γ-neutrosophic soft setby introducing a parameter Γ to the neutrosophic soft set, in which the parameter set Γ indicates the brand of the articles or goods.

Keywords: Comparison matrix, Γ- Soft set, Γ-neutrosophic softest.

NON-DARCY CONVECTIVE HEAT AND MASS TRANSFER FLOW THROUGH A POROUS MEDIUM IN VERTICAL CHANNEL WITH SORET, DUFOUR AND CHEMICAL REACTION EFFECTS

Paper ID -1010

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Abstract

The present paper aims to study thermo-diffusion, diffusion-thermo effects and chemical reaction effects on non-Darcy convective heat and mass transfer flow of a viscous fluid through a porous medium in a vertical channel with heat generating sources. The governing equations of flow are solved by using Galerkin finite element method (GFEM) with quadratic polynomial approximations. The velocity, temperature, concentration, shear stress and the rate of heat and mass transfer are evaluated numerically for different variations of parameter. The results obtained are compared with available literature and found to be in good agreement.

Keywords: Chemical reaction, Finite element analysis, Heat and mass transfer, Porous medium, Soret and dufour effects.

SORET AND DUFOUR EFFECTS ON MHD MICROPOLAR FLUID FLOW OVER A LINEARLY STRETCHING SHEET, THROUGH A NON-DARCY POROUS MEDIUM

Paper ID -1011

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Abstract

In this paper, we discuss the Soret and Dufour effects on an MHD micropolar fluid flow over a linearly stretching sheet, through a non-Darcy porous medium, where stretching velocity of the sheet varies linearly with distance from the origin, and, temperature and concentration vary non-linearly in the boundary layer region. By suitable similarity transformations, the governing boundary layer equations are transformed to ordinary differential equations. These equations are solved by numerical computations with bvp4c along with the shooting technique method. The effects of the magnetic parameter, Soret number and Dufour number on velocity profiles, microrotation profile, heat transfer, and concentration, skin-friction, Nusselt number and Sherwood number are computed, discussed and analysed numerically and presented through tables and graphs. © 2018 G.V.R. Reddy et al.,

Keywords: Dufour number, magnetic parameter, MHD flow, Soret number IS.

EXISTENCE AND UNIQUENESS OF SUZUKI TYPE RESULT IN SB-METRIC SPACES WITH APPLICATION TO INTEGRAL EQUATIONS

Paper ID -1012

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Abstract

In this paper we prove a Suzuki type unique common coupled fixed point theorem for two pairs of w-compatible mappings along with (ψ - Φ) - and Rational contraction conditions in Sb-metric spaces. We also furnish an example as well as application to integral equation.

Keywords: Sb-completeness, Sb-metric space, W-compatible pairs.

VAGUE SEMIPRIME IDEALS OF A Γ –SEMIRING

Paper ID -1013

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Abstract

The concept of vague semiprime ideal of a Γ -semiring with membership and non-membership functions taking the values in unit interval of real numbers are introduced and investigated some results.

Keywords: Left(resp. right) vague ideal, Regular Γ -semiring, Vague semiprime ideal, Γ -semiring.

ON REGULAR, IDEALS IN PARTIALLY ORDERED SOFT TERNARY SEMI GROUPS

Paper ID -1014

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Abstract

The concept of Ideal theory plays vita role in Algebraic Structures which are semigroups, rings and semirings etc. The theory of Ideals in partially ordered soft ternary semigropus is more general approach than the usual concept of Ideals. In this paper we studied the Ideals in partially ordered soft ternary semigroups, regular partially ordered soft ternary semigroups and some interesting theorems and prepositions on partially ordered soft ternary semigroups.

Keywords: Cartesian product of soft set, Left (Right Lateral) ideal of (H Q) generated by H(q), Partially ordered soft terary semigroup, Soft set relation.

MHD FREE CONVECTIVE HEAT AND MASS TRANSFER FLOW PAST AN ACCELERATED VERTICAL PLATE THROUGH A POROUS MEDIUM WITH HALL CURRENT, ROTATION AND SORET EFFECTS

Paper ID -1015

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Abstract

The free convective heat and mass transfer of viscous, incompressible, of unsteady rotating MHD flow past an infinite vertical plate was considered under the influence of Hall current, rotation and Soret effects. It is assumed that the flow possess an angular velocity ω about the normal to the plate. Transverse magnetic field was applied along the normal to the plate. The governing non linear coupled partial differential equations are reduced to dimensionless form using non - dimensional scheme and then solved analytically using two term perturbation method.

Keywords: Hall current, MHD, Porous medium, Rotation & soret effect.

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A STOCHASTIC MODEL FOR THREE SPECIES

Paper ID -1016

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Abstract

The present paper deals with a three species food web ecosystem consisting of mutualism interaction between two species and a predator, which depends on both the mutual species. All three species in this model are considered in limited resources. The sustainability of the system (local stability) is discussed through the perturbed technique at the possible existing each equilibrium points. The global stability of the system is also described by using the Liapunov's method. Further the dynamics of the system is observed by introducing the stochastic process to the species and the numerical simulations are studied to know the interaction among the species.

Keywords: Mutualism interaction, equilibrium points, global stability, Liapunov's method.

CHEMICAL REACTION AND RADIATION EFFECTS ON MHD CONVECTIVE DUSTY VISCOELASTIC FLUID FLOW BETWEEN TWO PARALLEL PLATES

Paper ID -1017

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Abstract

The present note consists, the effects of radiation and chemical reaction on MHD flow of dusty viscous incompressible, electrically conducting fluid between two vertical heated, porous, parallel plates with heat source. The plate temperature is raised linearly with time and concentration level near the plate to C_w. The variable temperature and uniform mass diffusion taking into account the chemical reaction of first order. The governing differential equations which describe the motion of the problem are converted into dimensionless formulas by using perturbation technique. The parameters of viscoelastic dissipation, internal heat source, constant magnetic field, radiation, chemical reaction and permeability of the porous medium are included and discussed numerically in the governing equations of momentum, energy and concentration. The effects of the elasticity, porosity, heat, radiation, reaction effect and magnetic interaction parameter, thermal diffusion parmeter, Prandtl and Schmidt numbers on the velocity, temperature and concentration distributions have been discussed and illustrated graphically.

Keywords: Radiation and chemical reaction, differential equations, perturbation technique, MHD flow, diffusion.

A STUDY ON *Γ*- IDEALS ON TERNARY *Γ* SEMIGROUPS

Paper ID -1018

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Abstract

The terms ternary Γ-ideal, trivial ternary Γ-ideal, prime ternary Γ-ideal, completel prime ternary Γ-ideal, ternary Γ-ideal generated by a subset, principal ternary Γ-ideal . Further it is proved that (1) the nonempty intersection of two ternary Γ-ideals of a ternary Γ-semigroup T is a ternary Γ-ideal of T, (2) the nonempty intersection of any family of ternary Γ-ideals of a ternary Γ-semigroup T is a ternary Γ-ideal of T, 3) the union of two ternary Γ-ideals of a ternary Γ-semigroup T is a ternary Γ-ideal of T and (4) the union of any family of ternary Γ-ideals of a ternary Γ-semigroup T is a ternary Γ-ideal of T.

Keywords: Ternary Γ-semigroup, Γ-ideal, ternary Γ-ideal.

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STUDY OF VARIOUS DOMINATIONS IN REGULAR FUZZY GRAPHS

Paper ID -1019

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Abstract

In this paper we study about dominations in regular fuzzy graphs. A set D V is said to be fuzzy dominating set of G, if every v ϵ V – D there exist u ϵ D such that u dominates v. In this paper we discuss the concept of regular split and non split domination in fuzzy graphs, regular connected domination in fuzzy graph, totally regular domination in fuzzy graphs and discuss their properties. In this paper we extended our study to inverse regular connected domination number and derived some results. Prompt some applications on them like as computer communication network, social network theory.

Keywords: Fuzzy graphs, regular split, communication network, social network theory.

A NUMERICAL STUDY OF TWO COMPETITIVE SPECIES MODEL OF SEMI-MONOD TYPE

Paper ID -1020

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Abstract

The present paper deals with some investigations on two competitive interacting species with a semi-monod type for one species while the resources are unlimited for the second species. The mathematical model equations of the two species of this model are characterized as before by first order non-linear coupled ordinary differential equations. In all four equilibrium states are identified. Further, solutions for the linearrized perturbed equations have been obtained and results illustrated. The numerical solutions for these model equations are computed employing Runge-Kutta fourth order method. The cases of strong and weak competitions are also examined and all numerical results are illustrated graphically.

Keywords: Interacting species, mathematical model, semi-monod type, Runge-Kutta fourth order method.

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A STUDY ON LAGUERRE AND KONHAUSER'S POLYNOMIALS

Paper ID -1021

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Abstract

In recent years, many authors studied Laguerre Polynomial and generalized in different ways. Konhauser, J.D.E. introduced Konhauser's biorthogonal polynomial. He made generating relations and recurrence relations for it and as a special case, he derived the results on Laguerre polynomial. Recently, Dr. B.Satyanarayana and N.Srimannarayana introduced a modified Konhauser polynomial with a discrete variable. In this paper an attempt has been made to obtain modified Laguerre-Konhauser polynomial with a discrete variable. Result is followed by its applications to the classical orthogonal polynomials.

Keywords: Laguerre polynomial, Konhauser's biorthogonal polynomial, generating functions, special functions.

MHD FREE CONVECTION FLOW PAST AN INCLINED PERMEABLE STRETCHING SHEET WITH VISCOUS DISSIPATION AND RADIATION

Paper ID -1022

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Abstract

The present analysis describes MHD free convection flow past inclined permeable stretching sheet under the influence of viscous dissipation and Radiation effects. Similarity transformations are used to reduce non linear partial differential equations to ordinary differential equations. Approximate solutions have been derived for velocity, temperature and concentration, using Matlab. Graphical analysis has been done to identify influence of different physical parameters on velocity, temperature and concentration.

Keywords: Partial differential equations, MHD, Radiation effects, Similarity transformations.

APPLICATION ON KNESER GRAPH AND HAMILTONIAN GRAPHS

Paper ID -1023

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Abstract

In 1856, Hamiltonian introduced the Hamiltonian Graph where a Graph which is covered all the vertices without repetition and end with starting vertex. In this paper I would like to proved Every Kneser Graphs having vertex transitive and Hamiltonian Graphs except for k(5, 2), which is the Peterson Graphs.

Keywords: Hamiltonian Graph, Kneser Graphs, Peterson Graphs.

PERIODIC MATRIX SYLVESTER DYNAMICAL SYSTEMS ON TIME SCALES

Paper ID -1024

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Abstract

The objective of this paper is to study the problem of solving for homogeneous and non homogeneous periodic matrix Sylvester dynamical system on time scales for which its coefficient matrix function is w-periodic and regressive. First we study some basic properties of time scale calculus and Kronecker product of matrices also develop preliminary results by converting the given problem into a Kronecker product problem. The solution to the corresponding initial value problem obtained in terms of two transition matrices of the homogeneous systems by using the standard technique of variation of parameters.

Keywords: Periodic matrix Sylvester dynamical system, time scales, Kronecker product of matrices, transition matrices.

AN EXPERIMENTAL STUDY OF SPLIT PLOT DESIGN OVER FUZZY INFERENCE SYSTEM

Paper ID -1025

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Abstract

Design of experiments is one of the most efficient methods for multifactor experiments. Among all the designs Split-plot experiments contain two types of experimental errors; the whole plot error (WP) and Split-plot (SP) error. Another method, called fuzzy logic is now a days a capable methodology in many applications. Here we compare the Fuzzy inference system over the split plot design. The data used for comparison is a 2^1X5^2 split plot experiment with three replicates. The result reveals the effectiveness of fuzzy inference system over split-plot design.

Keywords: Design of experiments, Split-plot experiments, fuzzy logic, fuzzy inference system.

FUZZY LAPLACE TRANSFORMS ON TIME SCALES

Paper ID -1026

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Abstract

In this paper, we develop the calculus of fuzzy Laplace transforms on time scales under Hukuhara delta derivative for the fuzzy valued functions of real variables on time scales whose values are normal, convex, upper semi-continuous and compactly supported fuzzy functions in R. We study the fundamental properties and related theorems which help to establish the relation between the fuzzy Laplace transforms of a fuzzy functions on time scales and Hukuhara delta derivative to solve first order fuzzy dynamic equations on time scales. These results generalize the results of fuzzy Laplace transforms on fuzzy differential and difference calculus. There are many other time scales than set of reals and integers, hence one can get much more general result.

Keywords: Fuzzy Laplace transforms, time scales, Hukuhara delta derivative, fuzzy dynamic equations on time scales.

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NON-NEWTONIAN VISCOUS FLUID LUBRICATION OF ROLLERS INCLUDING TEMPERATURE EFFECTS

Paper ID -1027

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Abstract

Hydrodynamic lubrication characteristics of roller bearings by Power-law fluids are analysed qualitatively for a rigid system. The governing equations such as momentum equation with continuity and thermal energy equations are solved first analytically and then numerically using MATLAB, assuming the consistency of the lubricant to vary with pressure and two dimensional temperature. The results including hydrodynamic pressure and temperature are calculated and presented in form of graphs. These results are compared and observed that they are in good agreement with previous findings.

Keywords: Hydrodynamic lubrication, hydrodynamic pressure, temperature.

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THE EFFECT OF CHEMICAL REACTION AND RADIATION MHD CONVECTIVE FLOW OF VISCO-ELASTIC FLUID THROUGH POROUS MEDIUM IN VERTICAL CHANNEL

Paper ID -1028

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Abstract

An analytical study of radiating and chemically reacting magneto hydro dynamic (MHD) convective flow of a viscoelastic, incompressible and electrically conducting fluid through a porous medium filled in a vertical channel is carried out. The fluid is acted upon by periodic time variation of the pressure gradient in the vertically upward direction. The temperature of one of the plates is non-uniform and the temperature difference of the walls of the channel is high enough to induce heat transfer due to radiation. An exact analytical solution of the problem is obtained. The velocity, temperature, species concentration, the respective amplitudes and the phase angles of the skin friction, Nusselt number and Sherwood number are shown graphically and discussed in detail. Two cases of small and large rotations have been considered to assess the effects of different parameters involved in the flow problem.

Keywords: Magneto hydro dynamic, porous medium, Nusselt number, Sherwood number.

ECONOMIC LOT SIZE MODEL WITH SAMPLE INSPECTION OF THE RECEIVED LOT

Paper ID -1029

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Abstract

This paper deal with an inventory problem in which the purchased lot is subject to inspection using a single sampling plan with advertising risk of committing error. When the lot is accepted, there is possibility unseen defectives which may reach the customer either at the time of purchase or while in use. When the lot is rejected by the sampling plan, the lot is 100% inspected and the defectives are set aside. This leads to reduced sample size, which indirectly affects the inventory cycle. A model is developed to determine (1) the optimum order quantity and (2) sampling plan by taking into account the cost of inspection and the indirect cost of a defective reaching the customer.

Keywords: Inventory problem, sampling, inventory cycle, optimum order quantity.

SORET AND DOFOUR EFFECTS ON MHD FREE CONVECTIVE FLOW PAST A VERTICAL POROUS PLATE IN A POROUS MEDIUM

Paper ID -1030

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Abstract

A steady MHD free convective heat and mass transfer flow past a semi-infinite vertical porous plate in the presence of Soret and Dofour effects has been studied. The governing equations are solved numerically by Runge – Kutta fourth order method along with shooting technique. The effect of various governing parameters for velocity, temperature, concentration; skin-friction, Nusselt number and Sherwood number are also obtained. The effects of various parameters have been shown numerically and discussed graphically.

Keywords: MHD, heat and mass transfer, Soret and Dofour effects, Runge – Kutta fourth order method, skin-friction, Nusselt number, Sherwood number.

INVENTORY MODEL WITH DIFFERENT DETERIORATION RATES FOR IMPERFECT QUALITY ITEMS AND SHORTAGES

Paper ID -1031

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Abstract

In this paper we propose an a deterministic inventory model for imperfect quality items with different deterioration rates for the cycle time. The Demand function is considered as exponential function of time. Shortages are allowed and completely backlogged. One numerical example is provided to illustrate the model. Sensitivity analysis for major parameters is also carried out.

Keywords: Inventory model, Demand function, Sensitivity analysis.

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α_1, α_2 NEAR SUBTRACTION SEMIGROUPS

Paper ID -1032

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Abstract

In this paper, we studied about near ring, α_1 near ring, α_2 near ring, β_1 near ring , subtraction algebra, subtraction semigroup, near subtraction semigroup, regular near ring, pseudo commutative near subtraction semi group, β_1 near subtraction semi group. Here we introduced the notions α_1 near subtraction semigroup, α_2 near subtraction semigroup and some of their properties are discussed.

Keywords: Near ring, α_1 near ring, α_2 near ring, β_1 near ring, subtraction algebra, semigroup.

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RADIATION AND HEAT SOURCE EFFECTS ON MHD STAGNATION POINT FLOW OF CHEMICALLY REACTING CASSON NANOFLUID OVER A NONLINEAR STRETCHING SHEET WITH VELOCITY SLIP AND CONVECTIVE BOUNDARY CONDITIONS

Paper ID -1033

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Abstract

The influence of thermal radiation, heat source and chemical reaction on steady MHD stagnation point flow of Casson nanofluid over a nonlinear stretching sheet in presence of viscous dissipation, velocity slip and convective boundary conditions is studied. Possessions of Brownian motion and thermophoresis are also depicted in this study. A uniform magnetic field as well as suction is taken into account. The governing non-linear PDEs are transformed into a set of non-linear coupled ODEs which are then solved numerically by using the Runge– Kutta–Fehlberg fourth–fifth order method along shooting technique. Notable accuracy of the present results has been obtained with the earlier results. Impact of distinct parameters on velocity, temperature, concentration, skin friction coefficient, Nusselt number and Sherwood number are canvassed through graphs and tabular forms.

Keywords: MHD, Casson nano-fluid, Runge– Kutta–Fehlberg fourth–fifth order method, skin friction coefficient, Nusselt number, Sherwood number.

MHD FREE CONVECTIVE HEAT AND MASS TRANSFER FLOW PAST AN ACCELERATED VERTICAL PLATE THROUGH A POROUS MEDIUM WITH HALL CURRENT, ROTATION AND SORET EFFECTS

Paper ID -1034

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Abstract

The free convective heat and mass transfer of viscous, incompressible, of unsteady rotating MHD flow past an infinite vertical plate was considered under the influence of Hall current, rotation and Soret effects. It is assumed that the flow possess an angular velocity ω about the normal to the plate. Transverse magnetic field was applied along the normal to the plate. The governing non linear coupled partial differential equations are reduced to dimensionless form using non - dimensional scheme and then solved analytically using two term perturbation method.

Keywords: Hall current, MHD, Porous medium, Rotation & soret effect.

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CERTAIN GENERATING FUNCTIONS OF GENERALIZED HYPERGEOMETRIC 2D POLYNOMIALS FROM TRUESDELL'S METHOD

Paper ID -1035

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Abstract

In this paper, the generating functions for generalized Hypergeometric 2D polynomials U_n (β, γ, x, y) are obtained by using the Truesdell's method giving a suitable interpretation to the index n. Further, a pair of linearly independent differential recurrence relations are used in order to derive generating functions for U_n (β,γ,x,y). The principal interest in our results lies in the fact that, how the Truesdell's method is utilized in an effective and suitable way to generalized Hypergeometric 2D polynomials in order to derive two generating functions independently from ascending and descending recurrence relations respectively.

Keywords: Generalized hypergeometric 2D polynomials Un(β,γ,x,y) generating functions, Special functions.

UNSTEADY MHD CASSON FLUID FLOW PAST AN OSCILLATING PERMEABLE VERTICAL SURFACE WITH NEWTONIAN HEATING AND THERMAL RADIATION

Paper ID -1036

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Abstract

The present analysis explores the unsteady boundary layer MHD free convective flow of Casson fluid over an oscillating vertical plate immersed in porous media with Newtonian heating. The governing equations describing the phenomena are converted into a dimensionless form, and then solved by using the technique of Laplace transform, to obtain the exact solutions of velocity and temperature. The expressions obtained for velocity and temperature are explained graphically to identify the influence of different critical parameters. The variation of skin friction and Nusselt number under the influence of different physical parameters are presented in tabular form.

Keywords: Casson fluid, MHD, Newtonian heating, Oscillating surface, Thermal radiation.

ANALYTICAL INVESTIGATIONS OF ALIGNED AND HALL EFFECTS ON UNSTEADY FREE CONVECTION FLOW PAST AN ACCELERATED INCLINED PLATE

Paper ID -1037

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Abstract

The objective of this study is to investigate aligned magnetic and hall effects on unsteady free convection chemically reacting fluid flow past an accelerated infinite inclined plate with variable temperature and mass diffusion under the influence of uniform transverse magnetic field. A general exact solution of the dimensionless governing partial differential equations are obtained by perturbation technique. The effects of various parameters describing the flow transport in the presence of thermal radiation and Dufour effect on the fluid velocity, temperature and concentration are concentrated on through graphs.

Keywords: Exponentially accelerated plate & inclined plate, Free convection, MHD.

NUMERICAL STUDY OF FLOW AND HEAT TRANSFER OF CASSON FLUID OVER AN EXPONENTIALLY POROUS STRETCHING SURFACE IN PRESENCE OF THERMAL RADIATION

Paper ID -1038

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Abstract

The present paper aims to study the of flow and heat transfer of anon Newtonian Casson fluid that passes an exponentially porous stretching surface in the presence of thermal radiation. Using similarity transformations the governing partial differential equations are converted into ordinary differential equations and solved using an implicit finite difference scheme known as a Keller Box method. It is observed that increasing values of Casson-parameter decreases the velocity and increases the temperature field. Radiation parameter increases the thermal diffusivity and temperature. Skin friction increases with an increase in suction.

Keywords: Casson fluid, Exponentially stretching surface, thermal radiation, Heat transfer, Keller box method.

MHD MIXED CONVECTION FLOW OF RADIATING AND CHEMICALLY REACTIVE CASSON NANOFLUID OVER A NONLINEAR PERMEABLE STRETCHING SHEET WITH VISCOUS DISSIPATION AND HEAT SOURCE

Paper ID -1039

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Abstract

Purpose: The purpose of this paper is to discuss the flow of Casson nanofluid past a nonlinear permeable stretching sheet in the presence of thermal radiation, chemical reaction, viscous dissipation, heat source, and magnetohydrodynamics. Design/methodology/approach: Appropriate transformations are used to convert the boundary layer equations into nonlinear ODEs which are then solved numerically by using the Runge-Kutta-Fehlberg fourth-fifth order method along with shooting technique. Findings: Solution of this systems is obtained for velocity, temperature, and concentration profiles. Graphical illustrations are added to discuss the effect of evolving parameters against above-mentioned distributions. Tabular values of local skin friction factor, local Nusselt number, and local Sherwood number are also added and studied accordingly. Originality/value: A good agreement of the present results has been observed by comparing with the existing literature results. It is noted that skin friction coefficient, Nusselt number, and Sherwood number decrease with Casson parameter and increase with suction parameter.

Keywords: Casson nanofluids, Chemical reaction, Heat source, Nonlinear stretching sheet, Radiation, Viscous dissipation.

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NANOFLUID FLOW OVER A STRETCHING SHEET WITH NON-UNIFORM HEAT SOURCE AND VARIABLE VISCOSITY

Paper ID -1040

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Abstract

The present article deals with the heat and mass transfer of mixed convection MHD Casson Nanofluid flow over a stretching sheet with variable viscosity and non-uniform heat source. The similarity transformations are utilized for the transformation of partial differential equations to ordinary differential equations. The RK fourth order method based on shooting technique is employed for solving the system. Heat and mass transfer characteristics are performed under the influence of non-uniform heat source and variable viscosity. Impacts of certain emerging parameters on the velocity distribution, temperature field and concentration profiles are studied with the aid of graphs. Numerical results of skin friction factor, local Nusselt and Sherwood numbers for certain values of non-Newtonian fluid parameter, Hartmann number, radiation parameter, Brownian motion parameter, thermophoresis parameter, Schmidt number and Prandtl number are calculated and shown in tabular form. The comparison of our results with the available results is carried out. The out coming result shows nice agreement.

Keywords: Casson nanofluid, Heat and mass transfer, MHD, Non-Uniform heat source, Thermal radiation, Variable viscosity.

NUMERICAL STUDY TO DIFFUSION OF CHEMICALLY REACTIVE SPECIES OVER MHD EXPONENTIALLY STRETCHING SURFACE OF A CASSON FLUID

Paper ID -1041

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Abstract

The present study of the paper deals with diffusion of chemically reactive species of a non-Newtonian MHD Casson fluid towards an exponentially stretching surface using keller box method. Casson fluid model is used to characterize the non-Newtonian fluid behaviour. The flow fields and mass transfer are affected significantly by the physical parameters. The effect of increasing values of the Casson parameter and Magnetic Parameter is to suppress the velocity field. But the concentration increases with increasing Casson parameter.

Keywords: Casson fluid, Chemical reaction, Exponentially stretching sheet, Magnetic Parameter.

AN INVENTORY MODEL WITH VARIABLE HOLDING COST AND PARTIAL BACKLOGGING UNDER INTERVAL UNCERTAINTY: GLOBAL CRITERIA METHOD

Paper ID -1042

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Abstract

In this paper, an inventory model with variable holding cost is proposed. Deterioration rate is constant and the demand varies with time until the shortage occurs; during shortages, demand rate becomes constant. Shortage is assumed to be partially backlogged. In inventory parameters, the interval type uncertainty is considered. The total cost function as an Economic Order Quantity problem is formulated by introducing the concept of interval-value fuzzy number into the cost function. Then, using nearest interval approximation, and the interval arithmetic, the problem is changed into multi objective non-linear programming problem. To solve this problem, the Global Criteria method is applied. The convexity of the cost function is shown graphically. Sensitivity analysis is also carried out to identify the most sensitive and uncertainty parameters in the proposed model.

Keywords: Global Criteria method, Interval Number, Inventory Model, Partial Backlogging.

BOUNDARY LAYER FLOW OF A MIXED CONVECTIVE NANOFLUID OVER A VERTICAL CIRCULAR CYLINDER UNDER THE INFLUENCE OF MAGNETIC FIELD, HEAT RADIATION AND EXTERNAL SURFACE TEMPERATURE

Paper ID -1043

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Abstract

The present paper deals with the study of steady of a nanofluid over a vertical circular cylinder under the influence of thermal radiation, heat generation and magnetic force with prescribed external flow of mixed convective boundary layer flow. The radiative heat loss is modelled by Rosseland approximation. Similarity variables are used to transform the partial differential equations into ordinary differential equations. The transformed equations are solved numerically using Runge-Kutta –Fehlberg method with shooting technique. In this study two different types of nano particles namely Titania (TiO_2) and Copper (Cu) with water as the base fluid is studied. For Titania-water nanofluid the nanoparticle volume fraction influences on velocity temperature are presented graphically. The influence of pertinent parameters on velocity and temperatures are determined and details are discussed through several plots. The coefficient of skin friction and local Nusselt number for different pertinent parameter are given in tabular form.

Keywords: Heat Source Parameter, Magnetic Parameter, Mixed Convection, Nano Particle Volume Fraction, Nanofluids, Radiation Parameter, Vertical Circular Cylinder.

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Ψ- STABILITY FOR NONLINEAR DIFFERENCE EQUATIONS

Paper ID -1044

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Abstract

This paper deals with obtaining sufficient conditions for the Ψ-(uniform)stability of trivial solutions of linear and nonlinear difference equations on N. And also we provide a way to construct (uniformly)stable difference equation from the given equation using the concept of Ψ-(uniform)stability.

Keywords: Difference equations, Fundamental matrix, Ψ-stable, Ψ-uniformly stable.

SORET AND DUFOUR EFFECTS ON MHD FLOW WITH HEAT AND MASS TRANSFER PAST A PERMEABLE STRETCHING SHEET IN PRESENCE OF THERMAL RADIATION

Paper ID -1045

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Abstract

An analysis has been carried out to study the combined effects of the magnetic field, Joule heating, thermal radiation absorption, viscous dissipation, Buoyancy forces, thermal-diffusion and diffusion-thermion the convective heat and mass transfer flow of an electrically conducting fluid over a permeable vertically stretching sheet. The boundary layer equations for the fluid flow, heat and mass flux under consideration have been obtained and reduced into a system of non-linear ordinary differential equations by using appropriate similarity transformation. Using shooting method coupled with the fourth order Runge-Kutta integration scheme, the numerically solutions have been obtained and presented graphically. The effects of various embedded thermo-physical parameters on the fluid velocity, temperature, skin friction, Nusselt number and Sherwood number have been determined and discussed quantitatively. An increase in values of thermal radiation, viscous dissipation, suction/injection coefficient and chemical reaction results in the increase of velocity, temperature and heat-mass transfer rates. Further, this work leads to study different flows of electrically conducting fluid over a permeable vertical stretching sheet problem that includes the two dimensional non-linear boundary equations.

Keywords: Buoyancy forces, Dufour effect, Joule heating, MHD, Soret effect, Thermal radiation.

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SOME APPLICATIONS VIA FIXED POINT RESULTS IN PARTIALLY ORDERED SB -METRIC SPACES

Paper ID -1046

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Abstract

In this paper we give some applications to integral equations as well as homotopy theory via fixed point theorems in partially ordered complete S_b-metric spaces by using generalized contractive conditions. We also furnish an example which supports our main result.

Keywords: Sb-completeness, Sb-metric space, w-compatible pairs.

EFFECTS OF CHEMICAL REACTION ON COMBINED HEAT AND MASS TRANSFER BY LAMINAR MIXED CONVECTION FLOW FROM VERTICAL SURFACE WITH INDUCED MAGNETIC FIELD AND RADIATION

Paper ID -1047

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Abstract

The elevated temperature electromagnetic materials production system in chemical engineering requires increasingly more refined theoretical and computational models for describing multiple, simultaneous thermophysical effects. Motivated by this application, the present paper addresses heat and mass transfer in a chemically reacting laminar mixed convection flow from a vertical sheet with induced magnetic field. The governing equations of the flow are solved analytically using a perturbation technique. The influences of various established parameters on the flow, induced magnetic field, and heat and mass transfer are studied graphically in the present analysis.

Keywords: Computational electromagnetics, Heat convection, Heat transfer, Magnetic field effects, Magnetic fields, Mixed convection, Perturbation techniques, Radiation effects, Shear flow, Shear stress.

CHEMICAL REACTION AND SORET EFFECTS ON RADIATING MHD BOUNDARY LAYER FLOW OVER A MOVING VERTICAL POROUS PLATE WITH HEAT SOURCE

Paper ID -1048

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Abstract

This paper is focused on the study of effect of heat and mass transfer on chemically reacting boundary layer flow over a porous stretching sheet in the differential equations are transformed by introducing similarity variables and solved numerically by using Range Kutta method along with shooting method. With the help of graphs, the effects of the various important governing parameters entering into the problem on the dimensionless velocity, dimensionless induced magnetic field, dimensionless temperature; dimensionless concentration fields with in the boundary layer are discussed. It is observed that the concentration decreases with increase of Soret number. The effect of chemical reaction increases with the increases on velocity.

Keywords: Chemical reaction, Heat generation, MHD, Radiation effect, Suction.

A MATHEMATICAL ANALYSIS OF CONVECTIVE HEAT AND MASS TRANSFER POUR OF A NON -NEWTONIAN FLUID THROUGH POROUS MEDIUM IN A RECTANGULAR DUCT WITH HEAT SOURCES

Paper ID -1049

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Abstract

In this paper, we investigate to frame the mathematical analysis of the convective warmth moreover accumulation transmit pour of micro-polar fluid through a absorbent standard in a rectangular enclosure with heat sources. Foremost equations are solved by employing limited element analysis with three waggle triangular elements. The computation is carried out for dissimilar standards of different central factor. The Nusselt number, Sherwood number and couple stress happening the side wall x=1 are analysed for distinct variations of the governing parameters.

Keywords: Heat sources, Heat transfer, Mass transfer, Non-Newtonian fluid, Rectangular duct.

INTRODUCTION TO VAGUE TOPOLOGY

Paper ID -1050

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Abstract

In this paper we are introducing the basic concepts of a Vague Topology such as Vague Point, Neighbourhood of a Vague Point and Vague Set, Local Base, Base and also discuss the properties of Neighbourhoods. In this paper we are explaining how to construct the Vague Topologies.

Keywords: Base, Local base, Neighbourhood of a vague point, vague point, vague topology

PATTERN OF LIFE EXPECTANCY AT BIRTH IN INDIA, SIGNIFICANT CHANGES OVER THE PAST YEARS

Paper ID -1051

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Abstract

This research paper reveals the significance of change over years in life expectancy for India. The interest of author is to find out the pattern of change and increase in life expectancy of India. The LE (Life expectancy) has been increasing drastically for India. There are several factors leading to increasing the LE. Concluded that Life expectancy is significant over years by sex and region of India. The data has been collected from the (WHO), World Health Organization and (SRS), Sample Registration System. Employed applications of Statistics; Post Hoc Tests of Least Significant Difference with the help of Software. © Serials Publications Pvt. Ltd.

Keywords: India and statistical analysis, Life expectancy at birth.

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HEAT TRANSFER ON MHD NANOFLUID FLOW OVER A SEMI INFINITE FLAT PLATE EMBEDDED IN A POROUS MEDIUM WITH RADIATION ABSORPTION, HEAT SOURCE AND DIFFUSION THERMO EFFECT

Paper ID -1052

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Abstract

The effects of radiation absorption, first order chemical reaction and diffusion thermo on MHD free convective heat and mass transfer flow of a nanofluid past a semi infinite vertical flat plate are analyzed. The temperature and concentration at the surface are assumed to be oscillatory type. Four types of cubic nano particles which are uniform and size namely, Silver (Ag), Aluminum (Al2O3), Copper (Cu) and Titanium Oxide (TiO2) with water as a base fluid is taken into account. The set of ordinary differential equations are solved by using regular perturbation technique. The impact of various flow parameters on nanofluid velocity, temperature, concentration as well as the friction factor coefficient, the rate of heat and mass transfer coefficients are derived and discussed through graphs and tables.

Keywrds: Boundary layer flow, Heat and mass transfer, Mhd, Nanofluids, Radiation absorption

RADIATION AND HEAT SOURCE EFFECTS ON MHD FLOW OVER A PERMEABLE STRETCHING SHEET THROUGH POROUS STRATUM WITH CHEMICAL REACTION

Paper ID -1053

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Abstract

The purpose of this paper is to investigate the steady 2D buoyancy effects on MHD flow over a permeable stretching sheet through porous medium in the presence of suction/injection. Design/methodology/approach: Similarity transformations are employed to transform the governing partial differential equations into ordinary differential equations. The transformed equations are then solved numerically by a shooting technique. Findings: The working fluid is examined for several sundry parameters graphically and in tabular form. It is observed that with an increase in magnetic field and permeability of porous parameter, velocity profile decreases while temperature and concentration enhances. Stretching sheet parameter reduces velocity, temperature and concentration, whereas it increases skin friction factor, Nusselt number and Sherwood number. Originality/value: Till now no numerical studies are reported on the effects of heat source and thermal radiation on MHD flow over a permeable stretching sheet embedded in porous medium in the presence of chemical reaction.

Keywords: Buoyancy effects, Chemical reaction, MHD, Porous medium, Stretching sheet, Suction/injection.

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AN APPLICATION OF LPP - GRAPHICAL METHOD FOR SOLVING MULTI SERVER QUEUING MODEL

Paper ID -1054

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Abstract

The subject of LPP (linear programming problems) plays an important role in finding the optimal solution and queuing models have vital role to find the required number of servers and expected waiting time in the system etc. Vijay Prasad et al. (2014) in their research paper, found the optimal number of servers and optimal minimum total cost by using the M/M/S queuing model. Vijay Prasad et al. (2014) in another research paper developed an alternating queuing model for Tatkal (emergency) railway reservation system. In this research article the required number of servers and expected number of customers in the system of multi server queuing model by using linear programming problem - graphical method has been found out.

Keywords: Expected waiting time in the system, Graphical Method, Linear Programming Problem, M/M/S Queuing Model, Number of Servers.

ON GENERATING RELATIONS FOR MODIFIED KONHAUSER POLYNOMIAL

Paper ID -1055

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Abstract

In previous papers, we introduced a modified Konhauser polynomial with discrete variable. In this paper an attempt has been made to obtain extended linear and bilinear generating relations for modified Konhauser polynomial with a discrete variable. Each result is followed by its applications to the classical orthogonal polynomials

.

Keywords: Konhauser polynomial, generating functions, special functions, orthogonal polynomials.

MIXED CONVECTIVE HEAT AND MASS TRANSFER FLOW OF A VISCOUS FLUID THROUGH A POROUS MEDIUM PAST A VERTICAL PLATE WITH RADIATION ABSORPTION

Paper ID -1056

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Abstract

We investigate the influence of radiation absorption on convective heat and mass transfer flow of a viscous fluid through a porous medium past a semi-infinite porous plate. The velocity, temperature and concentration are discussed for different values of various parameters. The shear stress, the rate of heat and mass transfer are evaluated for different variations.

Keywords: Heat and mass transfer, MHD, Viscous fluid, Radiation absorption, Porous medium.

VAGUE ANTI HOMOMORPHISM OF A Γ−SEMIRING

Paper ID -1057

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Abstract

In this paper, we introduce the concept of vague anti homomorphism of a Γ-semiring and we study the properties of anti homomorphic image and pre-image of a anti vague ideal of a Γ−semiring. Further we establish that the inverse image of an anti right vague ideal of a Γ-semiring is an anti left vague ideal of a Γ-semiring and the anti homomorphic image of an anti left vague ideal of a Γ-semiring is a anti right vague ideal of a Γ-semiring.

Keywords: Γ-semiring, anti-homomorphism, vague sets, vague ideal.

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INTUITIONISTIC FUZZY TRANSLATIONS OF INTUITIONISTIC FUZZY SUBALEBRAS AND IDEALS IN BF-ALGEBRAS

Paper ID -1058

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Abstract

In this paper, the concepts of intuitionistic fuzzy translation to intuitionistic fuzzy subalgebras and ideals in BF-algebras are introduced. The notion of intuitionistic fuzzy extensions and intuitionistic fuzzy multiplications of intuitionistic fuzzy subalgebras and ideals are introduced and several related properties are investigated. In this paper, the relationships between intuitionistic fuzzy translations and intuitionistic fuzzy extensions of intuitionistic fuzzy subalgebras and ideals are investigated.

Keywords: Intuitionistic fuzzy sets, BF-algebras, fuzzy translations, fuzzy subalgebras.

NON-ALIGNED STAGNATION POINT FLOW OF A CASSON FLUID PAST A STRETCHING SHEET IN A DOUBLY STRATIFIED MEDIUM

Paper ID -1059

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Abstract

The hydro magnetic stagnation point flow of an electrically conducting Casson fluid over a stretching sheet embedded in a doubly stratified medium in the presence of thermal radiation heat source/absorption with first order chemical reaction is studied. It is assumed that the fluid impinges on the wall obliquely. It is observed that a boundary layer is formed when the stretching velocity of the surface is less than the inviscid free stream velocity at a point decreases with increase in the non Newtonian rheology parameter. The augmentation of the temperature is observed with the magnetic parameter, heat source parameter and thermal radiation parameter while a reverse effect with thermal stratification number, Prandtl number and the velocity ratio parameter. The mass concentration is seen to be decrease with Schmidt number, chemical reaction parameter and solutal stratification number.

Keywords: Casson fluid, doubly stratified medium, thermal radiation, chemical reaction, Schmidt number.

TWO SIDED IDEALS IN TERNARY –SEMIGROUPS

Paper ID -1060

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Abstract

The main goal of this paper is to introduce the notion of a two sided ideal , two sided ideal generated by a subset; principal two sided ideal of a ternary – semigroup are introduced and characterised each of them.

Keywords: Two sided ideals, subset, ternary – semigroup.

LOW-POWER AND RANGE PRODUCTIVE CONVEY SELECT SNAKE

Paper ID -1061

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Abstract

Carry Select Adder (CSLA) is one of the fastest adders used in many data-processing processors to perform fast arithmetic functions. From the structure of the CSLA, it is clear that there is scope for reducing the area and power consumption in the CSLA. This work uses a simple and efficient gate-level modification to significantly reduce the area and power of the CSLA. Based on this modification 8-b, 16-b, 32-b, and 64-b square-root CSLA (SQRT CSLA) architecture have been developed and compared with the regular SQRT CSLA architecture. The proposed design has reduced area and power as compared with the regular SQRT CSLA with only a slight increase in the delay. This work evaluates the performance of the proposed designs in terms of delay, area, power, and their products by hand with logical effort and through custom design and layout in 0.18-µm CMOS process technology. The results analysis shows that the proposed CSLA structure is better than the regular SQRT CSLA.

Key words: CSLA, SQRT, CMOS.

POWER FRAMEWORK RECONFIGURATION AND MISFORTUNE MINIMIZATION FOR A CIRCULATION FRAMEWORKS UTILIZING BACTERIAL RUMMAGING IMPROVEMENT CALCULATION

Paper ID -1062

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Abstract

In this paper, a method based on bacterial foraging optimization algorithm (BFOA) is proposed for distribution network reconfiguration with the objective of loss minimization. A novel model to simplify a distribution network is presented. The feeder reconfiguration problem is formulated as a non-linear optimization problem, and BFOA is used to find the optimal solution. According to the characteristics of distribution network, some modifications are done to retain the radial structure and reduce the searching requirement. Test results of a 33 bus sample network have shown that the proposed feeder reconfiguration method can effectively ensure the loss minimization, and the BFOA technique is efficient in searching for the optimal solution.

Key words: Methods, BFO, Networks, Problem, etc.

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STUFFED BED SEGMENT THINKS ABOUT FOR THE EXPULSION OF MANUFACTURED COLORS FROM MATERIAL WASTEWATER UTILIZING IMMOBILIZED DEAD C. TROPICALIS

Paper ID -1063

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Abstract

An efficient dye bio sorbent was developed for the treatment of textile wastewater by entrapping dead cells of C. Tropicalis, within sodium alginate matrix. The bio sorbent performance was evaluated in packed bed column with different pH (3 to 6), wastewater strength (25%, 50% 75%), bed height (5cm-15cm) and flow rate (0.5mLmin -1 to 1mLmin -1). pH 5, undiluted wastewater, bed height 15cm and flow rate 0.5mLmin -1 were found to be optimum for dye bio sorption. The linearized form of the modified Thomas model equation fitted well with the experimental data and described the dynamic adsorption of synthetic dyes from textile wastewater. The Bed depth service time model was used to express the effect of bed height on breakthrough curves. Dye laden immobilised dead C. Tropicalis was regenerated using 0.01molL -1 NaOH at an elutant flow rate of 1mLmin -1. The reusability of the immobilised biomass was tested in consecutive adsorption-desorption cycles. The FT-IR spectral analysis showed the involvement of amine, hydroxyl, carbonyl, amide and phosphoryl groups in biosorption of dyes from wastewater. The analysis of treated samples showed almost zero colour and a significant decrease in Total Dissolved Solids (TDS).

Keywords: TDS, NaOH, FT-IT and Adsorption-desorption cycles.

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ECOFRIENDLY UNION OF SILVER NANOPARTICLES FROM INDUSTRIALLY ACCESSIBLE PLANT POWDERS AND THEIR ANTIBACTERIAL PROPERTIES

Paper ID -1064

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Abstract

Use of various plant materials for the biosynthesis of nanoparticles is considered a green technology, as it does not involve any harmful chemicals. The present study reports that silver nanoparticles (Ag NPs) were synthesized from a silver nitrate solution by commercially available plant powders, such as Solanum tricobatum, Syzygium cumini, Centella asiatica and Citrus sinensis. Ag NPs were characterized by UV-vis spectrophoto meter, X-Ray Diffractometer (XRD), Atomic Force Microscopy (AFM) and Fourier transform infrared (FTIR) spectroscopy. The formation and stability of the reduced silver nanoparticles in the colloidal solution were monitored by UV-vis spectrophotometer analysis. The mean particle diameter of silver nanoparticles was calculated from the XRD pattern, according to the line width of the plane, and the refraction peak, using Scherrer's equation. AFM showed the irregular shapes of Ag NPs, and the formation of silver nanoparticles was found to be 53, 41, 52 and 42 nm, corresponding to Syzygium cumini, Citrus sinensis, Solanum tricobatum and Centella asiatica, respectively. FTIR spectroscopy confirmed the presence of protein as the stabilizing agent surrounding the Ag NPs. Antimicrobial activity of the silver bio-nanoparticles was performed by a well diffusion method. The highest antimicrobial activity of Ag NPs synthesized by C. sinensis and C. asiatica was found against Pseudomonas aeruginosa (16 mm). The Ag NPs synthesized in this process were found to have efficient antimicrobial activity against pathogenic bacteria.

Key words: Nano particles, FTIR, AFM, XRD.

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TORSEMIDE AND FUROSEMIDE AS GREEN INHIBITORS FOR THE CONSUMPTION OF GENTLE STEEL IN HYDROCHLORIC CORROSIVE MEDIUM

Paper ID -1065

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Abstract

The performance of torsemide and furosemide drugs as corrosion inhibitors for mild steel in 1 N HCl was thoroughly investigated by weight loss and electrochemical methods. The inhibition efficiencies of drugs obtained by all methods were in good agreement with each other. Torsemide exhibited higher inhibition efficiencies than furosemide in all the experimental studies. Polarization studies revealed that the inhibiting action of the compounds is under mixed control. The free energy of adsorption and the influence of temperature on the adsorption of inhibitors onto a mild steel surface have been reported. The adsorption of the compounds was found to obey the Langmuir adsorption isotherm. The mechanism of inhibition and formation of the Fe-inhibitor complex were confirmed by FT-IR and UV-visible absorption spectral analysis. The scanning electron microscopy (SEM) and atomic force microscopy (AFM) results established the formation of a protective layer on the mild steel surface. Quantum chemical calculations were applied to correlate the inhibition performance of inhibitors with their electronic structural parameters. ©2013 American Chemical Society.

Key words: HCL, scanning electron microscopy (SEM), UV-visible absorption spectral analysis, and atomic force microscopy (AFM).

IDEAL VALUE MARKING DOWN AND PARCEL ESTIMATING ARRANGEMENTS FOR PERISHABLE THINGS IN A PRODUCTION NETWORK UNDER PROPEL INSTALLMENT PLAN AND TWO-ECHELON EXCHANGE CREDITS

Paper ID -1066

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Abstract

In this paper, an effective approach, Taguchi grey relational analysis, has been applied to experimental results of wire cut electrical discharge machining (WEDM) on Inconel 825 with consideration of multiple response measures. The approach combines the orthogonal array design of experiment with grey relational analysis. The main objective of this study is to obtain improved material removal rate, surface roughness, and spark gap. Grey relational theory is adopted to determine the best process parameters that optimize the response measures. The experiment has been done by using Taguchi's orthogonal array L36 (21 × 37). Each experiment was conducted under different conditions of input parameters. The response table and the grey relational grade for each level of the machining parameters have been established. From 36 experiments, the best combination of parameters was found. The experimental results confirm that the proposed method in this study effectively improves the machining performance of WEDM process.

Key words: Taguchi, SR, MRR, WEDM.

LASER ENGINEERED NET SHAPING PROCESS IN IMPROVEMENT OF BIO-COMPATIBLE IMPLANTS

Paper ID -1067

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Abstract

Additive manufacturing or Rapid Prototyping (RP) is an advanced manufacturing technology emerging as key player in both industrial and medical fields. Dissimilar to traditional manufacturing processes, in additive manufacturing process material is added as sequential thin layer to achieve the build parts with minimal post processing and it requires less time to fabricate prototypes with high accuracy. Additive manufacturing shows desired results for fabricating the customized medical implants. As there is a large variation to part structure from patient to patient, it is difficult to make implants from conventional manufacturing processes. So, rapid prototyping is most advanced and convenient to fabricate a medical implant that suits the patient's requirements. The present paper reviews the works produced by Laser Engineered Net Shaping (LENS) technique to fabricate the medical implants from bio-materials.

Key words: prototyping, fields, Additive manufacturing, Laser Engineered Net Shaping (LENS).

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CONDITION MONITORING AND DIAGNOSTIC ANALYSIS OF INDUCED DRAUGHT FAN ROTOR SYSTEM

Paper ID -1068

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Abstract

Today's machines are more complex as they have to meet more stringent functional and operational requirements. Growing demand on reliability and performance of these machines and maintaining high productivity without sacrificing product quality have made it imperative for maintenance engineers to device newer strategies in maintenance of plant and machines. One of such strategies is condition monitoring, which has emerged as the most powerful tool in maintenance engineering to prevent uneconomical, unreliable, unhealthy, unsafe and even lethal conditions. In this paper an attempt has been made to monitor the condition of induced draught fan rotor system of a large utility thermal power plant. The data has been logged for a period of 6 months and has been rationalized for ease of investigation. The values are plotted on time-domain for velocity to facilitate trend monitoring. Fault diagnosis of the rotor.

Keywords: Fault diagnosis of the rotor, Facilitate trend monitoring and condition monitoring.

RESEARCH ARTICLE DESIGN OPTIMIZATION OF A MICRO AIR VEHICLE (MAV) FIXED WING

Paper ID -1069

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Abstract

Micro air vehicles are gaining attention due to their wide range of applications in civilian and defense fields. The wings of these vehicles generate a particular flow regime which is to be explored further. Since the theories on the aerodynamics of all affects are still to be investigated, simulation based computational fluid dynamics is a good approach rather than wind tunnel experiments which involves cost and long periods of experimentation. This study mainly emphasize on the lift, lift coefficient, drag and drag coefficient with respect to Reynold's number and angle of attack, by modelling and analyzing the fixed wing of a micro air vehicle. The analysis has been done selecting NACA25411 air foil. Modelling has been done in Gambit and analysis is taken up using Fluent. Angle of attack and Reynold's number have been optimized to increase the lift and decrease the drag.

Key words: Micro air vehicle, Aerodynamics, Angle of attack, Lift coefficient and Drag coefficient.

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DESCRIPTION AND WEAR PROPERTIES OF CO-CR-W ALLOY DEPOSITED WITH LASER ENGINEERED NET SHAPING

Paper ID -1070

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Abstract

Commercially available Co-Cr-W alloy, known as Stellite 6, samples are deposited using Laser Engineered Net Shaping process using L9 orthogonal array of Taguchi method with three different process parameters, each at three levels. All the samples are tested for the microstructure analysis with ESEM and wear resistance. The EPMA mapping is also presented for analysis. The wear testing results reveal that the samples fabricated with 350W laser power, 7.5 g/min powder feed rate and 15mm/s laser scan speed have exhibited highest wear resistance at 30N load and 300rpm.

Key words: Satellite, EPMA, ESEM and ear resistance.

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VALID ARE SUGIYAMA' S EXPERIMENTS ON FOLLOWER FORCES

Paper ID -1070

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Abstract

This paper is inspired by the review articles of Langthjem and Sugiyama, and Elishakoff on the dynamic stability of non-conservative elastic systems. It examines Sugiyama's experimental results on a cantilever column subjected to the weight and thrust of a small rocket motor mounted at the tip end. The test results cannot be utilized directly for comparison with estimated critical loads of the column but they demonstrate the stabilization of the system due to rocket thrust.

Key words: Rocket thrust, dynamic stability of non-conservative elastic systems and cantilever column.

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ELECTRO CHEMICAL BEHAVIOUR OF LENSTM DEPOSITED CO-CR-W ALLOY FOR BIO-MEDICAL APPLICATIONS

Paper ID -1071

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Abstract

In additive manufacturing processes, Laser Engineered Net Shaping (LENS) is the promising technology in developing medical implants with minimal material wastage and high accuracy in shape and size. It enables the custom design of implants that vary from patient to patient. In the present work, the LENS process has been used to fabricate and test Co-Cr-W alloy for its corrosion resistance. The process parameters selected for fabricating the samples are laser power; powder feed rate and laser scan speed, each at three levels. Samples are fabricated as per the Taguchi L-9 orthogonal array and analysis is carried out through the ANOVA and Grey Relational Grade Analysis. Through this methodology, the primary process parameters viz. Laser power (LP), Powder feed rate (PFR) and scan speeds (SS) can be optimized simultaneously for achieving a better combination of multiple performance characteristics. From the experimental results, the multiple performance characteristics of the corrosion potential (Ecorr) and corrosion current (Icorr) of Co-Cr-W alloy are evaluated. The combination of high Laser Power (350W), high Powder Feed Rate (20 g/s) and low scan speed (10 mm/s) are most influencing process parameters to achieve the best corrosion resistance samples.

Key words: ANOVA, Grey Relational Grade Analysis and Powder feed rate (PFR).

A REVIEW ON DEVELOPMENT OF MEDICAL IMPLANTS BY RAPID PROTOTYPINGTECHNOLOGY

Paper ID -1073

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Abstract

Rapid prototyping/manufacturing is computer operated manufacturing technique, builds parts directly from CAD data by additive sequence layerby-layer, unlike traditional manufacturing process where material is removed in sequence to obtain a desired part. Rapid prototype plays a crucial role in development of medical implants. As medical implants have complex design and vary from patient to patient. It is easy to make custom made medical implants by rapid prototyping at very less cost and time, compared to conventional manufacturing techniques. The present article showcases the significance of rapid prototyping applications in medical industry with suitable bio-compatible materials and manufacturing techniques used to fabricate the complex medical models.

Key words: Rapid prototyping, CAD and Bio-compatible materials.

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EFFECTS OF LASER PARAMETERS ON MORPHOLOGICALCHANGE AND SURFACE PROPERTIES OF ALUMINUM INMASKED LASER SURFACE TEXTURING

Paper ID -1074

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Abstract

The masked laser surface texturing process was used to produce micro-pattern arrays. Using mesh grids as masks, the surface of the workpieces were selectively ablated and hundreds of micro-patterns were simultaneously generated by a single laser irradiation. The effects of laser energy intensity and number of laser pulses on surface morphologies and properties were investigated. It was found that it is more efficient to control the number of laser pulses than the laser energy intensity to form a uniform micro pattern array and to control the pattern shape. In addition, hardness values of the material surface can be selectively increased by adjusting laser parameters. When the laser energy intensity increased, the hardness of the whole region which was directly affected by the laser irradiation increased. When the surface was irradiated repeatedly by the multiple laser pulses, however, the increase in hardness was much pronounced in the masked bar region adjacent to the ablation zone. The structural changes of the patterned surface and the work hardening effect due to laser shock loading were superimposed to increase the hardness of the masked region. The contact angle decreased with increasing laser energy intensity and number of laser pulses. This is mainly due to an increase in surface heterogeneity at high laser energy intensities and an increase in bar width at multiple laser pulses condition.

Keywords: Masked, laser, surface heterogeneity, texturing, laser energy intensities and Multiple LASER pulses.

AN EVALUATION FOR MECHANICAL AND MICROSTRUCTURE BEHAVIOR OF DISSIMILAR MATERIAL WELDED JOINT BETWEEN NUCLEAR GRADE MARTENSITIC P91 AND AUSTENITIC SS304 L

Paper ID -1075

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Abstract

The microstructural evolution and mechanical properties of gas tungsten arc welded creep might enhanced martensitic (CSEM) and austenitic stainless steel (SS) dissimilar welded joint is explored in the as welded (AW) and post weld heat treated (PWHT) conditions. The as received normalized and tempered P91 steel has been welded with SS304 L by preparing a conventional groove and employing a P91 GTAW filler wire. The welded plate is subjected to PWHT at 760 °C for 120 min followed by air cooling. The P91 steel in as received condition exhibited fully martensitic (tempered) structure with lathe morphology and prior austenite grain boundaries while SS304 L have austenitic structure with twins. The heterogeneity (as-welded condition) across the welded joint were produced in terms of microstructure and mechanical properties (hardness, Charpy toughness and tensile strength). The variation in mechanical properties has been minimized after the PWHT. PWHT has experimental a drastic influence on mechanical properties and microstructure of weld fusion zone and HAZ of P91 side however, remain unaffected for the SS304 L side HAZ. The strength of the welded joint have been measured 1016 ± 2.5 MPa and 906 ± 6.5 in as-welded and PWHT condition with joint efficiency of 140 % and 125 %, respectively.

Keywords*:* SS304 L, Dissimilar welded joint, Microstructure, Mechanical properties.

AN EVALUATION OF THE WIRE ARC ADDITIVE MANUFACTURING OF METALS: PROPERTIES, DEFECTS AND QUALITY IMPROVEMENT

Paper ID -1076

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Abstract

Due to the feasibility of economically producing large-scale metal components with relatively high deposition rates, significant progress has been made in the understanding of the wire arc additive manufacturing (waam) process, as well as the microstructure and mechanical properties of the fabricated components. as waam has evolved, a wide range of materials have become associated with the process and its applications. This article reviews the emerging research on waam techniques and the commonly used metallic feedstock materials, and also provides a comprehensive over view of the metallurgical and material properties of the deposited parts. Common defects produced in waam components using different alloys are described, including deformation, porosity, and cracking. Methods for improving the fabrication quality of the additively manufactured components are discussed, taking into account the requirements of the various alloys. This paper concludes that the wide application of waam still presents many challenges, and these may need to be addressed in specific ways for different materials in order to achieve an operational system in an acceptable time frame. The integration of materials and manufacturing process to produce defect-free and structurally-sound deposited parts remains a crucial effort into the future.

Keywords: WAAM, Materials, Defects, Quality improvement and Metallic feedstock materials.

TRANSIENT LIQUID PHASE BONDING OF AZ31 MAGNESIUM ALLOY: METALLURGICAL STRUCTURE AND MECHANICAL PROPERTIES

Paper ID -1077

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Abstract

In the present paper, AZ31 magnesium alloy was transient liquid phase bonded using aluminum interlayers (with two different thicknesses of 9 and 14 μm), two bonding temperature of 440° and 455℃ and different holding times. Optical and scanning electron microscopies were employed to determine the progression of isothermal solidification. In addition, X-ray diffraction method was used to determine the formation of the brittle $Al_{12}Mg_{17}$ compound. The hardness was found to be higher at the joint center compared to the joint sides, which can be related to the eutectic structure and high amount of intermetallic compounds at the center. The results showed that the 9 μm-interlayer led to greater shear strength, elongation and failure energy than the 14 μm interlayer, and the highest shear strength of ∼35 MPa was obtained for 75 min bonding time and 9 μm interlayer. The fracture surface evaluation revealed the presence of more plastic deformation for the joints made by the thinner interlayer.

Keywords: TLP, bonding,AZ31, magnesium alloy, Metallurgy, Fracture surface evaluation.

EFFECT OF LASER BEAM WELDING PARAMETERS ON MORPHOLOGY AND STRENGTH OF DISSIMILAR AA2024/AA7075 T-JOINTS

Paper ID -1078

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Abstract

This paper investigates the effect of laser welding parameters, such as beam power, welding speed, incident beam angle, incident beam position and beam diameter, on the weld geometry, microstructure, porosity and mechanical properties of successive double-sided laser beam welded AA2024-AA7075 T-joints using 4047 filler wire. A change in the welding parameters influences the weld geometry and porosity, but does not cause significant variations in the weld microstructures, though some liquation cracking was observed in the heat-affected zone of alloys AA7075 and AA2024. The macro porosity occurs more in the second weld seam than in the first one. The pull-out test results presented higher values than those obtained by other authors. The ultimate tensile load in pull-out test is influenced by the laser power, laser beam diameter and incident beam position. Macro porosity plays a relevant role in fracture initiation during pull-out tests. Porosity and liquation cracking influenced the fracture mode of the pull-out test specimens, but they do not significantly affect the results.

Keywords: weld microstructures, heat-affected zone of alloys Laser, T-joints and Macro porosity.

EFFECT OF METAL TRANSFER MODE ON SPATTER AND ARC STABILITY IN UNDERWATER FLUX-CORED WIRE WET WELDING

Paper ID -1079

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Abstract

The effect of metal transfer mode on spatter and arc stability during underwater flux-cored wire wet welding at different process parameters are investigated adopting the synchronous acquisition system of X-ray image and electric signal. Two spatter modes i.e. the local droplet repelled spatter and the droplet explosion spatter were observed for the first time. The generation of the local droplet repelled spatter is attributed to the excessive and unstable repulsive forces, while the droplet explosion spatter is caused by the unstable repulsive forces and gas dynamic force. Welding spatters and arc stability depend on the metal transfer mode. During wide-angle globular repelled transfer mode, the droplet repelled spatter mode is observed and the forming frequencies of the local droplet repelled spatter and droplet explosion spatter are higher than other transfer modes. The short-circuit explosions are observed in short-circuit explosive transfer mode, causing numerous short-circuit explosive spatters. With the increase of arc voltage, both the spatter loss coefficient and voltage variation coefficient decrease firstly to the minimum at the arc voltage of 32 V and then increases gradually, attributed to the type and proportion of metal transfer mode.

Keywords*:* Wet welding, Welding spatter, Arc stability, Metal transfer mode**.**

INVESTIGATION OF EXPLOSIVE WELDING THROUGH WHOLE PROCESS MODELING USING A DENSITY ADAPTIVE SPH METHOD

Paper ID -1080

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Abstract

Explosive welding (EXW) involves processes like the detonation of explosive charge, impact of metal structures and strong fluid-structure interaction with complex features such as interfacial waves and jet generation. The whole EXW process has not been well modeled before due to the large deformation and moving interfaces while the associated mechanisms inherent in EXW are also not well understood. In this paper, the whole EXW process is simulated using a density adaptive smoothed particle hydrodynamics (SPH) model, in which a density adaptive algorithm is used to treat variable large density ratio in EXW and the kernel gradient correction (KGC) is used to improve computational accuracy of SPH. The mechanisms in EXW are investigated, and typical phenomena including the wavy interface, jet formation, interfacial temperature and pressure distribution as well as melting voids are examined. The mechanisms of wave formation are studied while two existing mechanisms, namely, the Jet Indentation Mechanism and the Vortex Shedding Mechanism are revealed with the present SPH simulations. It is demonstrated that with proper amount of explosive charge and initial welding angle, the present SPH method can well reproduce the morphology evolution of the welding interface from straight to wavy and further to wavy with vortex shedding. Furthermore, based on comprehensive numerical data from SPH simulations, two types of numerical weldability windows for EXW are presented together with discussions about different welding limits and effective explosive charge.

Keywords: Explosive welding (EXW) Smoothed particle hydrodynamics, Jet Indentation Mechanism and Vortex Shedding Mechanism.

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INVESTIGATION ON THE FRACTURE BEHAVIOR OF TITANIUM GRADE 2 SHEETS BY USING THE SINGLE POINT INCREMENTAL FORMING PROCESS

Paper ID -1081

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Abstract

The objective of the present research work is to study the fracture behaviour (void coalescence) of titanium grade 2 sheets using the Single Point Incremental Forming (SPIF) process and its dependence on various process parameters. The importance of tool diameter on the fracture behavior of the titanium grade 2 was investigated and it was found that the maximum deformation fracture strain was observed for the highest (12 mm) tool diameter. The Forming Limit Diagram (FLD) is plotted for each speed of titanium grade 2 sheets. The variation of fracture behaviour with respect to speed was examined and it showed that this was the maximum for higher speed of 600 rpm spindle speed. The void coalescence analysis was carried out using AutoCAD software, and the strain triaxiality was determined. The Energy Dispersive X-ray Spectroscopy (EDS) analysis was investigated to confirm the elemental composition of titanium grade 2 sheets.

Keywords: Titanium, SPIF, FLC and Energy Dispersive X-ray Spectroscopy (EDS).

METAL PROTOTYPING THE FUTURE OF AUTOMOBILE INDUSTRY: A REVIEW

Paper ID -1082

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Abstract

Metal prototyping an advanced rapid prototyping technique has shown a very high potential to reduce the time of manufacture and cost of product effectively. Implementation of metal prototyping to the extent of 4d printing improves the future of small, medium and large-scale enterprises of automobile industry. This paper gives a glance of metal prototyping to automobile industry. The implementation of future metal prototyping automobile industry involves 1. Re- engineering model generation for spare parts of two, three, four-wheeler automobiles, 2. Mathematical and software simulation by using fem techniques, 3.3d printing, 4. Metal prototyping though 3d/ 4d printing, 5. Prototype testing and research labs are described in detail. Finally this review gives a glance on future automobile industry through metal prototyping

Keywords: FEM, Metal prototyping, Automobile, scrap.

STUDY ON COLD METAL TRANSFER WELDING–BRAZING OF TITANIUM TO COPPER

Paper ID -1083

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Abstract

3 mm Pure titanium TA2 was joined to 3 mm pure copper T2 by Cold Metal Transfer (CMT) welding–brazing process in the form of butt joint with a 1.2 mm diameter ERCuNiAl copper wire. The welding–brazing joint between Ti and Cu base metals is composed of Cu–Cu welding joint and Cu–Ti brazing joint. Cu–Cu welding joint can be formed between the Cu weld metal and the Cu groove surface, and the Cu–Ti brazing interface can be formed between Cu weld metal and Ti groove surface. The microstructure and the intermetallic compounds distribution were observed and analyzed in details. Interfacial reaction layers of brazing joint were composed of Ti_2Cu, TiCu and $AlCu_2Ti$. Furthermore, crystallization behavior of welding joint and bonding mechanism of brazing interfacial reaction were also discussed. The effects of wire feed speed and groove angle on the joint features and mechanical properties of the joints were investigated. Three different fracture modes were observed: at the Cu interface, the Ti interface, and the Cu heat affected zone (HAZ). The joints fractured at the Cu HAZ had higher tensile load than the others. The lower tensile load fractured at the Cu interface or Ti interface was attributed to the weaker bonding degree at the Cu interface or Ti interface.

Keywords: Titanium, Copper, Cold metal transfer, heat affected zone (HAZ) and Welding–brazing.

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EFFECT OF STRAIN RATE AND TEMPERATURE ON STRAIN HARDENING BEHAVIOR OF A DISSIMILAR JOINT BETWEEN TI–6AL–4V AND TI17 ALLOYS

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Abstract

The aim of this study was to evaluate the influence of strain rate and temperature on the tensile properties, strain hardening behavior, strain rate sensitivity, and fracture characteristics of electron beam welded (EBWed) dissimilar joints between Ti–6Al–4V and Ti17 (Ti–5Al–4Mo–4Cr–2Sn–2Zr) titanium alloys. The welding led to significant microstructural changes across the joint, with hexagonal close-packed martensite (α') and orthorhombic martensite (α'') in the fusion zone (FZ), α' in the heat-affected zone (HAZ) on the Ti–6Al–4V side, and coarse β in the HAZ on the Ti17 side. A distinctive asymmetrical hardness profile across the dissimilar joint was observed with the highest hardness in the FZ and a lower hardness on the Ti–6Al–4V side than on the Ti17 side, where a soft zone was present. Despite a slight reduction in ductility, the yield strength (YS) and ultimate tensile strength (UTS) of the joints lay in-between the two base metals (BMs) of Ti–6Al–4V and Ti17, with the Ti17 alloy having a higher strength. While the YS, UTS, and Voce stress of the joints increased, both hardening capacity and strain hardening exponent decreased with increasing strain rate or decreasing temperature. Stage III hardening occurred in the joints after yielding. The hardening rate was strongly dependent on the strain rate and temperature. As the strain rate increased or temperature decreased, the strain hardening rate increased at a given true stress. The strain rate sensitivity evaluated via both common approach and Lindholm approach was observed to decrease with increasing true strain. The welded joints basically failed in the Ti–6Al–4V BM near the HAZ, and the fracture surfaces exhibited dimple fracture characteristics at different temperatures.

Keywords*:* Titanium alloy, Electron beam welding, Strain, hardening behavior, heat affected zone (HAZ).

FRICTION STIR WELDING OF DISSIMILAR MATERIALS BETWEEN AA6061 AND AA7075 AL ALLOYS EFFECTS OF PROCESS PARAMETERS

Paper ID -1085

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Abstract

Dissimilar AA6061 and AA7075 alloy have been friction stir welded with a variety of different process parameters. In particular, the effects of materials position and welding speed on the material flow, microstructure, microhardness distribution and tensile property of the joints were investigated. It was revealed that the material mixing is much more effective when AA6061 alloy was located on the advancing side and multiple vortexes centers formed vertically in the nugget. Three distinct zones with different extents of materials intercalations were identified and the formation mechanism of the three zones was then discussed. Grain refinement was observed in all three layers across the nugget zone with smaller grains in AA7075 Al layers. All the obtained joints fractured in the heat-affected zone on the AA6061 Al side during tensile testing, which corresponds very well to the minimum values in microhardness profiles. It was found that the tensile strength of the dissimilar joints increases with decreasing heat input. The highest joint strength was obtained when welding was conducted with highest welding speed and AA6061 Al plates were fixed on the advancing side. To facilitate the interpretation, the temperature history profiles in the HAZ and at zones close to TMAZ were also measured using thermocouple and simulated using a three-dimensional computational model.

Keywords: TMAZ, friction stir welding, microhardness profiles and vortexes centers.

TENSILE PROPERTIES OF FIBER LASER WELDED JOINTS OF HIGH STRENGTH LOW ALLOY AND DUAL-PHASE STEELS AT WARM AND LOW TEMPERATURES

Paper ID -1086

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Abstract

High strength low alloy (HSLA) and dual-phase DP980 (UTS ⩾ 980 MPa) steels were joined using fiber laser welding in similar and dissimilar materials combinations. The welded joints were characterized with respect to microhardness and tensile properties at three different temperatures: −40 °C, 25 °C, and 180 °C. Tensile properties of the welded joints were compared to those of the base metal (BM) obtained under similar conditions. A good correlation was found between the welded joints and the BM in relation to the tensile properties obtained at the different temperatures. A general trend of increase in the yield strength (YS), the ultimate tensile strength (UTS) and energy absorption (EA) with decreasing temperature was observed; however, work hardening coefficient was not altered and insignificant scatter was observed in case of the elongation. However, in the DP980 steel, dynamic strain ageing was observed only in the BM.

Keywords: High strength low alloy (HSLA), ultimate tensile strength (UTS), energy absorption (EA) and microhardness.

MICROSTRUCTURE AND MECHANICAL PROPERTIES OF HOT ROLLED TINBSN ALLOYS

Paper ID -1087

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Abstract

Titanium alloys with lower elastic modulus and free from toxic elements such as Al and V have been studied for biomedical matters. Ti–Nb–Sn alloys showed up as presenting great potential for the aforementioned purpose. The current study got Ti–35Nb-XSn alloys ($x = 2.5$; 5.0; 7.5) by applying the following techniques: arc melting, homogenizing and cooling in furnace, homogenizing and water quenched, hot rolling and water quenched. According to each step of the study, the microstructures were featured by means of optical microscopy, by applying a scanning electron microscopy (SEM) analysis as well as X-ray diffraction. The mechanical properties were gotten by means of: Vickers micro hardness, tensile and ultrasonic tests. Their ratio between tensile strength and elastic modulus as well as the ductility were compared to other biomedical alloys already available in the literature. The mechanical behavior of the Ti–Nb alloys directly depends on the Sn rates that constitutes the phases as well as on the thermo mechanical background to which the alloy was submitted to. The hot rolled Ti–35Nb–2.5Sn alloy showed high ratio between strength and elastic modulus as well as high ductility, just as high as those of some cold rolled Ti alloys.

Keywords: β Titanium alloys, Biomaterials, Mechanical properties, Vickers micro hardness, tensile and ultrasonic tests.

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A MATERIALS SELECTION PROCEDURE FOR SANDWICHED BEAMS VIA PARAMETRIC OPTIMIZATION WITH APPLICATIONS IN AUTOMOTIVE INDUSTRY

Paper ID -1088

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Abstract

The future of automotive industry faces many challenges in meeting increasingly strict restrictions on emissions, energy usage and recyclability of components alongside the need to maintain cost competiveness. Weight reduction through innovative design of components and proper material selection can have profound impact towards attaining such goals since most of the lifecycle energy usage occurs during the operation phase of a vehicle. In electric and hybrid vehicles, weight reduction has another important effect of extending the electric mode driving range between stops or gasoline mode. This paper adopts parametric models for design optimization and material selection of sandwich panels with the objective of weight and cost minimization subject to structural integrity constraints such as strength, stiffness and buckling resistance. The proposed design procedure employs a pre-compiled library of candidate sandwich panel material combinations, for which optimization of the layered thicknesses is conducted and the best one is reported. Example demonstration studies from the automotive industry are presented for the replacement of Aluminum and Steel panels with polypropylene-filled sandwich panel alternatives.

Keywords: Polypropylene-filled sandwich panel, electric and hybrid vehicles, weight reduction and buckling resistance.

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EFFECTS OF HEAT ACCUMULATION ON THE ARC CHARACTERISTICS AND METAL TRANSFER BEHAVIOR IN WIRE ARC ADDITIVE MANUFACTURING OF TI6AL4V

Paper ID -1089

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Abstract

Wire arc additive manufacturing (WAAM) offers a promising alternative to traditional subtractive manufacturing of metallic components, particularly in the case of large Ti6Al4V structures for the aerospace sector that feature high buy-to-fly ratios. This study investigates the influence of heat accumulation on bead formation, arc stability, and metal transfer behaviour during the manufacture of Ti6Al4V with the gas tungsten wire arc additive manufacturing (GT-WAAM) using localized gas shielding. An infrared pyrometer is used to measure the in-situ interpass temperature which is a key factor in determining the heat accumulation. Arc stability and metal transfer behaviour are monitored by means of a high speed camera. The results show that due to the various thermal dissipation paths along the building height, there exists a significant difference in temperature variation between substrate and in-situ layer. Owing to the influences of heat accumulation, the interlayer surface oxidation and bead geometries vary along the building direction, especially for the first few layers of the deposited wall, which lead to variation in arc shape and metal transfer behaviour. The research outcome provides a better understanding of the effects of heat accumulation on deposition stability during WAAM process, which benefits future process optimization and control.

Keywords: Wire arc additive manufacturing, Ti6Al4V, Heat accumulation, gas tungsten wire arc additive manufacturing (GT-WAAM) and Arc shape.

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MICROSTRUCTURE AND MECHANICAL PROPERTIES OF FRICTION STIR WELDS ON UNMODIFIED AND P-MODIFIED AL-MG_2SI-SI ALLOYS

Paper ID -1090

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Abstract

Welded joints formed by friction stir welding (FSW) consist of three distinct zones: a base material zone (BMZ), a thermo-mechanically affected zone (TMAZ), and a weld nugget (WN). Primary Mg_2Si phases are identified as equiaxed crystals and polygonal particles in unmodified and P-modified Al-Mg_2Si-Si alloys in the BMZ, respectively. In the WN, the equiaxed primary Mg_2Si crystals in the unmodified alloys are transformed to significantly smaller polygonal/irregular particles; the corners of the polygonal primary Mg_2Si particles in the modified alloys become smoother and smaller. The segregation of the primary Mg_2Si phase is reduced for both the unmodified and modified alloys in the WN. Both unmodified and modified alloys have a lower solidus temperature in the WN. The ultimate tensile strengths (UTSs) of the welded joints are enhanced by 5% and 8% for the unmodified and modified alloys, respectively, in comparison with the parent material. The UTS of the welded joints in the modified alloy is ∼20% higher than in the unmodified alloy.

Keywords*:* Al-Mg_2Si-Si alloy, Friction stir welding, Microstructure**.**

FATIGUE CRACK PROPAGATION BEHAVIOUR IN WIRE+ARC ADDITIVE MANUFACTURED TI-6AL-4V: EFFECTS OF MICROSTRUCTURE AND RESIDUAL STRESS

Paper ID -1091

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Abstract

Fatigue crack propagation tests of Ti-6Al-4V fabricated by the Wire+Arc Additive Manufacturing (WAAM) process are analysed. Crack growth rate and trajectory are examined before and after the crack tip crossing an interface between the WAAM and wrought alloys. The study has focused on the microstructure and residual stress effect. First, the differences in crack growth rate and path between WAAM and wrought alloys are attributed to their different microstructure; the equiaxed wrought alloy has straight crack path, whereas the WAAM lamellar structure causes tortuous crack path resulting in lower crack growth rate. Second, based on measured residual stress profile in the as-built WAAM piece, retained residual stress in the much smaller compact tension specimens and its effect on crack growth rate are calculated by the finite element method. Numerical simulation shows considerable residual stress in the test specimen and the stress magnitude depends on the initial crack location and propagation direction in relation to the WAAM-wrought interface. Residual stress is released immediately if the initial crack is in the wrought substrate; hence it has little effect. In contrast, when crack grows from WAAM to wrought, residual stress is retained resulting in higher stress intensity factor; hence greater crack growth rate.

Keywords: Additive manufacturing, Titanium alloy, Fatigue crack propagation, Residual stress**.**

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FORMATION MCHANISM OF TYPICAL ONION RING STRUCTURES AND VOID DEFECTS IN FRICTION STIR LAP WELDED DISSIMILAR ALUMINUM ALLOYS

Paper ID -1092

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Abstract

The formation mechanism for typical onion ring structure and void defect with heat input during FSLW was continuously visualized by an exit-hole continuous observation technique. Based on this result, the compatibility between microstructure, microtexture, element maps and strain maps using electron backscattered diffraction (EBSD) with the chemical indexing assisted by EDS analysis was simultaneously investigated. The results revealed that the threaded probe was significantly correlated to typical onion ring structure and the onion structure formed as soon as it touched the probe. This result is different from the results so far. On the other hand, the remnant of original interface between top and bottom plates after FSLW and asymmetrical flow around rotating tool were significantly correlated to the formation of void defect in low heat input condition.

Keywords: Friction stir lap welding, Dissimilar aluminum alloy, Material flow.

CHARACTERIZATION OF HEAT AFFECTED ZONE LIQUATION CRACKING IN LASER ADDITIVE MANUFACTURING OF INCONEL 718

Paper ID -1093

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Abstract

The heat affected zone liquation cracking behavior was studied in laser additive manufactured Inconel 718. Liquation cracking was found initiating from the weak site near the fusion line in the pre-deposited layer, propagating along the inter dendritic region with the further deposition proceeding layer by layer. Total cracking length calculation results showed that when controlling the heat input and height increment constant, liquation cracking susceptibility increased with the increase of laser scanning speed; and when controlling the laser scanning speed and height increment constant, liquation cracking susceptibility increased with the increase of heat input. The effect of grain boundary misorientation on susceptibility to liquation cracking was also investigated through electron backscatter diffraction (EBSD) measurement, and the results showed that liquation cracking tendency increased with the increase of grain boundary angle, which was considered to be attributed to the higher stability of liquation film at larger grain boundary during the last stage of solidification.

Keywords*:* HAZ cracking, Laser cladding, EBSD, Grain boundary misorientation**.**

3D PRINTING FOR FUNCTIONAL ELECTRONICS BY INJECTION AND PACKAGE OF LIQUID METALS INTO CHANNELS OF MECHANICAL STRUCTURES

Paper ID -1094

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Abstract

With the fabrication freedom and high efficiency introduced by 3D printing, such technology has been explored in the electronic manufacturing processes. In the present work, we reported a developed method for the fabrication of functional electronics with liquid phase electronic circuits. The technique involves printing hollow channels within elastomer structures via fused deposition modeling (FDM), then injecting and encapsulating liquid metal to form electrical traces. The process parameters in printing elastomer objects and the design of hollow channels were investigated via the extrusion experiments. The influence of flow rates on liquid metal injection was also studied under pressure injection. Based on these discussions and validations, the relationships between process parameters and the printing structures were demonstrated, and the flexible substrate with hollow channels was successfully printed by optimization of the process parameters. Moreover, a probe signal circuit has been fabricated to demonstrate the ability of injecting and packaging liquid metal into 3D printed structures for functional electronics.

Keywords: 3D printing, Functional electronics, Additive manufacturing, Hollow channel.

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POLYMER-BASED SMART MATERIALS BY PRINTING TECHNOLOGIES: IMPROVING APPLICATION AND INTEGRATION

Paper ID -1095

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Abstract

Smart and functional materials processed by printing technologies reveal an increasing interest due to reduced cost of assembly, easy integration into devices and the possibility to obtain multifunctional materials over flexible and large areas. After introducing smart materials, printing technologies and inks, this review discusses the materials that are already being printed, mainly piezoelectric, piezoresistive, magnetostrictive, shape memory polymers (SMP), pH sensitive and chromic system materials. Since polymer-based smart materials are particularly attractive for device implementation, this review will focus on printed polymer-based smart materials. Finally, critical challenges and future research directions will be addressed.

Keywords*:* Printing, technologies, Smart materials, Internet, Additive manufacturing, Polymers

3D PRINTING OF POLYMER-BONDED MAGNETS FROM HIGHLY CONCENTRATED, PLATE-LIKE PARTICLE SUSPENSIONS

Paper ID -1096

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Abstract

This paper reports the 3d printing of polymer-bonded magnets using highly concentrated suspensions of non-spherical magnetic particles. In a previous study, magnets of arbitrary shapes have been successfully fabricated using the uv-assisted direct write (uadw) method. The magnetic remanence (b_r) of the uadw magnets was limited by the type of magnetic particles used and the highest printable particle loading. Magnetic particles produced from melt spinning have better intrinsic magnetic properties, but their plate-like shape has resulted in a higher working viscosity, posing a major challenge in 3d printing with uadw. Inspired by the "farris effect" in rheology, we mixed the plate-like particles of two different sizes to increase the poly dispersity and reduce the overall viscosity of the mixture as the smaller particles can now fill the interstitial space between the larger ones. Using this rheological technique, a particle loading of as high as 65% by volume, or 93% by weight, was 3d printed. The resulting magnet has a density of 5.2 g/cm^3, an intrinsic coercivity (h_{ci}) of 9.39 koe, a remanence (b_r) of 5.88 kg, and an energy product ($(BH)_{max}$) of 7.26 mgoe, marking the highest values reported for 3d printed polymer-bonded magnets.

Keywords: 3D printing, Magnets, Rheology, Direct write, Suspensions.

WIRE + ARC ADDITIVELY MANUFACTURED INCONEL 718: EFFECT OF POST-DEPOSITION HEAT TREATMENTS ON MICROSTRUCTURE AND TENSILE PROPERTIES

Paper ID -1097

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Abstract

Wire + Arc Additive Manufacturing (WAAM) can be used to create large free-form components out of specialist materials such as nickel-base super alloys. Inconel (IN) 718 is well suited for the WAAM process due to its excellent weld ability. However, during deposition, WAAM IN718 is susceptible to micro-segregation, leading to undesirable Laves phase formation in the inter dendritic regions. Further, the WAAM process encourages columnar grain growth and the development of a strong fibre texture, leading to anisotropy in grain structure. This unfavourable microstructure can be addressed through specialised post-deposition homogenisation heat treatments. A new modified heat treatment was found to be effective in dissolving Laves phase, whereas a standard treatment precipitated δ phase. Tensile test results revealed that Laves and δ phases lead to low ductility when present in a precipitation-hardened matrix. The modified heat treatment also reduced the anisotropy in grain structure, leading to almost isotropic elevated temperature tensile properties, which meet minimum specifications for conventional cast but not for wrought material. Specialised post-deposition heat treatments, which address the unique microstructure of WAAM IN718, are crucial to achieving optimal mechanical properties.

Keywords*:* manufacturing, Nickel-base super alloy, Heat treatment, Microstructure**.**

REVIEW ON DESIGN AND STRUCTURAL OPTIMISATION IN ADDITIVE MANUFACTURING: TOWARDS NEXT-GENERATION LIGHTWEIGHT STRUCTURES

Paper ID -1098

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Abstract

As the application of additive manufacturing (AM) reaches an unprecedented scale in both academia and industry, a reflection upon the state-of-the-art developments in the design for additive manufacturing (DfAM) and structural optimisation, becomes vital for successfully shaping the future AM-landscape. A framework, highlighting both the interdependencies between these two central aspects in AM and the necessity for a holistic approach to structural optimization, using lightweight strategies such as topology optimization and/or latticing, was established to summarize the reviewed content. Primarily focusing on isotropic material considerations and basic stiffness-optimal problems, these concepts have already found wide application, bridging the gaps between design and manufacturing as well as academia and industry. In pursuit of streamlining the AM-workflow towards digitally print-ready designs, studies are increasingly investigating mathematically-based structural optimization approaches in conjunction with DfAM-specific constraints, providing a portfolio of solutions like generative design, which is gaining traction in industry. Besides an overview on economically-driven to performance-driven design optimizations, insight into commercial AM-specific software is provided, elucidating potentials and challenges for the community. Despite the abundance of AM design methods to-date, computationally inexpensive solutions for common engineering problems are still scarce, which is constituting one of many key challenges for the future.

Keywords*:* AM design methods design for additive manufacturing (DfAM), latticing and structural optimization.

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PERFORMANCE OF TRANSMISSION LOSS ON HYBRID MUFFLER BY USING ROCK WOOL AND GLASS FIBER AS A ABSORBING MATERIALS

Paper ID -1099

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Abstract

Muffler is categorized in two broad manners as absorptive muffler and reactive muffler. A Muffler (silencer) is an important noise control element for reduction of machinery exhaust noise, fan noise, and other noise sources involving the flow of gases. Reactive mufflers which reduce noise by reflecting sound energy back to its source, and absorption mufflers, which absorb sound due to the energy dissipated in the sound-absorbing material. The attenuation levels of these types of muffler are dependent on the frequency of the noise source. Investigations on absorption mufflers have indicated that these have fairly good noise attenuation over a relatively wide frequency band. The combination of both reactive and absorptive muffler is termed as hybrid muffler. Hybrid muffler design may be expected to provide broadband high noise attenuation and low pressure drop. Experimental Two load setup and Wave 1-D is used to predict the transmission loss of hybrid muffler. Hybrid muffler generally includes the number of perforated tubes, number of perforated baffles with absorptive materials like asbestos, rock wool, bensoil, powertex & advantex etc. Transmission loss measurement using hybrid muffler is discussed in this paper. Various sound absorption materials that are currently used for noise reduction are used. This paper shows the acoustic performance of packed dissipative muffler with the variation in packing density of absorptive material. Here easy available absorptive materials glass fiber & rock wool is used with same space. This study is performed by taking four designs to observe the transmission loss performance by applying different absorptive materials with different packing density.

Keywords: Transmission Loss (TL), Hybrid Muffler, Sound Absorptive Materials, Two Load Method, Wave 1-D.

EFFECT OF CHANGE IN DIAMETER ON MUFFLER TRANSMISSION LOSS USINGCOMSOL

Paper ID -1100

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Abstract

Muffler analysis is always challenging task due to complex design, shape and size limitation for specific application. In this paper the inlet diameter of muffler is varied for comparison. Two finite element methods (FEM) Results are compared using COMSOL 5.0 software. Two different muffler configurations are considered, representing the effects of adding absorptive lining and without absorptive lining to increase the transmission loss (TL), from computational analysis it is observed that for 40 mm inlet transmission loss is more compared with 30 mm inlet diameter.

Keywords – Transmission loss (TL), Acoustic liners.

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DESIGN, ASSESSMENT AND OPTIMIZATION OF AUTOMOTIVE MUFFLER

Paper ID -1101

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Abstract

Mufflers are important part of engine system and commonly used in exhaust system to minimize sound transmissions caused by exhaust gases. Design of mufflers is a complex function that affects noise characteristics, emission and fuel efficiency of engine. Therefore muffler design becomes more and more important for noise reduction. The objective of the paper is to propose a design of simple reactive muffler for effective sound attenuation and for getting highest transmission losses. The paper contains two optimization problem to get optimize model which can further optimize by using Taguchi method. The problem were built and analysed by using 'COMSOL MULTIPHYSICS' in pressure acoustic analysis domain for getting Maximum Transmission Losses and minimum Sound Pressure Level (SPL). First optimization problem contain muffler in which perforation diameter and pipe diameter are varied which again optimizes by eliminating perforation and by varying pipe lengths in second optimization problem. Among the best problem is further optimized by using Taguchi method.The effect of SPL on the walls of the muffler is not considered. The material of the muffler is also not considered. This optimized model of elliptical muffler is manufacture and then validate with the experimental analysis.

Keywords: Transmission Losses, Sound Pressure Level, Acoustic, Optimization

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ANALYSIS OF EXHAUST SYSTEM- 'SEMI ACTIVE MUFFLER'

Paper ID -1102

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Abstract

Main drawback of I.C. engines working is that it is a major source of noise pollution. That is why the reduction of exhaust noise generated from engine is in today's world an important issue. Attaching a muffler in the exhaust pipe is the good option for reducing noise. But muffler requires specific design and construction considering various noise parameters produced by the engine. Since early development of mufflers, the main objective of design was attenuation of sound in regular mufflers. Which causes a great amount of back pressure at the exhaust port thus losingpower, increasing fuel consumption and piston effort to exhale the gases out. For high performance engines the free flow exhaust is made in which the sound level is not important but zero or less back pressure is. There is no intermediate muffler type in between both these, so semi active muffler is an step between these two, in which it attenuates sound when engine is running at low rpm , and converts in free flow when engine at higher revs.

Keywords: CFR-cylinder firing ratio, EFR-engine firing ratio, Semi active muffler, Vm-volume of muffler.

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ANALYSIS OF FLOW FIELD AND PRESSURE LOSS FOR FORK TRUCK MUFFLER BASED ON THE FINITE VOLUME METHOD

Paper ID -1103

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Abstract

Having the premise of the certain acoustic performance, a muffler should make the pressure loss as small as possible. A simulation model of a fork truck muffler with a complex structure is established. Based on the finite volume method, multidimensional numerical simulation regarding velocity field and pressure field of steady flows for a muffler is performed using CFD (computational fluid dynamic method). Flow characteristics and pressure distribution of the muffler are analyzed. It is found that the vortex inside the muffler creates a great pressure loss. With the increases of inlet gas flow rate , the pressure loss of the muffler increases gradually. The internal structure of the muffler is redesigned for obtaining the optimized structure on the basis of analysis. The influences of the inner tube length on the flow and pressure loss of muffler are researched. The study will provide a theoretical basis for designing a complex muffler.

Keywords: Complex muffler, Velocity field, Pressure field, Structure improvement.

STUDY OF MULTI-CHAMBER MICRO-PERFORATED MUFFLFLER WITH ADJUSTABLE TRANSMISSION LOSS

Paper ID -1104

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Abstract

The noise behavior of the blower used on fuel cell vehicles is measured and analyzed. According to the noise behaviors, the multi-chamber micro-perforated muffler with adjustable transmission loss is proposed for silencing. The adjustment is achieved by the change of the third chamber length. The relation model between the chamber length and the muffler resonant frequency is fitted. In addition, the muffler sample is manufactured for experiment. According to the study, the blower noise contains the wide band noise with frequency range of 500–1000 Hz and the narrow band harmonics with frequency range of 2000–3500 Hz. The experimental results show that the proposed muffler is effective and efficient to attenuate the low-medium frequency wide band noise and the narrow band harmonics simultaneously.

Keywords: Blower noise, Micro-perforated muffler , Adjustable transmission loss .

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ASSESSMENT OF VARIOUS ALGORITHMS FOR IMPROVING ACOUSTIC ATTENUATION PERFORMANCE AND FLOW CHARACTERISTIC OF REACTIVE MUFFLFLERS

Paper ID -1105

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Abstract

The parametric optimization of the reactive mufflers is researched by numerical analysis, regarding the performance of the acoustic and flow fifields synthetically. The finite element method, based on the Helmholtz equation and the Navier–Stokes equation respectively, is utilized in the analysis of the acoustic and flow fifields. And the initial and boundary conditions are set up in the physical fifields respectively. The weighting multi-objective function about acoustic and flow fifields is formulated. In addition, the optimization results of multidisciplinary, obtained by the Nelder Mead algorithm (NMA) based on the sensitivity analysis, the Monte Carlo algorithm (MCA) and Genetic Algorithm (GA) based on the random sampling, are analyzed comparatively. The optimization results indicate that the NMA can maximize the transmission loss (TL) and minimize the pressure drop with the given weight factor. Finally, numerical optimization examples confirm the validity and reliability of the proposed optimization method in the acoustic-flow field.

Keywords: Transmission loss, Pressure drop, Reactive muffler, Multidisciplinary optimization

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TOPOLOGY OPTIMIZATION OF A SUCTION MUFFLER IN A FLUID MACHINE TO EXPLOIT ENERGY COMPETENCE AND MINIMIZE BROADBAND SOUND

Paper ID -1106

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Abstract

A suction muffler used in a fluid machine has three functions: noise reduction; minimizing pressure drop and improving energy efficiency using acoustic effects. However, no method of suction muffler design considers all three of these functions concurrently. Therefore, in this study, we attempt to provide an integrated design method of a suction muffler in afluid machine that considers all three functions. The topology optimization method for acoustic and fluid systems was applied to an integrated design. However, the interaction between fluid and acoustic was not considered. In addition, the acoustic input impedance of a suction muffler was used for a specific acoustical resonance frequency to improve the energy efficiency of a fluid machine. Finally, the sequential optimization method based on physical investigations was proposed to satisfy several design criteria. The proposed method was applied to the suction muffler in refrigerator's compressor.

Key words: Muffler, pressure drop and improving energy efficiency.

FINITE ELEMENT ANALYSIS OF AN INDUSTRIAL RASH SILENCER

Paper ID -1107

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Abstract

Classical analytical models used for prediction of the performance of reactive silencers are limited to conditions where the dimensions of the duct and resonators are small compared to the wavelength of the sound. Finite Element Analysis does not suffer from such limitations and has therefore been used to analyse the design of a reactive silencer for the exhaust stack of a 980MW power station. To assist in the design process, resonators of various dimensions were analysed using FEA which has led to the derivation of expressions for the resonance frequencies of slot-type rhomboid shaped resonators as a function of the geometry. An important design issue is the influence that adjacent resonators have on the overall performance of the system. It was found that when resonators of similar resonance frequency are in close proximity, they can interact and lead to a decrease in the overall performance compared to that of a single resonator.

Key words: reactive silencers, Finite Element Analysis, resonators and exhaust stack.

FLOW STUDY OF REACTIVE MUFFLER USING CFD ANALYSIS

Paper ID -1108

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Abstract

Muffler design is traditionally a trial and error process. This paper describes the flow analysis of a reactive muffler using CFD simulation in order to improve its performance by reducing the back pressure created on the engine. The back pressure of the muffler is computed from CFD simulation. The CFD analysis is done to avoid the tedious experimentation. The flow simulation is carried out using k-ε turbulent model as it is most suitable for turbulent flows having less converging time. Total four cases were analyzed including the base model muffler. Thus three modifications were done in muffler geometry. The modification with reduced baffle spacing produced least back pressure with reduction in back pressure by 8.59%.

Keywords: CFD simulation, turbulent model, baffle and back pressure.

STRUCTURAL ANALYSIS FOR EXHAUST GAS FLOW THROUGH AN ELLIPTICAL CHAMBER MUFFLER UNDER STATIC AND DYNAMIC LOADING CONDITION

Paper ID -1109

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Abstract

High pressure and temperature exhaust gases coming out from automobile engine are made to pass through muffler for reduction of sound resulting from propagation of these pressure waves. The mufflers may be of reactive, dissipative and resonating type. The present paper deals with an automotive muffler that is modeled based on practical dimensions of a 4-stroke 2-cylinder MAHINDRA MAXIMO PLUS C.I. engine in CATIA V5software. The geometry adopted is elliptical in nature. Comparative static structural analysis for stress, strain and deformation along with modal analysis for deformation under dynamic loading has been performed for perforated and non-perforated design of the muffler using ANSYS Workbench 14.5. The effect of incorporation of perforation is studied on the corresponding static and dynamic behavior of the muffler.

Keywords: Automotive muffler, dynamic loading, modal analysis, static loading, structural analysis.

DESIGN AND ANALYSIS OF PERFORATED MUFFLER IN AUTOMOBILE

Paper ID -1110

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Abstract

A muffler is a device for reducing the amount of noise emitted by an automobile. To reduce the noise, the engine drain is connected via output pipe to silencer called muffler. The muffler makes a major contribution to reduce the noise. Mufflers are connected to the exhaust pipe of internal combustion engine to suppress the acoustic flow of the engine in combustion process. Mufflers form an integral part of automobile. Mufflers are designed to increase the back pressure so as to reduce the noise level. In this study, attempt has been made to improve the design of muffler for reducing noise. The design of a muffler is to reduce the noise, for that an existed automobile muffler has modified and compared with the arrangement of plates inside the muffler where the noise emitted by the muffler gets changed and to improve the acoustic efficiency of the modified design. Modeling has performed by using CATIA V5.Analysis has to be performed in ANSYS Fluid Flow (Fluent)simulation, can be used to analyse the acoustic power level flow in the muffler, Pressure developed while air flows through the muffler, Velocity of air inside the muffler, Strain rate of the Muffler. By varying the muffler design parameters the flow will be analysed.

Keywords: Muffler, Catia modeling, Acoustic Power level, Back Pressure.

REVIEW PAPER ON DESIGN AND DEVELOPMENT OF MUFFLER TO OPTIMIZETRANSMISSION LOSSES

Paper ID -1111

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Abstract

New regulations and standards for noise reductions and emission compel the automobile industries to make some improvements in the design of silencer for attaining desired noise reduction. In this project, modifications are desired in the silencer design of upcoming Eicher tractor to fulfill the current standards. The current noise level at Operator Ear Level (OEL) is 97dB (decibels), it is desired to reduce it to 94 dB and below. Also the maximum backpressure of 50 mm of Hg is to be maintained. New design should be analyzed with respect to both acoustics and back pressure. As per the various studies reactive mufflers with extended inlet and outlet pipes into muffler, which is not present in current design can significantly reduce the noise level. Helmholtz resonator can also be introduced to cancel the noise of dominating frequencies. Also a sound absorbing material like glass fibers and steel wool can be incorporated for better results. Further, the design modifications are to be verified for noise reduction by COMSOL Multi-physics software. Also the numerical results for transmission loss will be verified with experimentally measured results.

Keywords: Operator Ear Level (OEL), backpressure, mufflers, COMSOL Multiphysics, transmission loss.

CFD FLOW ANALYSIS AND OPTIMIZATION OF EXHAUST MUFFLER

Paper ID -1112

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Abstract

Silencer is an integral part of the exhaust system. The silencer serves the function of noise and vibration reduction. The exhaust gases in the combustion chamber which are at temperatures of around 1200K are released to the atmosphere at around 323K. Temperature reduction takes place efficiently as the flue gases flow through the exhaust system. In this study, flow analysis is carried out on various geometries and the geometries are checked for the pressure drop and temperature drop based on which the optimum geometry having minimum pressure drop and maximum temperature drop across the flow is selected and considered suitable. The entire flow analysis is done using ANSYS Fluent 18.0. Various Geometry combinations are used considering the minimum pressure drop. These geometries are analysed for flow considering Standard Air, Air as Ideal gas and Real gas as the fluid material for each of the geometries. For all the load cases the geometry which is having minimum pressure drop and maximum temperature drop is considered suitable for structural analysis.

Keywords: Silencer, CFD, Fluent, ANSYS, Flow.

OPTIMAL TOPOLOGY OF REACTIVE MUFFLER ACHIEVING TARGET TRANSMISSIONLOSS VALUES: DESIGN AND EXPERIMENT

Paper ID -1113

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Abstract

A topology-optimization-based muffler design method for a reactive muffler is proposed and experimentally validated. In a reactive muffler design problem, rigid partitions should be located optimally inside the muffler to improve its acoustical attenuation performance in the target frequency range. In an optimal-performance muffler, the partition volume should be made as small as possible, and the transmission loss value in the target frequency range should be high enough for flow noise reduction in a duct. To this end, a partition-volume-minimization problem achieving target transmission loss values is formulated by using acoustical topology optimization. The formulated muffler design problem is solved for several target frequencies, and the effect of the initial values of the design variables on the optimal topology is investigated. Numerical simulation results show that the proposed formulation requires a smaller volume of partition than the previous topology-optimization-based formulation. The calculated transmission loss curves of the optimal mufflers agree well with the measured transmission loss curves of mufflers made of acrylic.

Keywords: Muffler design, optimal muffler Topology optimization Transmission loss, Finite element method.

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OPTIMAL PARTITION LAYOUT OF EXPANSION CHAMBER MUFFLER WITH OFFSET INLET/OUTLET

Paper ID -1114

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Abstract

An optimal partition layout inside an expansion chamber muffler with an offset inlet/outlet is systematically designed by using topology optimization to achieve the desired characteristics in terms of acoustics and fluid mechanics. To that end, a partition volume minimization problem is formulated by applying acoustical and flow topology optimization methods. The partition volume is set as an objective function with constraints imposed on the target values of the transmission loss and pressure drop. The finite element method is employed for the acoustical and flow analyses. A design variable is assigned to each finite element such that it changes continuously between 0 and 1 to determine the state of the associated finite element. The design variables are updated during the optimization process and parameterized to converge to 0 or 1 at the end of the process. Finite elements with design variables of 1 build up rigid partitions which are optimally placed to achieve the target values of transmission loss and pressure drop. Different optimal partition layouts are obtained depending on the target frequency, the target values of transmission loss and pressure drop, and the initial values of the design variables. An experiment-based validation strongly supports the validity of the proposed muffler design method.

Key Words: Muffler design, Topology optimization, Transmission loss, Pressure drop.

DESIGN AND ANALYSIS OF MUFFLER TO REDUCE THE STUDY OF BACK PRESSURE

Paper ID -1115

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Abstract

The function of an exhaust muffler is to make the smooth path for flue gases emitted from the exhaust manifold while reduces the clam our build by the engine. Due to the twists and turns that the exhaust gas has to make to reach the atmosphere, there is a considerable amount of backpressure which restricts the free flow of the exhaust gases. It is necessary to reduce the Back pressure as it reduces the fuel consumption of the engine. The major concern for a designer is to ensure that the backpressure is minimum. This project deals with four different models of chambered exhaust muffler and concludes the best possible design for least pressure drop. Solid Works 2014 version was used to design the exhaust mufflers. Numerical analysis for backpressure testing was conducted by Flow Simulation of Solid Works 2014. Heat balance test on single cylinder diesel engine was performed to know the mass flow rate of the exhaust gases. Flow trajectories are viewed to know the flow of exhaust gases through the muffler. The cut plots for pressure and exhaust gas velocity are viewed. Pressure drop is calculated across the exhaust muffler by viewing the pressure distribution.

Keywords: Back pressure, CFD analysis, Diesel engine, Muffler.

PREDICTION OF COMPRESSOR MUFFLER FREQUENCY RESPONSE FUNCTION USING CFD

Paper ID -1116

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Abstract

The acoustic filters of hermetic reciprocating compressors, also called mufflers, are usually developed through acoustic simulation solving the discretized wave equation to obtain the Frequency Response Function, which translates the acoustic response of the muffler. Nonlinear effects are neglected in this approach, which are attributed to flow patterns, as turbulence phenomena, which occur in the contractions, expansions and changing directions within the geometry. The main aim of this work is to investigate the influence of non-linear effects in the acoustic response of mufflers, solving the flow field by computational fluid dynamics (CFD). A discharge acoustic filter design was simplified for the study purpose and simulated using both CFD and Linear Acoustic techniques; the difference in the two approaches is made by comparing the Frequency Response Function (FRF). The flow effects are analyzed varying the compressor piston displacement and operating conditions. FRF predicted by CFD presents reasonable agreement with acoustics approach for lower frequencies identifying resonances and anti-resonances. It was observed increased disagreement for higher mass flow rates due to the predominance of flow effects over acoustics vibrations modes.

Keywords: filters, compressors, muffler.

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TOPOLOGY OPTIMIZATION OF REACTIVE ACOUSTIC MUFFLERS USING A BI-DIRECTIONAL EVOLUTIONARY OPTIMIZATION METHOD

Paper ID -1117

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Abstract

This article proposes an acoustic muffler design procedure based on finite element models and a Bi-directional Evolutionary Acoustic Topology Optimization. The main goal is to find the best configuration of barriers inside acoustic mufflers used in the automotive industry that reduces sound pressure level in the outlet of the muffler. The acoustic medium is governed by Helmholtz equation and rigid wall boundary conditions are introduced to represent acoustic barriers. The continuum problem is written in the frequency domain and it is discretized using the finite element method. The adopted objective function is Transmission Loss (TL). Increasing TL guarantees that the sound pressure level ratio between outlet and inlet of the muffler is reduced. To find the configuration of acoustic barriers that increases the Transmission Loss function of the muffler an adaptation of the Bi-directional Evolutionary Structural Optimization (BESO) method is used. Applying the proposed design procedure topologies in 2D models are reached, which raises the Transmission Loss function for one or multiple frequencies. Three examples are presented to show the efficiency of the proposed procedure.

Keywords: Transmission, loss BESO Acoustics Topology, optimization Mufflers.

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DESIGN AND ANALYSIS OF MUFFLER FOR TWOWHEELER

Paper ID -1118

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Abstract

Noise from automobiles is one of the components for noise pollution to environment. Exhaust noise is one of the main source of vehicle and exhaust systems are developed to attenuate noise meeting required levels and sound quality emissions based on environment norms. Muffler is important part of engine system and commonly used in exhaust system to minimize sound transmission caused by exhaust gases. So to deal with this problem, muffler should be modified. But again there is one problem that is selection of type of muffler either reactive or absorptive. Absorptive muffler has more weight than reactive type as it is consisted of wound material over perforated pipes. So in this study reactive type muffler is modified for 110 cm3 four stroke engine of two wheelers. But maximum noise reduction affect backpressure of engine. Also pressure drop is one of the parameter which influences backpressure of engine as minimum pressure drop indicates minimum backpressure. Depending on space availability for muffler on vehicle body, external dimensions of new muffler are kept same as that of existing one. In this paper, a muffler is analyzed for varying porosity of pipes and it's effect on pressure drop by simulation.

Keyword: Acoustic Analysis, Backpressure, Muffler, Noise Reduction, Transmission Loss.

DESIGN AND ANALYSIS OF AUTOMOTIVE MUFFLER

Paper ID -1119

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Abstract

Noise pollution is a very crucial problem for today's life, so to reduce noise level sound proofing is necessary. Muffler is a very important part of the vehicle exhaust system to reduce the noise produced by engine combustible products when passing through the exhaust system. To achieve maximum noise reduction with the minimum pressure drop is very difficult. A conventional muffler of Maruti-Suzuki Wagonr is taken as reference and depending upon parameters new muffler is designed and modelled in software and analysis will be done numerical codes. Analysis ease the design parameters to be change, so that an appropriate design can be generate and maximum amount of noise reduction and pressure drop takes place with minimum back pressure. Comparison of conventional muffler and proposed designed muffler is based on amount of noise reduction, pressure drop and muffler life. In experimental setup pressure drop calculated by the water manometer tube and sound intensity measured by Sound Level Meter (SLM) device.

Keywords: Pressure Drop; Back Pressure; Noise Reduction; Water Tube Manometer; Sound Level Meter(SLM).

EFFECT OF PERFORATED TUBE ON TRANSMISSION LOSS OF MUFFLER- A REVIEW

Paper ID -1120

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Abstract

Noise pollution produced by engines becomes a vital concern especially for residential areas or in the areas where noise creates hazard. The main source of noise produced by an engine is the exhaust noise. With the increased use of industrial machinery and automobiles, it is necessary to have an effective noise attenuation device. Muffler is such a device used for reducing the amount of noise produced by an IC Engine. Noise attenuation quality of muffler depends on the used materials and its internal geometry. Perforated tube is used in muffler to reduce backpressure as well as to increase transmission loss of muffler. There are many methods for evaluation of transmission loss of muffler such as analytical method, computational method using FEM and BEM and experimental method. This paper discuss the effect of various parameters of perforated tube on transmission loss.

Keywords – muffler, expansion chamber, perforated tube, transmission loss, FEM, BEM, backpressure.

A COUPLED 1D-MULTID NONLINEAR SIMULATION OF I.C. ENGINE SILENCERS WITH PERFORATES AND SOUND-ABSORBING MATERIAL

Paper ID -1121

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Abstract

Nowadays a great attention is paid to the level and quality of noise radiated from the tailpipe end of intake and exhaust systems, to control the gas dynamic noise emitted by the engine as well as the characteristics of the cabin interior sound. The muffler geometry can be optimized consequently, to attenuate or remark certain spectral components of the engine noise, according to the result expected. Evidently the design of complex silencing systems is a time-consuming operation, which must be carried out by means of concurrent experimental measurements and numerical simulations. In particular, 1D and multiD linear/non-linear simulation codes can be applied to predict the silencer behavior in the time and frequency domain. This paper describes the development of a 1D-multiD integrated approach for the simulation of complex muffler configurations such as reverse chambers with inlet and outlet pipe extensions and perforated silencers with the addition of sound absorbing material. The 1D-multiD integrated approach is exploited to validate the transmission loss prediction of reverse chamber configurations with inlet and outlet extensions. Results have pointed out the capability of capturing transversal resonances at high and mid frequencies. Moreover, a non linear approach is proposed to take into account the presence of the sound absorbing material into the conservation equations of a multidimensional solver. The properties of the sound absorbing material have been taken from correlations adopted in the literature for 1D models. The momentum and energy conservation equations have been modified to take into account the interaction between the gas and sound absorbing material. Both the 1D and the integrated 1D-multiD approach have been exploited for validation, considering two different geometries: an expansion chamber with an extended outlet pipe, with the sound absorbing material placed between the pipe extension and the canning, and a perforated pipe whose cavity has been completely filled with sound absorptive metallic wool. The results obtained by the fully 1D analysis and the integrated approach are in agreement with the measured muffler performances.

Keywords: components of the engine, frequencies**,** metallic wool**.**

EFFECT OF AQUA SILENCER & CATALYTIC CONVERTER ON EXHAUST EMISSION: A REVIEW

Paper ID -1122

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Abstract

Automobile exhaust emission is one of the major part of air pollution all around. A human will take 20 to 22Kg of O2 while 20000 times taking breadth. It means in order to take clean O2 environment need to be clean & automobile pollution like CO, HC & NOX which creates human illness need to be reduce. This study will gives highlight of advance catalytic converter which uses non noble metals & technology with which disadvantage of catalytic converter like cold start & back pressure can be minimize & design modification in aqua silencer till date, These technologies are economical & able to reduce emission up to emission norms also research gap is identified at the end of the review which gives direction for the future research.

Keywords: Aqua Silencer, Catalytic Converter, Catalyst, Emission Control Technique, Exhaust Emission.

OPTIMIZATION OF TRANSMISSION LOSS OF PERFORATED TUBE MUFFLER BY USING CAE TOOL ANSYS

Paper ID -1123

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Abstract

Noise produced by exhaust of an IC Engine, is one of the main cause of noise pollution in today's environment. With the increase in vehicles at alarming rate, it has become necessary to have an effective noise attenuating device to control this noise pollution. Muffler is one of such device that can be used for noise reduction. Transmission loss is the major performance parameter of muffler and it depends on the acoustic filters applied to it. This paper reveals the performance of transmission loss on using perforated tube as an acoustic filter. Different parameter of the perforated tube such as perforated whole diameter, porosity and dimension of the tube are considered for study. All the analysis for the evaluation of transmission loss is performed by using ANSYS which is one of the major CAE tool for simulation. The paper also reveals new models that have better sound attenuation capabilities than the conventional model especially at low to medium frequencies level.

Keywords: ANSYS, COMSOL, Exhaust muffler, perforated tube, transmission loss.

ASSEMBLY LINE BALANCING: A CASE STUDY IN SILENCER

Paper ID -1124

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Abstract

An assembly line balancing is to know how tasks are to be assigned to workstations, so that the predetermined goal is achieved. Minimization of the number of workstations and maximization of the production rate are the most common goals. The silencer assembly line is studied in this paper which assembles four products. For line improvement purpose, various Lean Manufacturing tools are employed such as cycle time study, line imbalance calculation, bottleneck identification, Kaizen, space utilization through layout change. Many industries are facing lot of problems like inability to meet production targets, imbalance of work content at work stations, discontinuity in material flow, manpower allotment. In this paper, the design to evaluate the performance, bottleneck identification , reduction in bottleneck cycle time, minimizing line imbalance, workstations organization, reduction in manpower and space saving, increasing manpower utilization of industrial production assembly line are discussed.

Keywords: Assembly Line Balancing, Cycle Time Reduction, resource utilization.

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FIELD MEASUREMENT OF THE ACOUSTICAL AND AIRFLOW PERFORMANCE OF INTERIOR NATURAL-VENTILATION OPENINGS AND SILENCERS

Paper ID -1125

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Abstract

This paper discusses measurements of the acoustical and airflow performance of interior natural ventilation openings and silencers ('ventilators') in existing buildings. It reviews the characterization of ventilator performance, and methods and theory for measuring it. Performance measures for sixteen ventilators in five buildings are presented and discussed. The measured acoustical and air flow performance of rectangular ventilation openings in thin partitions is slightly better than the theoretical performance of a sharp-edged, rectangular opening. The measured performance of slot openings next to reflective surfaces is similar to the theoretical performance of a sharp-edged, rectangular opening. Adding absorptive material to a surface next to a slot opening increases the sound-transmission loss by about ASTC 5, with negligible reduction in airflow. Duct-like ventilation openings have airflow performance approximately 50% greater than for a thin opening of the same cross-section. Z-shaped crosstalk silencers were measured to reduce sound transmission by at least ASTC 16, and only slightly to restrict airflow. Adding a grille to a ventilation opening results in negligible change in sound transmission, but approximately halves airflow.

Keywords: Natural ventilation Ventilation opening Sound transmission Airflow Open area ratio Silencer.

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A REVIEW ON DESIGN AND DEVELOPMENT OF AQUA SILENCER

Paper ID -1126

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Abstract

Instantly, a like pollution has become a greatest threat in the world. It is important from the public health point of view, because Polluted air causes physical ill effects. Increasing toxic pollutant in the air has focused the world's attention on the need of reducing it. The main pollutants contribute by automobiles are carbon monoxide, unburned hydrocarbon, oxides of nitrogen and Lead. Aqua silencer is used to reduce harmful pollutants and noise levels. Since water is used in this silencer it has been named as Aqua silencer. Aqua silencer is cheaper, effective and easy to install.

Keywords*:* Aqua Silencer; Pollutant; Air Pollution; Emission; Noise.

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A REVIEW ON DESIGN OF ABSORPTIVE MUFFLER WITHAMMONIA PULSATOR FOR IC ENGINE

Paper ID -1127

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Abstract

In these review paper, we discuss about the absorptive muffler. There are various types of engines exhaust noise pollutes harmful in environment. The main principle of this paper is on reducing the noise and emission of engine. Any type of engine exhaust noise is controlled by using silencers/mufflers. By attaching of muffler in the exhaust pipe is the most effective means of reducing the noise, but muffler requires specific design and construction by considering various noise parameters which produced by the engine. The analysis and design work for the absorptive muffler has been going on since the early 1920s. Here we are taking different design parameters and improving the efficiency of the absorptive muffler. The formulated muffler traditional design problem will be solved by new design and optimization.

Keywords: Internal combustion Engine, Absorptive Muffler, Engine Exhaust Noise and Emission Reduction.

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A REVIEW ON ANALYSIS OF DOUBLE BAFFLE MUFFLER

Paper ID -1128

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Abstract

Muffling devices are essential part of any vehicle that uses internal combustion engine. Noise from automobile is one of the components for noise pollution to environment thus Exhaust noise is one of the main source of vehicle and exhaust system to attenuate noise meeting required levels and sound quality emission based on environment norms. Change in muffler design may be expected to provide broadband high noise attenuation and low pressure drop. Various sound absorption material used in this process. Here easily available absorptive materials are glass fiber which used with same space. Generally there are different process which used in reduction of noise and pollution so basically such all things are studied in this system and their application.

Keyword: ANOVA, hybrid muffler, material for sound absorption, Taguchi, pollution reduction technique.

PERFORMANCE OF TRANSMISSION LOSS ON HYBRID MUFFLER BY USING ROCK WOOL AND GLASS FIBER AS A ABSORBING MATERIALS

Paper ID -1129

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Abstract

Muffler is categorized in two broad manners as absorptive muffler and reactive muffler. A Muffler (silencer) is an important noise control element for reduction of machinery exhaust noise, fan noise, and other noise sources involving the flow of gases. Reactive mufflers which reduce noise by reflecting sound energy back to its source, and absorption mufflers, which absorb sound due to the energy dissipated in the sound-absorbing material. The attenuation levels of these types of muffler are dependent on the frequency of the noise source. Investigations on absorption mufflers have indicated that these have fairly good noise attenuation over a relatively wide frequency band. The combination of both reactive and absorptive muffler is termed as hybrid muffler. Hybrid muffler design may be expected to provide broadband high noise attenuation and low pressure drop. Experimental Two load setup and Wave 1-D is used to predict the transmission loss of hybrid muffler. Hybrid muffler generally includes the number of perforated tubes, number of perforated baffles with absorptive materials like asbestos, rock wool, bensoil, powertex & advantex etc. Transmission loss measurement using hybrid muffler is discussed in this paper. Various sound absorption materials that are currently used for noise reduction are used. This paper shows the acoustic performance of packed dissipative muffler with the variation in packing density of absorptive material. Here easy available absorptive materials glass fiber & rock wool is used with same space. This study is performed by taking four designs to observe the transmission loss performance by applying different absorptive materials with different packing density.

Keywords: Transmission Loss (TL), Hybrid Muffler, Sound Absorptive Materials, Two Load Method, Wave 1-D.

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FFECT OF CHANGE IN DIAMETER ON MUFFLER TRANSMISSION LOSS USINGCOMSOL

Paper ID -1130

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Abstract

Muffler analysis is always challenging task due to complex design, shape and size limitation for specific application. In this paper the inlet diameter of muffler is varied for comparison. Two finite element methods (FEM) Results are compared using COMSOL 5.0 software. Two different muffler configurations are considered, representing the effects of adding absorptive lining and without absorptive lining to increase the transmission loss (TL), from computational analysis it is observed that for 40 mm inlet transmission loss is more compared with 30 mm inlet diameter.

Keywords – Transmission loss (TL), Acoustic liners.

DESIGN, ASSESSMENT AND OPTIMIZATION OF AUTOMOTIVE MUFFLER

Paper ID -1131

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Abstract

Mufflers are important part of engine system and commonly used in exhaust system to minimize sound transmissions caused by exhaust gases. Design of mufflers is a complex function that affects noise characteristics, emission and fuel efficiency of engine. Therefore muffler design becomes more and more important for noise reduction. The objective of the paper is to propose a design of simple reactive muffler for effective sound attenuation and for getting highest transmission losses. The paper contains two optimization problem to get optimize model which can further optimize by using Taguchi method. The problem were built and analysed by using 'COMSOL MULTIPHYSICS' in pressure acoustic analysis domain for getting Maximum Transmission Losses and minimum Sound Pressure Level (SPL). First optimization problem contain muffler in which perforation diameter and pipe diameter are varied which again optimizes by eliminating perforation and by varying pipe lengths in second optimization problem. Among the best problem is further optimized by using Taguchi method. The effect of SPL on the walls of the muffler is not considered. The material of the muffler is also not considered. This optimized model of elliptical muffler is manufacture and then validate with the experimental analysis.

Keywords: Transmission Losses, Sound Pressure Level, Acoustic, Optimization.

ANALYSIS OF EXHAUST SYSTEM- 'SEMI ACTIVE MUFFLER'

Paper ID -1132

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Abstract

Main drawback of I.C. engines working is that it is a major source of noise pollution. That is why the reduction of exhaust noise generated from engine is in today's world an important issue. Attaching a muffler in the exhaust pipe is the good option for reducing noise. But muffler requires specific design and construction considering various noise parameters produced by the engine. Since early development of mufflers, the main objective of design was attenuation of sound in regular mufflers. Which causes a great amount of back pressure at the exhaust port thus losing power, increasing fuel consumption and piston effort to exhale the gases out. For high performance engines the free flow exhaust is made in which the sound level is not important but zero or less back pressure is. There is no intermediate muffler type in between both these, so semi active muffler is an step between these two, in which it attenuates sound when engine is running at low rpm , and converts in free flow when engine at higher revs.

Keywords: CFR-cylinder firing ratio, EFR-engine firing ratio, Semi active muffler, Vm-volume of muffler.

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ANALYSIS OF FLOW FIELD AND PRESSURE LOSS FOR FORK TRUCK MUFFLER BASED ON THE FINITE VOLUME METHOD

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Abstract

Having the premise of the certain acoustic performance, a muffler should make the pressure loss as small as possible. A simulation model of a fork truck muffler with a complex structure is established. Based on the finite volume method, multidimensional numerical simulation regarding velocity field and pressure field of steady flows for a muffler is performed using CFD (computational fluid dynamic method). Flow characteristics and pressure distribution of the muffler are analyzed. It is found that the vortex inside the muffler creates a great pressure loss. With the increases of inlet gas flow rate , the pressure loss of the muffler increases gradually. The internal structure of the muffler is redesigned for obtaining the optimized structure on the basis of analysis. The influences of the inner tube length on the flow and pressure loss of muffler are researched. The study will provide a theoretical basis for designing a complex muffler.

Keywords: Complex muffler, Velocity field, Pressure field, Structure improvement.

STUDY OF MULTI-CHAMBER MICRO-PERFORATED MUFFLFLER WITH ADJUSTABLETRANSMISSION LOSS

Paper ID -1134

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Abstract

The noise behavior of the blower used on fuel cell vehicles is measured and analyzed. According to the noise behaviors, the multi-chamber micro-perforated muffler with adjustable transmission loss is proposed for silencing. The adjustment is achieved by the change of the third chamber length. The relation model between the chamber length and the muffler resonant frequency is fitted. In addition, the muffler sample is manufactured for experiment. According to the study, the blower noise contains the wide band noise with frequency range of 500–1000 Hz and the narrow band harmonics with frequency range of 2000–3500 Hz. The experimental results show that the proposed muffler is effective and efficient to attenuate the low-medium frequency wide band noise and the narrow band harmonics simultaneously.

Keywords: Blower noise, Micro-perforated muffler ,Adjustable transmission loss ,Resonant frequency.

COMPARISON OF VARIOUS ALGORITHMS FOR IMPROVING ACOUSTIC ATTENUATION PERFORMANCE AND FLOW CHARACTERISTIC OF REACTIVE MUFFLFLERS

Paper ID -1135

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Abstract

The parametric optimization of the reactive mufflers is researched by numerical analysis, regarding the performance of the acoustic and flow fields synthetically. The finite element method, based on the Helmholtz equation and the Navier–Stokes equation respectively, is utilized in the analysis of the acoustic and flow fields. And the initial and boundary conditions are set up in the physical fields respectively. The weighting multi-objective function about acoustic and flow fields is formulated. In addition, the optimization results of multidisciplinary, obtained by the Nelder Mead algorithm (NMA) based on the sensitivity analysis, the Monte Carlo algorithm (MCA) and Genetic Algorithm (GA) based on the random sampling, are analyzed comparatively. The optimization results indicate that the NMA can maximize the transmission loss (TL) and minimize the pressure drop with the given weight factor. Finally, numerical optimization examples confirm the validity and reliability of the proposed optimization method in the acoustic-flow field.

Keywords: Transmission loss, Pressure drop, Reactive muffler, Multidisciplinary optimization.

TOPOLOGY OPTIMIZATION OF A SUCTION MUFFLER IN A FLUID MACHINE TO MAXIMIZE ENERGY EFFICIENCY AND MINIMIZE BROADBAND NOISE

Paper ID -1136

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Abstract

A suction muffler used in a fluid machine has three functions: noise reduction; minimizing pressure drop and improving energy efficiency using acoustic effects. However, no method of suction muffler design considers all three of these functions concurrently. Therefore, in this study, we attempt to provide an integrated design method of a suction muffler in a fluid machine that considers all three functions. The topology optimization method for acoustic and fluid systems was applied to an integrated design. However, the interaction between fluid and acoustic was not considered. In addition, the acoustic input impedance of a suction muffler was used for a specific acoustical resonance frequency to improve the energy efficiency of a fluid machine. Finally, the sequential optimization method based on physical investigations was proposed to satisfy several design criteria. The proposed method was applied to the suction muffler in refrigerator's compressor.

Keywords: fluid machine, efficiency, muffler, compressor.

FINITE ELEMENT ANALYSIS OF AN INDUSTRIAL REACTIVE SILENCER

Paper ID -1137

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Abstract

Classical analytical models used for prediction of the performance of reactive silencers are limited to conditions where the dimensions of the duct and resonators are small compared to the wavelength of the sound. Finite Element Analysis does not suffer from such limitations and has therefore been used to analyse the design of a reactive silencer for the exhaust stack of a 980MW power station. To assist in the design process, resonators of various dimensions were analysed using FEA which has led to the derivation of expressions for the resonance frequencies of slot-type rhomboid shaped resonators as a function of the geometry. An important design issue is the influence that adjacent resonators have on the overall performance of the system. It was found that when resonators of similar resonance frequency are in close proximity, they can interact and lead to a decrease in the overall performance compared to that of a single resonator.

Keywords: dimensions, Analysis, FEA.

FLOW ANALYSIS OF REACTIVE MUFFLER USING CFD

Paper ID -1138

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Abstract

Muffler design is traditionally a trial and error process. This paper describes the flow analysis of a reactive muffler using CFD simulation in order to improve its performance by reducing the back pressure created on the engine. The back pressure of the muffler is computed from CFD simulation. The CFD analysis is done to avoid the tedious experimentation. The flow simulation is carried out using k-ε turbulent model as it is most suitable for turbulent flows having less converging time. Total four cases were analyzed including the base model muffler. Thus three modifications were done in muffler geometry. The modification with reduced baffle spacing produced least back pressure with reduction in back pressure by 8.59%.

Keywords: Muffler design, CFD simulation, pressure.

STRUCTURAL ANALYSIS FOR EXHAUST GAS FLOW THROUGH AN ELLIPTICAL CHAMBER MUFFLER UNDER STATIC AND DYNAMIC LOADING CONDITION

Paper ID -1139

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Abstract

High pressure and temperature exhaust gases coming out from automobile engine are made to pass through muffler for reduction of sound resulting from propagation of these pressure waves. The mufflers may be of reactive, dissipative and resonating type. The present paper deals with an automotive muffler that is modeled based on practical dimensions of a 4-stroke 2-cylinder MAHINDRA MAXIMO PLUS C.I. engine in CATIA V5software. The geometry adopted is elliptical in nature. Comparative static structural analysis for stress, strain and deformation along with modal analysis for deformation under dynamic loading has been performed for perforated and non-perforated design of the muffler using ANSYS Workbench 14.5. The effect of incorporation of perforation is studied on the corresponding static and dynamic behavior of the muffler.

Keywords: automotive muffler, dynamic loading, modal analysis, static loading, structural analysis.

DESIGN AND ANALYSIS OF PERFORATED MUFFLER IN AUTOMOBILE

Paper ID -1140

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Abstract

A muffler is a device for reducing the amount of noise emitted by an automobile. To reduce the noise, the engine drain is connected via output pipe to silencer called muffler. The muffler makes a major contribution to reduce the noise. Mufflers are connected to the exhaust pipe of internal combustion engine to suppress the acoustic flow of the engine in combustion process. Mufflers form an integral part of automobile. Mufflers are designed to increase the back pressure so as to reduce the noise level. In this study, attempt has been made to improve the design of muffler for reducing noise. The design of a muffler is to reduce the noise, for that an existed automobile muffler has modified and compared with the arrangement of plates inside the muffler where the noise emitted by the muffler gets changed and to improve the acoustic efficiency of the modified design. Modelling has performed by using CATIA V5.Analysis has to be performed in ANSYS Fluid Flow (Fluent)simulation, can be used to analyse the acoustic power level flow in the muffler, Pressure developed while air flows through the muffler, Velocity of air inside the muffler, Strain rate of the Muffler. By varying the muffler design parameters the flow will be analysed.

Keywords: Muffler, Catia modeling, Acoustic Power level, Back Pressure.

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REVIEW PAPER ON DESIGN AND DEVELOPMENT OF MUFFLER TO OPTIMIZETRANSMISSION LOSSES

Paper ID -1141

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Abstract

New regulations and standards for noise reductions and emission compel the automobile industries to make some improvements in the design of silencer for attaining desired noise reduction. In this project, modifications are desired in the silencer design of upcoming Eicher tractor to fulfill the current standards. The current noise level at Operator Ear Level (OEL) is 97dB (decibels), it is desired to reduce it to 94 dB and below. Also the maximum backpressure of 50 mm of Hg is to be maintained. New design should be analyzed with respect to both acoustics and back pressure. As per the various studies reactive mufflers with extended inlet and outlet pipes into muffler, which is not present in current design can significantly reduce the noise level. Helmholtz resonator can also be introduced to cancel the noise of dominating frequencies. Also a sound absorbing material like glass fibers and steel wool can be incorporated for better results. Further, the design modifications are to be verified for noise reduction by COMSOL Multi-physics software. Also the numerical results for transmission loss will be verified with experimentally measured results.

Keywords: Operator Ear Level (OEL), backpressure, mufflers, COMSOL Multiphysics, transmission loss.

CFD FLOW ANALYSIS AND OPTIMIZATION OF EXHAUST MUFFLER

Paper ID -1142

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Abstract

Silencer is an integral part of the exhaust system. The silencer serves the function of noise and vibration reduction. The exhaust gases in the combustion chamber which are at temperatures of around 1200K are released to the atmosphere at around 323K. Temperature reduction takes place efficiently as the flue gases flow through the exhaust system. In this study, flow analysis is carried out on various geometries and the geometries are checked for the pressure drop and temperature drop based on which the optimum geometry having minimum pressure drop and maximum temperature drop across the flow is selected and considered suitable. The entire flow analysis is done using ANSYS Fluent 18.0. Various Geometry combinations are used considering the minimum pressure drop. These geometries are analysed for flow considering Standard Air, Air as Ideal gas and Real gas as the fluid material for each of the geometries. For all the load cases the geometry which is having minimum pressure drop and maximum temperature drop is considered suitable for structural analysis.

Keywords: Silencer, CFD, Fluent, ANSYS, Flow.

OPTIMAL TOPOLOGY OF REACTIVE MUFFLER ACHIEVING TARGET TRANSMISSIONLOSS VALUES: DESIGN AND EXPERIMENT

Paper ID -1143

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Abstract

A topology-optimization-based muffler design method for a reactive muffler is proposed and experimentally validated. In a reactive muffler design problem, rigid partitions should be located optimally inside the muffler to improve its acoustical attenuation performance in the target frequency range. In an optimal-performance muffler, the partition volume should be made as small as possible, and the transmission loss value in the target frequency range should be high enough for flow noise reduction in a duct. To this end, a partition-volume-minimization problem achieving target transmission loss values is formulated by using acoustical topology optimization. The formulated muffler design problem is solved for several target frequencies, and the effect of the initial values of the design variables on the optimal topology is investigated. Numerical simulation results show that the proposed formulation requires a smaller volume of partition than the previous topology-optimization-based formulation. The calculated transmission loss curves of the optimal mufflers agree well with the measured transmission loss curves of mufflers made of acrylic.

Keywords: Muffler design optimal muffler Topology optimization Transmission loss Finite element method.

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OPTIMAL PARTITION LAYOUT OF EXPANSION CHAMBER MUFFLER WITH OFFSET INLET/OUTLET

Paper ID -1144

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Abstract

An optimal partition layout inside an expansion chamber muffler with an offset inlet/outlet is systematically designed by using topology optimization to achieve the desired characteristics in terms of acoustics and fluid mechanics. To that end, a partition volume minimization problem is formulated by applying acoustical and flow topology optimization methods. The partition volume is set as an objective function with constraints imposed on the target values of the transmission loss and pressure drop. The finite element method is employed for the acoustical and flow analyses. A design variable is assigned to each finite element such that it changes continuously between 0 and 1 to determine the state of the associated finite element. The design variables are updated during the optimization process and parameterized to converge to 0 or 1 at the end of the process. Finite elements with design variables of 1 build up rigid partitions which are optimally placed to achieve the target values of transmission loss and pressure drop. Different optimal partition layouts are obtained depending on the target frequency, the target values of transmission loss and pressure drop, and the initial values of the design variables. An experiment-based validation strongly supports the validity of the proposed muffler design method.

Key Words: Muffler design, Topology optimization, Transmission loss, Pressure drop.

DESIGN AND ANALYSIS OF MUFFLER TO REDUCE THE BACK PRESSURE

Paper ID -1145

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Abstract

The function of an exhaust muffler is to make the smooth path for flue gases emitted from the exhaust manifold while reduces the clam our build by the engine. Due to the twists and turns that the exhaust gas has to make to reach the atmosphere, there is a considerable amount of backpressure which restricts the free flow of the exhaust gases. It is necessary to reduce the backpressure as it reduces the fuel consumption of the engine. The major concern for a designer is to ensure that the backpressure is minimum. This project deals with four different models of chambered exhaust muffler and concludes the best possible design for least pressure drop. SolidWorks 2014 version was used to design the exhaust mufflers. Numerical analysis for backpressure testing was conducted by Flow Simulation of SolidWorks 2014. Heat balance test on single cylinder diesel engine was performed to know the mass flow rate of the exhaust gases. Flow trajectories are viewed to know the flow of exhaust gases through the muffler. The cut plots for pressure and exhaust gas velocity are viewed. Pressure drop is calculated across the exhaust muffler by viewing the pressure distribution.

Keywords - Back pressure, CFD analysis, Diesel engine, Muffler.

PREDICTION OF COMPRESSOR MUFFLER FREQUENCY RESPONSE FUNCTION USING CFD

Paper ID -1146

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Abstract

The acoustic filters of hermetic reciprocating compressors, also called mufflers, are usually developed through acoustic simulation solving the discretized wave equation to obtain the Frequency Response Function, which translates the acoustic response of the muffler. Nonlinear effects are neglected in this approach, which are attributed to flow patterns, as turbulence phenomena, which occur in the contractions, expansions and changing directions within the geometry. The main aim of this work is to investigate the influence of non-linear effects in the acoustic response of mufflers, solving the flow field by computational fluid dynamics (CFD). A discharge acoustic filter design was simplified for the study purpose and simulated using both CFD and Linear Acoustic techniques; the difference in the two approaches is made by comparing the Frequency Response Function (FRF). The flow effects are analyzed varying the compressor piston displacement and operating conditions. FRF predicted by CFD presents reasonable agreement with acoustics approach for lower frequencies identifying resonances and anti-resonances. It was observed increased disagreement for higher mass flow rates due to the predominance of flow effects over acoustics vibrations modes.

Keywords: compressors, mufflers, CFD, FRF.

TOPOLOGY OPTIMIZATION OF REACTIVE ACOUSTIC MUFFLERS USING A BI-DIRECTIONAL EVOLUTIONARY OPTIMIZATION METHOD

Paper ID -1147

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Abstract

This article proposes an acoustic muffler design procedure based on finite element models and a Bi-directional Evolutionary Acoustic Topology Optimization. The main goal is to find the best configuration of barriers inside acoustic mufflers used in the automotive industry that reduces sound pressure level in the outlet of the muffler. The acoustic medium is governed by Helmholtz equation and rigid wall boundary conditions are introduced to represent acoustic barriers. The continuum problem is written in the frequency domain and it is discretized using the finite element method. The adopted objective function is Transmission Loss (TL). Increasing TL guarantees that the sound pressure level ratio between outlet and inlet of the muffler is reduced. To find the configuration of acoustic barriers that increases the Transmission Loss function of the muffler an adaptation of the Bi-directional Evolutionary Structural Optimization (BESO) method is used. Applying the proposed design procedure topologies in 2D models are reached, which raises the Transmission Loss function for one or multiple frequencies. Three examples are presented to show the efficiency of the proposed procedure.

Keywords: Transmission loss BESO Acoustics Topology, optimization Mufflers.

DESIGN AND ANALYSIS OF MUFFLER FOR TWOWHEELER

Paper ID -1148

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Abstract

Noise from automobiles is one of the components for noise pollution to environment. Exhaust noise is one of the main source of vehicle and exhaust systems are developed to attenuate noise meeting required levels and sound quality emissions based on environment norms. Muffler is important part of engine system and commonly used in exhaust system to minimize sound transmission caused by exhaust gases. So to deal with this problem, muffler should be modified. But again there is one problem that is selection of type of muffler either reactive or absorptive. Absorptive muffler has more weight than reactive type as it is consisted of wound material over perforated pipes. So in this study reactive type muffler is modified for 110 cm3 four stroke engine of two wheelers. But maximum noise reduction affect backpressure of engine. Also pressure drop is one of the parameter which influences backpressure of engine as minimum pressure drop indicates minimum backpressure. Depending on space availability for muffler on vehicle body, external dimensions of new muffler are kept same as that of existing one. In this paper, a muffler is analyzed for varying porosity of pipes and it's effect on pressure drop by simulation.

Keyword: - Acoustic Analysis, Backpressure, Muffler, Noise Reduction, Transmission Loss.

DESIGN AND ANALYSIS OF AUTOMOTIVE MUFFLER

Paper ID -1149

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Abstract

Noise pollution is a very crucial problem for today's life, so to reduce noise level sound proofing is necessary. Muffler is a very important part of the vehicle exhaust system to reduce the noise produced by engine combustible products when passing through the exhaust system. To achieve maximum noise reduction with the minimum pressure drop is very difficult. A conventional muffler of Maruti-Suzuki Wagonr is taken as reference and depending upon parameters new muffler is designed and modelled in software and analysis will be done numerical codes. Analysis ease the design parameters to be change, so that an appropriate design can be generate and maximum amount of noise reduction and pressure drop takes place with minimum back pressure. Comparison of conventional muffler and proposed designed muffler is based on amount of noise reduction, pressure drop and muffler life. In experimental setup pressure drop calculated by the water manometer tube and sound intensity measured by Sound Level Meter (SLM) device.

Keywords: Pressure Drop; Back Pressure; Noise Reduction; Water Tube Manometer; Sound Level Meter(SLM).

EFFECT OF PERFORATED TUBE ON TRANSMISSION LOSS OF MUFFLER- A REVIEW

Paper ID -1150

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Abstract

Noise pollution produced by engines becomes a vital concern especially for residential areas or in the areas where noise creates hazard. The main source of noise produced by an engine is the exhaust noise. With the increased use of industrial machinery and automobiles, it is necessary to have an effective noise attenuation device. Muffler is such a device used for reducing the amount of noise produced by an IC Engine. Noise attenuation quality of muffler depends on the used materials and its internal geometry. Perforated tube is used in muffler to reduce backpressure as well as to increase transmission loss of muffler. There are many methods for evaluation of transmission loss of muffler such as analytical method, computational method using FEM and BEM and experimental method. This paper discuss the effect of various parameters of perforated tube on transmission loss.

Keywords: muffler, expansion chamber, perforated tube, transmission loss, FEM, BEM, backpressure.

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A COUPLED 1D-MULTID NONLINEAR SIMULATION OF I.C. ENGINE SILENCERS WITH PERFORATES AND SOUND-ABSORBING MATERIAL

Paper ID -1151

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Abstract

Nowadays a great attention is paid to the level and quality of noise radiated from the tailpipe end of intake and exhaust systems, to control the gas dynamic noise emitted by the engine as well as the characteristics of the cabin interior sound. The muffler geometry can be optimized consequently, to attenuate or remark certain spectral components of the engine noise, according to the result expected. Evidently the design of complex silencing systems is a time-consuming operation, which must be carried out by means of concurrent experimental measurements and numerical simulations. In particular, 1D and multi D linear/non-linear simulation codes can be applied to predict the silencer behavior in the time and frequency domain. This paper describes the development of a 1D-multiD integrated approach for the simulation of complex muffler configurations such as reverse chambers with inlet and outlet pipe extensions and perforated silencers with the addition of sound absorbing material. The 1D-multiD integrated approach is exploited to validate the transmission loss prediction of reverse chamber configurations with inlet and outlet extensions. Results have pointed out the capability of capturing transversal resonances at high and mid frequencies. Moreover, a non linear approach is proposed to take into account the presence of the sound absorbing material into the conservation equations of a multidimensional solver. The properties of the sound absorbing material have been taken from correlations adopted in the literature for 1D models. The momentum and energy conservation equations have been modified to take into account the interaction between the gas and sound absorbing material. Both the 1D and the integrated 1D-multiD approach have been exploited for validation, considering two different geometries: an expansion chamber with an extended outlet pipe, with the sound absorbing material placed between the pipe extension and the canning, and a perforated pipe whose cavity has been completely fifilled with sound absorptive metallic wool. The results obtained by the fully 1D analysis and the integrated approach are in agreement with the measured muffler performances.

Keywords: Mufflers, metallic wool, analysis, exhaust systems.

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EFFECT OF AQUA SILENCER & CATALYTIC CONVERTER ON EXHAUST EMISSION: A REVIEW

Paper ID -1152

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Abstract

Automobile exhaust emission is one of the major part of air pollution all around. A human will take 20 to 22Kg of O2 while 20000 times taking breadth. It means in order to take clean O2 environment need to be clean & automobile pollution like CO, HC & NOX which creates human illness need to be reduce. This study will gives highlight of advance catalytic converter which uses non noble metals & technology with which disadvantage of catalytic converter like cold start & back pressure can be minimize & design modification in aqua silencer till date, These technologies are economical & able to reduce emission up to emission norms also research gap is identified at the end of the review which gives direction for the future research.

Keywords: Aqua Silencer, Catalytic Converter, Catalyst, Emission Control Technique, Exhaust Emission.

OPTIMIZATION OF TRANSMISSION LOSS OF PERFORATED TUBE MUFFLER BY USING CAE TOOL ANSYS

Paper ID -1153

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Abstract

Noise produced by exhaust of an IC Engine, is one of the main cause of noise pollution in today's environment. With the increase in vehicles at alarming rate, it has become necessary to have an effective noise attenuating device to control this noise pollution. Muffler is one of such device that can be used for noise reduction. Transmission loss is the major performance parameter of muffler and it depends on the acoustic filters applied to it. This paper reveals the performance of transmission loss on using perforated tube as an acoustic filter. Different parameter of the perforated tube such as perforated whole diameter, porosity and dimension of the tube are considered for study. All the analysis for the evaluation of transmission loss is performed by using ANSYS which is one of the major CAE tool for simulation. The paper also reveals new models that have better sound attenuation capabilities than the conventional model especially at low to medium frequencies level.

Keywords: ANSYS, COMSOL, Exhaust muffler, perforated tube, transmission loss.

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ASSEMBLY LINE BALANCING: A CASE STUDY IN SILENCER MANUFACTURING

Paper ID -1154

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Abstract

An assembly line balancing is to know how tasks are to be assigned to workstations, so that the predetermined goal is achieved. Minimization of the number of workstations and maximization of the production rate are the most common goals. The silencer assembly line is studied in this paper which assembles four products. For line improvement purpose, various Lean Manufacturing tools are employed such as cycle time study, line imbalance calculation, bottleneck identification, Kaizen, space utilization through layout change. Many industries are facing lot of problems like inability to meet production targets, imbalance of work content at work stations, discontinuity in material flow, manpower allotment. In this paper, the design to evaluate the performance, bottleneck identification , reduction in bottleneck cycle time, minimizing line imbalance, workstations organization, reduction in manpower and space saving, increasing manpower utilization of industrial production assembly line are discussed.

Keywords: Assembly Line Balancing, Cycle Time Reduction, resource utilization.

FIELD MEASUREMENT OF THE ACOUSTICAL AND AIRFLOW PERFORMANCE OF INTERIOR NATURAL-VENTILATION OPENINGS AND SILENCERS

Paper ID -1155

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Abstract

This paper discusses measurements of the acoustical and airflow performance of interior natural ventilation openings and silencers ('ventilators') in existing buildings. It reviews the characterization of ventilator performance, and methods and theory for measuring it. Performance measures for sixteen ventilators in five buildings are presented and discussed. The measured acoustical and airflow performance of rectangular ventilation openings in thin partitions is slightly better than the theoretical performance of a sharp-edged, rectangular opening. The measured performance of slot openings next to reflective surfaces is similar to the theoretical performance of a sharp-edged, rectangular opening. Adding absorptive material to a surface next to a slot opening increases the sound-transmission loss by about ASTC 5, with negligible reduction in airflow. Duct-like ventilation openings have airflow performance approximately 50% greater than for a thin opening of the same cross-section. Z-shaped crosstalk silencers were measured to reduce sound transmission by at least ASTC 16, and only slightly to restrict airflow. Adding a grille to a ventilation opening results in negligible change in sound transmission, but approximately halves airflow.

Keywords*:* Natural ventilation Ventilation opening Sound transmission Airflow Open area ratio Silencer.

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REVIEW ON DESIGN AND DEVELOPMENT OF AQUA SILENCER

Paper ID -1156

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Abstract

Instantly, a like pollution has become a greatest threat in the world. It is important from the public health point of view, because Polluted air causes physical ill effects. Increasing toxic pollutant in the air has focused the world's attention on the need of reducing it. The main pollutants contribute by automobiles are carbon monoxide, unburned hydrocarbon, oxides of nitrogen and Lead. Aqua silencer is used to reduce harmful pollutants and noise levels. Since water is used in this silencer it has been named as Aqua silencer. Aqua silencer is cheaper, effective and easy to install.

Keywords: Aqua Silencer; Pollutant; Air Pollution; Emission; Noise.

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A REVIEW ON DESIGN OF ABSORPTIVE MUFFLER WITHAMMONIA PULSATOR FOR IC ENGINE

Paper ID -1157

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Abstract

In these review paper, we discuss about the absorptive muffler. There are various types of engines exhaust noise pollutes harmful in environment. The main principle of this paper is on reducing the noise and emission of engine. Any type of engine exhaust noise is controlled by using silencers/mufflers. By attaching of muffler in the exhaust pipe is the most effective means of reducing the noise, but muffler requires specific design and construction by considering various noise parameters which produced by the engine. The analysis and design work for the absorptive muffler has been going on since the early 1920s. Here we are taking different design parameters and improving the efficiency of the absorptive muffler. The formulated muffler traditional design problem will be solved by new design and optimization.

Keywords: Internal combustion Engine, Absorptive Muffler, Engine Exhaust Noise and Emission Reduction.

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A REVIEW ON ANALYSIS OF DOUBLE BAFFLE MUFFLER

Paper ID -1158

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Abstract

Muffling devices are essential part of any vehicle that uses internal combustion engine. Noise from automobile is one of the components for noise pollution to environment thus Exhaust noise is one of the main source of vehicle and exhaust system to attenuate noise meeting required levels and sound quality emission based on environment norms. Change in muffler design may be expected to provide broadband high noise attenuation and low pressure drop. Various sound absorption material used in this process. Here easily available absorptive materials are glass fiber which used with same space. Generally there are different process which used in reduction of noise and pollution so basically such all things are studied in these system and their application.

Keyword: ANOVA, hybrid muffler, material for sound absorption, Taguchi, pollution reduction technique.

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TECHNICAL AND ECONOMIC OPTIMIZATION OF SUBCRITICAL, WET EXPANSION ANDTRANSCRITICAL ORGANIC RANKINE CYCLE (ORC) SYSTEMS COUPLED WITH A BIOGAS POWER PLANT

Paper ID -1159

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Abstract

Generally,>40% of the useful energy (cooling engine and exhaust gases) are wasted by a biogas power plant through the cooling radiator and the exhaust gases. An efficient way to convert this waste heat into work and eventually electricity is the use of an organic Rankine cycle (ORC) power system. Over the last few years, different architectures have been widely investigated (subcritical, wet expansion and trans-critical). Despite the promising performances, realistic economic and technical constraints, also related to the application, are required for a meaningful comparison between ORC technologies and architectures. Starting from the limited literature available, the aim of the present paper is to provide a methodology to compare sub-critical, trans critical and wet expansion cycles and different types of expanders (both volumetric and turbo machinery) from both technical and economic point of view, which represent one of the main novel aspects of the present work. In particular, the paper focuses on the thermo-economic optimization of an ORC waste heat recovery unit for a 500 kWe biogas power plant located in a detailed regional market, which was not investigated yet. By means of a genetic algorithm, the adopted methodology optimizes a given economic criteria (Pay-Back Period, Net Present Value, Profitability Index and Internal Rate of Return) while respecting technical constraints (expander limitations) and thermodynamic constraints (positive pinch points in heat exchangers, etc.).The results show that optimal ORC solutions with a potential of energy savings up to 600 MWh a year and with a pay-back period lower than 3 years are achievable in the regional market analysed.

Key Words: Biogas, power, plant, recovery, Organic Rankine cycle, etc.

MULTI-OBJECTIVE OPTIMIZATION AND SENSITIVITY ANALYSIS OF AN ORGANIC RANKINECYCLE COUPLED WITH A ONE-DIMENSIONAL RADIAL-INFLOW TURBINE EFFICIENCY PREDICTION MODEL

Paper ID -1160

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Abstract

The organic Rankine cycle (ORC) has been demonstrated to be a viable approach to recover low-grade waste heat and has been widely investigated in recent years. In the current research focused on the multi-objective optimization problem of ORC systems, few scholars consider the variation in turbine efficiency with the cycle parameters. This paper focused on the comparison of multi-objective optimization with variable turbine efficiency and that with constant turbine efficiency. The results obtained for the two types of turbine efficiency were compared, and the differences were analyzed. Flue gas at 523.15 K was used as the heat source, and pentane, hexane, heptane, cyclohexane, benzene and toluene were selected as working fluid candidates. The one-dimensional radial-inflow turbine efficiency prediction model was applied to replace constant turbine efficiency.The multi-objective model in conjunction with the turbine efficiency model was constructed by defining the net power output and system total cost per unit net power output as the objective functions. The non-dominated sorting genetic algorithm-II (NSGA-II) was used to optimize the evaporation temperature and condensation temperature as the decision variables. With the aid of the ideal point, the optimal solution of each working fluid was selected from the Pareto frontier. The results showed that the turbine efficiency varies with changes in evaporation temperature and condensation temperature. In the multi-optimization with constant turbine efficiency, toluene and cyclohexane are the optimal working fluids, whereas with variable turbine efficiency, benzene is the optimal working fluid. In the sensitivity analysis, the optimal exergy efficiency shows opposite trends for the multi-objective optimization with constant and variable turbine efficiency.

Key Words: Organic, Rankine ,cycle, optimization, thermo economic, etc.

THERMODYNAMIC AND ECONOMIC ANALYSES AND OPTIMIZATION OF A MULTIGENERATIONSYSTEM COMPOSED BY A COMPRESSED AIR STORAGE, SOLAR DISH COLLECTOR, MICRO GAS TURBINE, ORGANIC RANKINE CYCLE, AND DESALINATION SYSTEM

Paper ID -1161

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Abstract

In this work, a hybrid system composed of compressed air energy storage, a micro gas turbine, an organic Rankine cycle, a solar dish collector, and a multi effect distillation is presented as a combined power, heat, and fresh water production system. Energy and exergy analyses are applied to investigate thermodynamic performance of the system. The results show that the system consumes 278 kWh electricity and produces about 3.7 ton hot water during charging mode. Also, the system is capable of generating up to 523 kWh electrical energy and 2.5 ton potable water during the discharge period. The charge and the discharge period are 6.52 and 4 h respectively. Exergy analyses reveals that solar dish collector and combustion chamber are the major contributors for exergy destruction. Parametric analysis is employed to investigate the key parameters which have the major influence on the system performance. These parameters include cavern minimum and maximum pressures, gas turbine inlet temperature, dish collector aperture diameter, steam turbine inlet pressure, and desalinator feed water temperature. Optimization results show that round trip efficiency can rise from 65.2% to 70.35%, using upper limits of cavern minimum and maximum pressures. Besides, rising inlet temperature of gas turbine and restricting air cavern maximum and minimum pressures to their lower limits results in a 19.18% exergy efficiency improvement. Finally, economic analysis is performed to evaluate main cost and income sources of the system. As multi objective optimization shows, devising conditions that lead to produce more electrical energy improves system economic performance considerably.

Key Words: Hybrid system Micro gas turbine, Dish collector, ORC, etc.

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MULTI-OBJECTIVE OPTIMISATION AND FAST DECISION-MAKING METHOD FOR WORKING FLUID SELECTION IN ORGANIC RANKINE CYCLE WITH LOW-TEMPERATURE WASTE HEAT SOURCE IN INDUSTRY

Paper ID -1162

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Abstract

In China, the utilization of low-temperature waste heat (especially at temperatures lower than 100 °C) plays a significant role in increasing the energy-consumption efficiency in the industry. The organic Rankine cycle (ORC) is considered as a promising method to recover the aforementioned part of the waste heat. In the study, six potential candidates, namely R141b, R142b, R245ca, R245fa, R600a, and R601a were screened from 12 dry or adiabatic organic working fluids based on their thermodynamic performances in the ORC. A multi-objective optimization (MOO) was performed for the thermodynamic performance (exergy efficiency, EXE) and economic performance (levelised energy cost, LEC) by using non-dominated sorting genetic algorithm-II (NSGA-II). The Pareto frontiers were obtained for the six candidates with the algorithm, and each optimal compromise solution was accurately obtained with the fuzzy set theory. Based on the EXE and LEC of the optimal compromise solution, the total cost and power generation efficiency for the six candidates were determined. This was used to obtain an explicit evaluation index in economic performance, namely static investment payback period (SIPP), to identify that the R245ca corresponded to the most cost-effective working fluid with the shortest SIPP. This suggests R245ca was the fastest to cover the investment and cost of the ORC system. Furthermore, a fast decision-making method was introduced to select the optimal working fluid based on the grey relational analysis (GRA) by considering key physical property parameters of the working fluids. The results suggest that any potential working fluid to recover low-temperature waste heat in the ORC can be evaluated by the simplified grey relational degree (SGRD) proposed in the study.

Key Words: Working, fluid, selection, Lowetc

OPTIMIZATION OF A NOVEL COGENERATION SYSTEM INCLUDING A GAS TURBINE, A SUPERCRITICAL CO2 RECOMPRESSION CYCLE, A STEAM POWER CYCLE AND AN ORGANIC RANKINE CYCLE

Paper ID -1163

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Abstract

According to the principles of energy grade recovery and cascade utilization, a novel cogeneration system including a gas turbine, a supercritical CO2 (S-CO2) recompression cycle, a steam power cycle and an organic Rankine cycle (ORC) is proposed. In particular, a part of waste heat from the supercritical CO2 recompression cycle is used to preheat the steam power cycle, and ORC uses the zeotropic mixture as working fluid. Comprehensive thermodynamic and exergoeconomic analyses are presented for the proposed cogeneration system. Parametric studies are conducted to study the effects of key system design parameters as pressure ratio of gas turbine, pressure ratio of the S-CO2 cycle, split ratio of the S-CO2 cycle, evaporation temperature of the steam power cycle, mass fraction of is pentane in the geotropic mixture, evaporation temperature of ORC and pinch point temperature difference in the ORC evaporator on the exergy efficiency and total product unit cost. The optimum system parameters are obtained through the multi-objective optimization method based on GA (genetic algorithm) and TOPSIS (Technique for Order Preference by Similarity to Ideal Situation) decision making. The optimization results indicate that the optimum values of exergy efficiency and total product unit cost are 69.33% and 10.77$/GJ, respectively. Furthermore, the superiority of the proposed cogeneration system is verified by comparison with other seven forms of power generation systems.

Key Words: Cogeneration system, Gas turbine, recompression, cycle, etc.

THERMODYNAMIC OPTIMISATION OF A HIGH-ELECTRICAL EFFICIENCY INTEGRATED INTERNAL COMBUSTION ENGINE – ORGANIC RANKINE CYCLE COMBINED HEAT AND POWER SYSTEM

Paper ID -1164

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Abstract

Organic Rankine cycle (ORC) engines are suitable for heat recovery from internal combustion engines (ICE) forthe purpose of secondary power generation in combined heat and power (CHP) systems. However, trade-offs must be considered between ICE and ORC engine performance in such integrated solutions. The ICE design and operational characteristics influence its own performance, along with the exhaust-gas conditions available as heat source to the ORC engine, impacting ORC design and performance, while the heat-recovery heat exchanger (ORC evaporator) will affect the ICE operation. In this paper, an integrated ICE-ORC CHP whole-system optimization framework is presented. This differs from other efforts in that we develop and apply a fully-integrated ICE-ORC CHP optimization framework, considering the design and operation of both the ICE and ORC engines simultaneously within the combined system, to optimize the overall system performance. A dynamic ICE model is developed and validated, along with a steady-state model of subcritical recuperative ORC engines. Results highlight that by optimizing the complete integrated ICE-ORC CHP system simultaneously, the total power output increases by up to 30% in comparison to a nominal system design. In the integrated CHP system, the ICE power output is slightly lower than that obtained for optimal standalone ICE application, as the exhaust-gas temperature increases to promote the bottoming ORC engine performance, whose power increases by 7%. The ORC power output achieved accounts for up to 15% of the total power generated by the integrated system, increasing the system efficiency by up to 11%.. This study proves that by taking a holistic approach to whole-system ICE-ORC CHP design and operation optimization, more power can be generated efficiently, with a lower fuel consumption. The findings are relevant to ICE and ORC manufacturers, integrators and installers, since it informs component design, system integration and operation decisions.

Key Words: Combined, heat , power, Efficient, etc.

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AN INNOVATIVE ORGANIC RANKINE CYCLE (ORC) BASED OCEAN THERMAL ENERGY CONVERSION (OTEC) SYSTEM WITH PERFORMANCE SIMULATION AND MULTI-OBJECTIVE OPTIMIZATION

Paper ID -1165

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Abstract

Based on multi-objective particle swarm optimization (MOPSO) algorithm, with considering levelized cost of energy (LCOE) and exergy efficiency as two different objective functions, an innovative Organic Rankine Cycle (ORC) model based Ocean Thermal Energy Conversion (OTEC) system is investigated for trade-off Pareto optimization. In the present study, six key parameters including evaporating temperature, condensing temperature, warm seawater temperature at the outlet of evaporator, cool seawater temperature at the outlet of condenser, degree of superheat, and depth of cool seawater have been selected as decision variables. R717, R152a, R134a, R227ea, R600a and R601 are chosen as working fluids. Meanwhile, Linear Programming Technique for Multidimensional Analysis of Preference (LINMAP) is introduced in order to make decision for Pareto frontier. The results indicate that LCOE and exergy efficiency are two conflicting objectives, which are impossible to both achieve their optimal values simultaneously. According to the non-dominated sorting of Pareto optimal solution (POS) for the six working fluids, R717 and R601 have the best performance with 0.34 $/kWh of LCOE, 28.17% of exergy efficiency and 0.52 $/kWh of LCOE, 28.47% of exergy efficiency, respectively, followed by R152a, R600a and R134a which have relatively poor performance, but better than R227ea.

Key Words: OTEC,ORC, MOPSO, Multi, objective, etc.

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ARTIFICIAL NEURAL NETWORK (ANN) BASED PREDICTION AND OPTIMIZATION OF AN ORGANIC RANKINE CYCLE (ORC) FOR DIESEL ENGINE WASTE HEAT RECOVERY

Paper ID -1166

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Abstract

This paper presents performance prediction and optimization of an organic Rankine cycle (ORC) for diesel engine waste heat recovery based on artificial neural network (ANN). An ANN based prediction model of the ORC system is established with consideration of mean squared error and correlation coefficient. A test bench of combined diesel engine and ORC waste heat recovery system is developed, and the experimental data used to train and test the proposed ANN model are collected. A genetic algorithm (GA) is also considered in this study to increase prediction accuracy, and the ANN model is evaluated with different learning rates, train functions and parameter settings. A prediction accuracy comparison of the ANN model with and without using GA is presented. The effects of seven key operating parameters on the power output of the ORC system are investigated. Finally, a performance prediction and parametric optimization for the ORC system are conducted based on the proposed ANN model. The results show that prediction error of the ANN model with using the GA is lower than that without using GA. Therefore, it is recommended to optimize the weights of the ANN model with GA for a high prediction accuracy. The proposed ANN model shows a strong learning ability and good generalization performance. Compared to the experimental data, the maximum relative error is less than 5%. The experimental results after optimizing the operating parameters are very close to ANN's predictions, indicating one or more operating parameters can be adjusted to obtain a higher power output during the experiment process.

Key Words: Diesel engine, Organic Rankine cycle, Artificial neural network.

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DESIGN AND OPERATION OPTIMIZATION OF ORGANIC RANKINE CYCLE COUPLED TRIGENERATION SYSTEMS

Paper ID -1167

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Abstract

The utilization of organic Rankine cycle (ORC) technology is increasing rapidly due to its adaptability to various low-grade heat sources. This paper examines the economic and environmental performances of different regeneration systems integrated with ORC unit based on different low/medium-temperature heat sources. By coupling the ORC unit to combined cooling, heating and power (CCHP) plant, solar collector and biomass boiler, three systems, namely, CCHP-ORC, Solar-ORC as well as Biomass-ORC are proposed. In order to realize the best performance of each integrated system, a mixed integer linear programming (MILP) model is developed to deduce the optimal system combination and corresponding operation strategies, from different preferences. As an illustrative example, the above three integrated systems have been assumed to cover the energy demands of two typical commercial buildings: hotel and office for a calendar year. Comparative analysis among the proposed three systems is implemented considering both economic and environmental objectives. The simulation results indicate that the Solar- ORC system has the best economic performance, whereas the Biomass-ORC system enjoys the best environmental benefit. In addition, the potential environmental benefits of the ORC unit are recognized be higher than the economic ones.

Key Words: Combined, cooling heating, power, Solar, etc.

DESIGNED BINARY MIXTURES FOR SUBCRITICAL ORGANIC RANKINE CYCLES BASED ON MULTIOBJECTIVE OPTIMIZATION

Paper ID -1168

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Abstract

The use of binary zeotropic mixtures as working fluids applied to Organic Rankine Cycles (ORCs) is investigated in this paper. In total, six (6) hydrocarbons and (2) hydro fluorocarbons are considered, leading to twenty-eight (28) possible binary combinations. The mixtures were tested with a basic Rankine cycle while using the heat source temperature as independent variable, which assumed six different values, ranging from 80 °C to 180 °C, in steps of 20 °C. The simulations aimed to identify the ideal mixtures that maximized the net power and exegetic efficiency, and minimized the heat exchanger's global conductance for a given temperature of the heat source. The optimization process relied on a genetic algorithm and the selection of the best mixtures, on a non-dominated sorting method (NDS), which returned Pareto fronts gathering the best solutions. While no one specific ideal mixture was identified, the results showed that the range of the so-called ideal mixtures narrows as the heat source temperature increases, with mixtures including fluids like R245fa and pentane being good options, whereas at low temperature, a larger number of fluid mixtures perform well. Finally, a scale analysis is proposed and shows that the maximal net power varies linearly with a Number of Transfer Units (NTU) factor while its slope depends on the heat source temperature. The latter analysis is compared with the results obtained with the Pareto front and NDS, showing that both sets of results agree well while correlated by a single constant for the entire temperature range covered in the present study.

Key Words: Organic Rankine Cycle (ORC),Working fluid, Mixture, Genetic algorithms (GA),Multi-objective optimization.

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DEVELOPMENT AND MULTI-OBJECTIVE OPTIMIZATION OF GEOTHERMAL-BASED ORGANIC RANKINE CYCLE INTEGRATED WITH THERMOELECTRIC GENERATOR AND PROTON EXCHANGE MEMBRANE ELECTROLYZER FOR POWER AND HYDROGEN PRODUCTION

Paper ID -1169

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Abstract

The aim of this study is to enhance the performance of a geothermal-based organic Rankine cycle by proposing two novel systems in which some part of the waste heat is recovered employing thermoelectric generator for power and/or hydrogen production (using proton exchange membrane electrolyzer). Accordingly, two novel systems are proposed and analyzed along with the basic organic Rankine cycle (configuration (a)). In the first proposed system, some part of the waste heat is recovered by employing thermoelectric generator (configuration (b)), while in the second one the additional power generated by thermoelectric generator is used in the proton exchange membrane electrolyzer for hydrogen production (configuration (c)). The performances of the proposed systems are investigated and compared with that of the basic cycle from energy, exergy and exergoeconomic viewpoints and are optimized using genetic algorithm via a multi-objective optimization strategy. The results indicate that, at the best solution point obtained from multi-objective optimization, the exergy efficiencies of the proposed systems (configurations (b) and (c)) are higher than that of the basic organic Rankine cycle by 21.9% and 12.7%, respectively. Furthermore, another interesting result is found which reveals that the specific product cost for the proposed configurations (b) and (c) is lower than that for the basic organic Rankine cycle, despite the higher total cost rate for the proposed configurations.

Key Words: Multi-objective, optimization, Exergoeconomic, Thermoelectric generator.

ECONOMIC OPTIMIZATION OF ORGANIC RANKINE CYCLE WITH PURE FLUIDS AND MIXTURES FOR WASTE HEAT AND SOLAR APPLICATIONS USING PARTICLE SWARM OPTIMIZATION METHOD

Paper ID -1170

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Abstract

The optimization criterion for designing the thermodynamic layout of an organic Rankine cycle is often based on either achieving maximum thermodynamic efficiency or incurring minimum initial specific investment costs. Such designs, however, need not lead to the maximum utilization of waste heat potential or an optimal investment. For full potential utilization of a waste heat source, its temperature should be brought down to near ambient temperatures via transfer of enthalpy to the organic Rankine cycle working fluid. In the limit, however, pursuit of complete source utilization may lead to capital intensive organic Rankine cycle layouts that demand infinitesimal temperature gradients in heat exchangers leading to massive heat transfer areas. This paper defines a new objective function that reveals the tradeoffs between specific investment cost and the extent to which waste heat is utilized. A particle swarm optimization algorithm is used to optimize 7 and 8 dimensional search space for pure and mixture based working fluids, respectively, for case studies involving power capacities of 5, 50 and 500 kWe, waste heat source temperatures ranging from 75 to 275 °C and a number of working fluids. As a practical aid to designers, a methodology for generating high isentropic efficiency scroll geometries corresponding to optimized cycles is presented, and the optimization analysis is further extended to solar thermal applications.

Keywords: Organic Rankine cycles, Thermo-economics, Waste heat application, solar heat application, Particle swarm optimization.

ENERGETIC OPTIMIZATION OF REGENERATIVE ORGANIC RANKINE CYCLE (ORC) CONFIGURATIONS

Paper ID -1171

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Abstract

The present study focuses on the energetic optimization of regenerative Organic Rankine Cycle (ORC) configurations. More specifically, three regenerative ORCs are examined. The first includes an open preheater, in which the bleed stream is mixed with the working fluid exiting the pump of the cycle (O-ORC). The other two configurations include a closed preheater. In the second configuration, the bleed stream is throttled and conveyed to the condenser (CB-ORC), while in the third one, it is repressurized via a secondary pump and recirculates into the evaporator of the cycle (CF-ORC). The systems are optimized for different working fluids, and their energetic efficiencies are estimated and compared to that of a standard ORC (S-ORC). In all cases, the inclusion of a recuperator has also been investigated. In principle, recuperative and regenerative ORCs are mostly suitable for dry fluids, while the critical temperature can also have a positive influence on the performance improvement. Furthermore, it is estimated that while the recuperative S-ORC has a higher efficiency than the non-recuperative regenerative cycles, recuperative O-ORC and CF-ORC exhibit a relative efficiency gain ranging from 4.98% to 8.05% and 6.22% to 9.29%, respectively. The highest efficiency improvement achieved by the CB-ORC, however, is minimal.

Key Words: ORC, Regenerative Recuperator, Optimization.

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EXERGETIC AND HEAT LOAD OPTIMIZATION OF HIGH TEMPERATURE ORGANIC RANKINECYCLE

Paper ID -1172

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Abstract

This paper presents an optimization of a high temperature organic Rankine cycle (ORC) system providing the basis for optimal fluid selection and subsequent design parameters based on the working fluid selected. The working fluids used are m-xylene, propyl cyclohexane and decane having high critical temperatures. The proposed system deals with the application of biomass due to the high content heat available during its combustion. The system is optimized through non-dominated sorting genetic algorithm (NSGA-II) by taking the prime operators such as; exergetic efficiency (ηex) to extract maximum work and total heat transfer requirement (UA) to get a prediction of the heat transfer area and hence the cost of the system. The parameters subjected to constraints for optimization are evaporation pressure, degree of superheating and pinch point conditions at heat exchangers. The optimization results exhibit an increase of 22.9% for propyl cyclohexane and 45.5% for decanein UA values, relative to m-xylene. Highest exergetic efficiency values for m-xylene among three working fluids further ensures its use in the system as the most viable option from both thermodynamic and economic aspect. Moreover, optimal evaporation pressure range is evaluated by taking the maximum and minimum of exergeticefficiency and UA value, respectively. Both objective functions show negative trend with increase in degree of superheating, with less significant drop. As the pinch point value increases, the UA value decreases showing significantly smaller areas of heat transfer and less cost, but with low exergetic efficiency, therefore, moderate pinch point condition of 8–10 °C is recommended.

Key Words: Organic Rankine cycle, High temperature, Heat transfer requirement, Optimization.

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EXERGETIC OPTIMIZATION OF DOUBLE STAGE ORGANIC RANKINE CYCLE (ORC)

Paper ID -1173

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Abstract

The present work focuses on the exergetic optimization of double stage Organic Rankine Cycle (DS ORC) for waste heat recovery. A model of a DS ORC, consisting of a high temperature (HT) stage serially connected to a low temperature (LT) stage is developed, while different combinations of working fluids with variable critical temperatures are considered in each stage. The optimization variables are the evaporation pressures in the HT and LT stages, as well as the evaporator pinch point and condenser temperature in the HT stage. The aim is to explore the exergetic efficiency improvement potential of DS ORCs compared to the single stage cycles and establish optimization guidelines for maximizing their total power output for heat source temperatures ranging from 100 _C to 300_C. Compared to single stage ORCs, DS ORCs can lead to a relative increase of the exergetic efficiency by up to 25%, depending on the heat source temperature and the working fluids considered. Meanwhile, DS ORCs are especially favourable when the heat source temperature is far lower or between the critical temperatures of the fluids used in their two stages.

Key Words: Organic Rankine Cycle, ORC, Double stage, Double evaporation.

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ENERGY AND EXERGO-ECONOMIC ANALYSIS AND OPTIMIZATION OF A SOLAR DOUBLE PRESSURE ORGANIC RANKINE CYCLE

Paper ID -1174

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Abstract

This study presents an exergo-economic analysis and optimization of a double pressure organic Rankinecycle coupled with a solar collector via a thermal storage tank. Numerical analysis has been done to perform the exergetic analysis along with economic analysis. The performance of the system was examined during a day. Results showed that the system is capable of generating stable power during the day with a solar fraction of 100%. In nights and overcasts, the system can still generate power with the help of storage tank and an auxiliary heater. A parametric analysis examined the effect of key parameters on the system performance including exergy efficiency and product cost rate. The effective parameters included turbine inlet pressure and temperature. Exergo-economic criteria revealed that solar collector has the most value of Z_ þ C_ D which is due to both high exergy destruction and high investment costs of the collector. Following the collector, the storage tank, condenser, turbine, recuperator and evaporators had the highest destruction. To perform the optimization process, two objective functions including exergy efficiency and product cost rate were considered. Ten decision variable including inlet temperature and pressure of the turbines, heat exchanger minimum temperature differences and the mass flow rate of solar collector and tank and pressure of condenser were chosen according to the parametric analysis. Also, with the aid of a reliable decision-making technique called TOPSIS method, the optimal point was selected among the Pareto frontier of the genetic algorithm. Results show that system can reach the efficiency of 22.7% and product cost rate of 2.66 million dollars per year.

Keywords: Exergo-economic, Organic Rankine cycle, Solar collector, Optimization, decision making.

EXPERIMENTAL COMPARISON AND OPTIMIZATION GUIDANCE OF R1233ZD (E) AS A DROP-IN REPLACEMENT TO R245FA FOR ORGANIC RANKINE CYCLE APPLICATION

Paper ID -1175

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Abstract

The organic Rankine cycle is capable of converting the low-temperature waste heat into electricity. The commonly used working fluid R245fa will be phased out in the near future because of the significant impact to climate change. In that case, a new refrigerant R1233zd (E) with extremely low GWP is proposed as an environmental friendly substitute in this paper. The investigation is processed with four steps: firstly, a thermodynamic analysis was carried out for prior prediction of the applicability of R1233zd (E) as an alternative to R245fa; secondly, an experimental comparison between two refrigerants was implemented under a design of extensive operating conditions; Afterwards, experimental results were presented. Differences in expansion and evaporation procedure based on three non-dimensionless indicators were analyzed; eventually, a multi-objective optimization guidance involved with aforementioned indicators was proposed. Comparing the maximum cycle thermal efficiency, R1233zd (E) leads to approximately 3.8% higher than R245fa. Comparing the maximum output electrical power, R1233zd (E) leads to 4.5% better than R245fa. R1233zd (E) is proven as an appropriate alternative to R245fa based on current study. Prediction precision of the volume ratio dependent curves of filling factor and isentropic effectiveness are within 1.2% and 2.7%, which can be used to model a certain expander in optimization procedure.

Key Words: R1233zd(E),R245fa,ORC,Cycle thermal efficiency.

GLOBAL OPTIMIZATION OF THE DIESEL ENGINE–ORGANIC RANKINE CYCLE (ORC) COMBINED SYSTEM BASED ON PARTICLE SWARM OPTIMIZER (PSO)

Paper ID -1176

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Abstract

The organic Rankine cycle (ORC) system powered by exhaust heat has great potential in improving engine performance. Many optimizations of the only ORC system were conducted, while the existing literature pays limited attention to the optimization of the engine–ORC combined system. By considering the importance of interaction, cooperation, and influence between the engine and ORC system, a global optimization of the diesel engine–ORC combined system (herein, the combined system) is conducted in this paper with respect to power output and fuel economy. A GT-Suite model of the combined system and a GT-Suite/Simulink co-simulation model are proposed to obtain the optimum operating parameters of the engine and the ORC system under various operating conditions. Furthermore, the effects of the operating parameters, namely, exhaust valve timing, injection timing, expander speed, and pump speed, are evaluated on the combined system. In addition, models of the engine and the ORC system are calibrated, and a particle swarm optimizer (PSO) is designed and adopted for global optimization. Optimization results show improvements of 3.24% and 3.13% on the power output and brake specific fuel consumption (BSFC), respectively, with full engine load when the engine is operated at 3600 r/min. In the optimization of fuel economy with partial engine load, a maximum reduction of 5.71% on the BSFC of the combined system is obtained at 3600 r/min engine speed.

Key Words: Organic Rankine cycle, combined system, integrated simulation Global optimization, Particle swarm optimizer.

MODELING AND OPTIMIZATION CRITERIA OF SCROLL EXPANDER INTEGRATED INTO ORGANIC RANKINE CYCLE FOR COMPARISON OF R1233ZD (E) AS AN ALTERNATIVE TO R245FA

Paper ID -1177

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Abstract

HFCs are suggested to be banned in 2020 because of high GWP (Global Warming Potential). New type of HFO refrigerant R1233zd (E) is proposed as a drop-in replacement to R245fa for organic Rankine cycle application considering the similar thermo-physical properties. In this paper, a description of previous experimental comparison between two refrigerants is presented in the first section. In the second section, further investigation in expansion procedure is implemented with a semi-empirical expander model, which is validated with experimental data based on 'Genetic Algorithm'. Internal leakage, mechanical friction and heat transfer are presented as main irreversible losses. Input parameters are assigned to mass flow rate, expander rotational speed, supply temperature and exhaust pressure. Supply pressure, exhaust temperature and net power are computed as output results. The maximum deviation between the measured and predicted results are 3.35%, 2.24 K and 6.09% respectively. In the last section, polynomial curve-fittings of dimensionless expander efficiency are conducted for wider prediction of operating range of the expander. Values of filling factor and expander isentropic efficiency are predicted with $R2$ = 99.517% and $R2$ = 97.997%. Curve-fittings of expander efficiency can be integrated into systematic simulation, which is aimed for further optimization of cycle performance to better take advantage of new refrigerants.

Key Words: croll expander, ORC, Alternative, Polynomial curve-fitting.

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OPTIMISATION OF A HIGH-EFFICIENCY SOLAR-DRIVEN ORGANIC RANKINE CYCLE FOR APPLICATIONS IN THE BUILT ENVIRONMENT

Paper ID -1178

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Abstract

Energy security, pollution and sustainability are major challenges presently facing the international community, in response to which increasing quantities of renewable energy are to be generated in the urban environment. Unlike previous studies that focus on the optimization of the ORC subsystem, this study performs a complete system optimization considering both the design parameters of the solar collector array and the ORC engine simultaneously. Firstly, we present thermodynamic models of different collectors, including flat-plate and evacuated-tube designs, coupled to a non-recuperative sub-critical ORC architecture that delivers power and hot water by using thermal energy rejected from the engine. Then, hourly dynamic simulations of the optimised system configurations are performed to complete the system sizing. Results are presented of: (i) dynamic 3-D simulations of the solar collectors together with a thermal energy storage tank, and (ii) of an optimization analysis to identify the most suitable working fluids for the ORC engine, in which the configuration and operational constraints of the collector array are considered. The best performing working fluids (R245fa and R1233zd) are then chosen for a whole-system annual simulation in a southern European climate. The system configuration combining an evacuated-tube collector array and an ORC engine is found to be best-suited for electricity prioritization, delivering an electrical output of 3,605 kWh/year from a 60m2 collector array. In addition, the system supplies 13,175 kWh/year in the form of domestic hot water, which is equivalent to more than 6 times the average annual household demand. A brief cost analysis and comparison with photovoltaic (PV) systems is also performed, where despite the lower PV investment cost per kWel, the levelised energy costs of the different systems are found to be similar if the economic value of the thermal output is taken into account. Finally, a discussion of the modelled solar-CHP systems results shows how these could be used for real applications and extended to other locations.

Key Words: Solar energy, Organic Rankine cycle, Dynamic modeling, Optimisation, Energy efficiency**.**

OPTIMIZATION AND MULTI-TIME SCALEMODELING OF PILOT SOLAR DRIVEN POLYGENERATION SYSTEM BASED ON ORGANIC RANKINE CYCLE

Paper ID -1179

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Abstract

Pilot-scale distributed poly generation system driven by solar energy and its effective simulation mechanism provides promising solutions for the technology promotion and implementation, as the emerging of smart grid concepts. In this regard, this study aims to preliminary test such a system based on organic Rankine cycle with the power output of 200 kW, which is combined with cooling and heating cycle. The developed pilot system is proven to sustain the power thermal efficiency of 10% with R123 and a self-made expansion valve. Targeting a whole optimized system in practical application, a multi-time scale mechanism is proposed and consists of long-, mid- and short-term simulation with yearly, hourly and second time step, respectively. The functionality of the concept is proven by showing the model-guided optimal sequential system with hexa methyl disiloxane working fluid. It achieves a high performance ratio, efficient cost, and less land occupation, corresponding to 67.61%, $0.12 million and 3774.2m2, respectively, under the long-term simulation. Rated operation decisions are correspondingly determined and present acceptable supply-and-demand matching performance at the level of midterm modeling, with the payback time of 7.41 years. Furthermore, the system dynamic behavior is analyzed in two typical sunny and cloudy days to understand and compare its running states. The short-term model shows a steady thermal efficiency of 9.6% within 15,000 s and capture a smaller period of safety state only within 6000 s under the sunny day condition. Although the peak irradiance in the cloudy day is higher than that in the sunny day, the performance degrades dramatically due to the irradiance fluctuation. It is expected that the proposed mechanism can be extended in analyzing operational security and control strategy.

Key Words: Combined cooling, heating, and power, Organic Rankine cycle, Pilot system.

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OPTIMIZATION OF ORGANIC RANKINECYCLE POWER SYSTEMS CONSIDERING MULTISTAGE AXIAL TURBINE DESIGN

Paper ID -1180

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Abstract

Organic Rankine cycle power systems represent a viable and efficient solution for the exploitation of medium-to low temperature heat sources. Despite the large number of commissioned units, there is limited literature on the design and optimization of organic Rankine cycle power systems considering multistage turbine design. This work presents a preliminary design methodology and working fluid selection for organic Rankine cycle units featuring multistage axial turbines. The method is then applied to the case of waste heat recovery from a large marine diesel engine. A multistage axial turbine model is presented and validated with the best available data from literature. The methodology allows the identification of the most suitable working fluid considering the trade-off between cycle and multistage turbine designs. The results of the optimization of cycle and turbine suggest that the fluid n-butane yields the best compromise in terms of cycle net power output, turbine cost and efficiency for the considered case study. When a conservative design approach is adopted, the turbine features a two-stage configuration with supersonic converging nozzles and post-expansion. Conversely, a single-stage turbine featuring a supersonic converging-diverging nozzle and Mach number up to 2 is the resulting idealchoice when a more advanced design approach is implemented.

Key Words: Organic Rankine cycle, Axial turbine, Multistage turbine.

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OPTIMIZATION OF ORGANIC RANKINE CYCLE USED FOR WASTE HEAT RECOVERY OF CONSTRUCTION EQUIPMENT ENGINE WITH ADDITIONAL WASTE HEAT OF HYDRAULIC OIL COOLER

Paper ID -1181

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Abstract

The aim of this study is to provide an optimal organic Rankine cycle (ORC) system for waste heat recovery (WHR) from a construction equipment engine. Construction equipment machines have very high annual fuel consumption, and most of the engine power is used to drive a hydraulic oil pump, thus producing additional waste heat from the hydraulic oil cooler. In order to compare the WHR of the construction equipment engine with that of a conventional engine without the heat of the hydraulic oil, four different single-loop ORC cases were considered and optimized for maximum net power. The results of this study showed that at the half-load condition as the primary operating condition, the use of additional waste heat from the hydraulic oil can increase the net power output of the ORC in the construction equipment engine by 11% despite at a low expander inlet temperature without arecuperator as compared to the system without the heat of hydraulic oil. However, the use of waste heat from the hydraulic oil increased the cost of the system owing to the preheater used by hydraulic oil and the increased condenser size.

Key Words: Organic Rankine cycle (ORC), Engine, Waste heat recovery (WHR).

OPTIMIZATION OF ORGANIC RANKINE CYCLE USED FOR WASTE HEAT RECOVERY OF CONSTRUCTION EQUIPMENT ENGINE WITH ADDITIONAL WASTE HEAT OF HYDRAULIC OIL COOLER

Paper ID -1182

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Abstract

The aim of this study is to provide an optimal organic Rankine cycle (ORC) system for waste heat recovery (WHR) from a construction equipment engine. Construction equipment machines have very high annual fuel consumption, and most of the engine power is used to drive a hydraulic oil pump, thus producing additional waste heat from the hydraulic oil cooler. In order to compare the WHR of the construction equipment engine with that of a conventional engine without the heat of the hydraulic oil, four different single-loop ORC cases were considered and optimized for maximum net power. The results of this study showed that at the half-load condition as the primary operating condition, the use of additional waste heat from the hydraulic oil can increase the net power output of the ORC in the construction equipment engine by 11% despite at a low expander inlet temperature without arecuperator as compared to the system without the heat of hydraulic oil. However, the use of waste heat from the hydraulic oil increased the cost of the system owing to the preheater used by hydraulic oil and the increased condenser size.

Key Words: Organic Rankine cycle (ORC), Engine, Waste heat recovery (WHR), oil.

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OPTIMIZATION OF THE COMBINED SUPERCRITICAL CO2 CYCLE AND ORGANIC RANKINECYCLE USING ZEOTROPIC MIXTURES FOR GAS TURBINE WASTE HEAT RECOVERY

Paper ID -1183

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Abstract

In order to further improve the efficiency of the gas turbine, a novel combined supercritical CO2 regenerative cycle and organic Rankine cycle using zeotropic mixtures for waste heat recovery of gas turbine is proposed. The zeotropic mixtures used in the present study are cyclopentane/R365mfc. Exergoeconomic analysis is reported for the proposed system and parametric studies have been carried out to investigate the effect of system parameters on the exergy efficiency and the unit cost of electricity. The multi-objective optimization method based on genetic algorithm is chosen to obtain the optimum system parameters. The results show that the overall values of the exergoeconomic factor, the optimal exergy efficiency and the optimal unit cost of electricity of the proposed system are 31.88%, 62.23% and 3.95 cent/kW h, respectively. The obtained result reveals the superiority of the proposed combined regenerative S-CO2 cycle and ORC system compared to the combined basic S-CO2 cycle and ORC system, the combined recompression S-CO2 cycle and ORC system. Therefore, the proposed system is suitable for gas turbine waste heat recovery, and it has advantages of deep utilization of waste heat, high efficiency and low cost.

Key Words: Gas, turbine, waste heat recovery,CO2, regenerative cycle.

OPTIMIZATIONS OF THE ORGANIC RANKINE CYCLE-BASED DOMESTIC CHP USING BIOMASS FUEL

Paper ID -1184

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Abstract

The purpose of this study is to determine the optimal operating conditions and performance for the design of ORC based biomass compact CHP for 2 kW of electric, 25 kW of thermal power productions and 60 °C warm water supply. Eight organic working fluids were selected based on thermo-physical properties and related environmental regulations: cyclopentane, isopentane, n-pentane, diethyl ether, HFO-1233zd, HFC-245fa, HFE- 7000 and HFE-7100. The selected organic fluids were classified into three groups considering latent heat and boiling point. The group A fluids contained cyclopentane, isopentane, n-pentane and diethyl ether. The group B fluids contained HFO-1233zd and HFC-245fa. The group C fluids contained HFE-7000 and HFE-7100. The subcritical ORC cycle and saturated vapor state at the inlet of the expander were considered for the analysis. As a result of thermodynamic analyses and optimizations, the group A fluids have the best CHP performance because of the greatest latent heat amount. The systems using the group A fluids have the lowest mass flow rates from 0.053 kg/s to 0.081 kg/s, the lowest required heat supplies from 31.64 kW to 34.61 kW, the highest ORC efficiencies from 5.95% to 7.29% and the CHP efficiencies from 71.83% to 72.32%. The group B fluids have the mass flow rates from 0.157 to 0.215 kg/s, the highest required heat supplies from 36.98 kW to 46.41 kW, the lowest system efficiencies from 4.59% to 6.05% and the highest CHP efficiencies from 72.05% to 73.41%. The group C fluids have the highest mass flow rates from 0.213 kg/s to 0.230 kg/s, the required heat supplies from 32.30 kW to 40.54 kW, the system efficiencies from 5.07% to 6.36% and the lowest CHP efficiencies from 71.31% to 72.33%. In addition, ORC systems using the group A or group C fluids can operate at low pressure and can meet system requirements with low cooling water mass flow rate because of the high boiling points. For the group A fluids, both post-heater and IHE are very effective for the system, and the system using the group B fluids can highly improve the system through the application of the post heater. For the group C fluids, application of the IHE significantly improves system performance.

Key Words: Combined heat and power (CHP), Organic Rankine cycle, Biomass.

PARAMETRIC OPTIMIZATION AND THERMODYNAMIC PERFORMANCE COMPARISON OF SINGLE-PRESSURE AND DUAL-PRESSURE EVAPORATION ORGANIC RANKINE CYCLES

Paper ID -1185

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Abstract

Dual-pressure evaporation organic Rankine cycle (ORC) involves two evaporation processes with different pressures, and can significantly reduce the exergy loss in the heat absorption process compared with conventional single-pressure evaporation ORCs. However, the applicable heat source temperatures of dual-pressure vaporation ORCs and the effects of the working fluid thermo physical properties on the applicable conditions remain indeterminate. Optimal cycle parameters for various heat source temperatures also need to be studied. Solving these questions is crucial for the application and promotion of dual-pressure evaporation ORCs. This Study focuses on a typical dual-pressure evaporation ORC driven by the 100–200 °C heat sources without a limit on the outlet temperature. Nine pure organic fluids were selected as working fluids. Evaporation pressures and evaporator outlet temperatures of the single-pressure and dual-pressure evaporation ORCs were optimized, and their optimized system thermodynamic performance was compared. Results show that the applicable heat source temperature range of the dual-pressure evaporation ORC (*W*net,dual>*W*net,single) generally increases as the working fluid critical temperature increases. The upper limit of the applicable heat source temperatures (*T*HS,inTP), working fluid critical temperature and pinch point temperature difference generally conform to a linear relation. For the heat source temperature below *T*HS,inTP, the maximized net power output of the dual-pressure evaporation ORC is larger than that of the single-pressure evaporation ORC. Furthermore, the increment generally increases as the heat source temperature decreases, and the maximum increments are 21.4–26.7% for nine working fluids. For the heat source temperature above *T*HS,inTP, the dual-pressure evaporation ORC is unbefitting.

Key Words: Organic Rankine cycle, Dual-pressure evaporation,, aste heat recovery.

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PERFORMANCE ANALYSIS AND PARAMETRIC OPTIMIZATION OF SUPERCRITICAL CARBON DIOXIDE (S-CO2) CYCLE WITH BOTTOMING ORGANIC RANKINE CYCLE (ORC)

Paper ID -1186

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Abstract

Supercritical carbon dioxide (S-CO2) cycle is proven to be one promising alternative to provide high Efficiency and has been developed for a wide range of energy conversion applications. Thermal efficiency of the S-CO2 cycle can be further improved by incorporating an appropriate bottoming cycle utilizing the Heat recovery. Different recuperative ratios of the topping S-CO2 cycle are considered and the influence of heat source initial temperature and total heat load on the bottoming ORC is evaluated. Two configurations of the SCO2- ORC combined cycle system are presented, one without a pre-cooler and the other still with a precooler, corresponding to total and partial residual heat recovery respectively. Though the entire residual heat recovery by the bottoming cycle could definitely increase the system thermal efficiency, the low ORC evaporation temperature and mediocre ORC performance leads to a limited improvement. While in the combined cycle system with a pre-cooler, higher ORC evaporation temperature could be attained and it has a remarkable effect on the ORC performance, even though part of the topping cycle residual heat is discharged to the ambient. The simulation results reveal that the S-CO2-ORC combined cycle system performance could be significantly improved through this parametric optimization. The recompression S-CO2 cycle with bottoming ORC is then analyzed and thermal performance is improved based on the previous optimization results. The bottoming ORC could effectively recover the residual heat of the topping S-CO2 cycle and increase the system thermal efficiency, thus it can be considered and applied in similar practical cases.

Key Words: S-CO2 cycle, ORC, Combined cycle, parametric optimization.

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PERFORMANCE OPTIMIZATION OF COMBINED SUPERCRITICAL CO2 RECOMPRESSION CYCLE AND REGENERATIVE ORGANIC RANKINE CYCLE USING ZEOTROPIC MIXTURE FLUID

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Abstract

Thermodynamic and exergoeconomic analysis are performed for a novel combined supercritical CO2 (S-CO2) recompression cycle and regenerative organic Rankine cycle (ORC) using zeotropic mixture. Comprehensive parametric studies are carried out to investigate the effect of significant system parameters as pressure ratio, split ratio, evaporation temperature, pinch point temperature difference in the evaporator and the mass fraction of zeotropic mixture on the exergy efficiency and total product unit cost. Employing the multi-objective optimization method based on genetic algorithm and the TOPSIS (Technique for Order Preference by Similarity to Ideal Situation) decision making, the Pareto front solutions and optimum system parameters are obtained. In particular, several zeotropic mixtures are parameterized and used as a decision variable to participate in the multi objective optimization process to obtain the optimal zeotropic mixture. The result shows that the optimal zeotropic mixture is R236fa/R227ea (0.46/0.54). The optimum values of exergy efficiency and total product unit cost are found to be 73.65% and 10.93 $/GJ, respectively. Furthermore, comparison analysis reveals the superiority of the proposed combined cycle to the single S-CO2 cycle and the combined S-CO2 cycle and basic ORC.

Key Words: Supercritical, CO2, Rankine cycle, Combined cycle.

PROCESS OPTIMIZATION AND WORKING FLUID MIXTURE DESIGN FOR ORGANIC RANKINECYCLES (ORCS) RECOVERING COMPRESSION HEAT IN OXY-COMBUSTION POWER PLANTS

Paper ID -1188

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Abstract

In this study, an Organic Rankine Cycle (ORC) is proposed to be integrated with the flue gas pre-compression process to reduce the energy cost resulting from Carbon Capture and Storage (CCS). An equation-based flow sheet optimization model is developed considering the mixture working fluid design, ORC operating conditions and the compression process simultaneously. The optimal number of stages of CO2 compression, the working fluid composition and the optimal operating conditions of ORCs and the compression train can be determined simultaneously using the proposed mathematical model. Proper heat integration can boost the power output of the ORC system significantly. The heat integration model considering variable process streams is extended to the Integrated ORC and flue gas compression train process. The results show that the optimal number of stages is 4 and a pure working fluid could perform better than a mixture working fluid if operating conditions are chosen properly. The integration of ORCs can reduce the energy penalty by 7.9% compared with the original optimal design that did not include ORCs. In addition, one compressor stage is avoided.

Key Words: Carbon Capture and Storage (CCS), Compression waste heat, Organic Rankine cycle.

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SIMULTANEOUS OPTIMIZATION OF THE DISTRICT HEATING NETWORK TOPOLOGY AND THE ORGANIC RANKINE CYCLE SIZING OF A GEOTHERMAL PLANT

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Abstract

This contribution presents the optimization of parallel distribution between electricity and heat production for a geothermal plant. The geothermal fluid is split into two streams, one used for an Organic Rankine Cycle (ORC) system, and the other for a District Heating Network (DHN). The superstructure to be used for the optimization problem includes the ORC components, one of which is an optional internal heat exchanger which allows exchange between the outlet streams of the turbine and the pump. Each of the components' characteristic dimensions (used in the installation cost) is an optimization variable. The operating cost of the ORC is proportional to the installation cost. The superstructure also includes the DHN topology constituted by a definite consumer and optional consumers. A Mixed Integer Non-Linear Programming (MINLP) optimization problem is formulated and solved using the GAMS software. The strategy used to overcome the critical point of the initialization of the MINLP problem is presented. It consists in dividing the general problem into sub-problems which are solved successively. Three different academic study cases are compared to a reference case. The results validate the stability and the robustness of this optimization tool. A sensitivity analysis is performed in geothermal source conditions. All these results highlight the relevance of the simultaneous approach.

Key Words: Economic optimization, Geothermal power plant, Combined heat and power (CHP).

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STUDY OF WASTE HEAT RECOVERY POTENTIAL AND OPTIMIZATION OF THE POWER PRODUCTION BY AN ORGANIC RANKINE CYCLE IN AN FPSO UNIT

Paper ID -1190

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Abstract

This paper aims to explore the alternatives for waste heat recovery in a floating production storage and offloading (FPSO) platform to meet the demand for heat (from hot water) and to maximize the electric power generation through the organic Rankine cycle (ORC) with purpose to increase the overall thermal efficiency of the process and reduce CO2 emissions. Two different cycles' configurations are explored (simple and regenerative) using exhaust gases from the gas turbines as the heat sources for the ORC and the cogeneration system. The curves of the GE LM2500 and GE LM2000 turbines are modeled together with the water heating systems and the organic Rankine cycle. The model is solved using a genetic algorithm optimization method, whose objective function is set to meet the electric power demand for the FPSO platform. The purchased equipment costs of the ORC, the reduction in fuel consumption and CO2 avoided are estimated. Waste heat recovery meets the heat demand and contributes up to 21% of the electric energy demand, which increases the overall efficiency of the system, and improves the utilization factor by up to 10.8% and 19.2%, respectively. There is an average reduction of 22.5% in fuel consumption and CO2 emissions during the lifetime of the FPSO. The economic analysis based on the NPV shows that a US$12.55 million return on investment is possible, in addition to reducing the initial investment cost by US$14.2 million through the exclusion of the GE LM2500 gasturbine at project implementation.

Key Words: Organic Rankine cycle, Optimization, Offshore,CO2 reduction.

THERMODYNAMIC AND ECONOMIC OPTIMIZATION OF A DOUBLE-PRESSURE ORGANIC RANKINE CYCLE DRIVEN BY LOW-TEMPERATURE HEAT SOURCE

Paper ID -1191

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Abstract

Low-temperature heat source has been exploited for decades to generate electricity. Organic Rankine cycle (ORC) system has a high energy conversion efficiency due to the good performance of organic fluids under the low-temperature heat source. In this study, a double-pressure organic Rankine cycle system driven by low-temperature heat source is used to generate electricity. The double-pressure ORC system achieves the cascaded utilization of energy, which can improve the efficiency of energy conversion. Geothermal heat source is employed as a typical low-temperature heat source. Mathematical model is established based on thermodynamic and economic laws, and the overall system performance has been evaluated. Parametric analysis is conducted to examine the effects of some key thermodynamic parameters, namely turbine high-level inlet pressure, turbine low-level inlet pressure, turbine high-level inlet temperature, on the system's performance. Multi-objective Parametric optimization based on turbine 1-D design is conducted by means of genetic algorithm (GA) to find the best operation conditions for both economic and thermodynamics. At the same time, the performances of three organic working fluids are examined. Results indicate that the double-pressure ORC system has a better performance than single-pressure ORC system, and R245fa has a better performance among three organic fluids. It is also found that the exergy efficiency has a peak value with the change of turbine high-level inlet pressure and turbine low-level inlet pressure. In addition, increasing turbine high-level inlet temperature brings a positive effect on the system performance. Exergy analysis is also conducted and the result indicated that the main exergy loss occurs in high-pressure evaporator. After system optimization, the double-pressure organic Rankine cycle has a better performance in utilizing geothermal energy than single-pressure system.

Key Words: Low-temperature heat source, Organic Rankine cycle, Double-pressure Geo thermal.

THERMO-ECONOMIC-ENVIRONMENTAL OPTIMIZATION OF A LIQUID SEPARATION CONDENSATION-BASED ORGANIC RANKINE CYCLE DRIVEN BY WASTE HEAT

Paper ID -1192

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Abstract

Organic Rankine cycle (ORC) is a promising thermal-to-power conversion technology utilizing low enthalpy renewable resources or waste heat energy. The coupling of environmental impact analysis and thermo-economic optimization is effective in evaluating and improving the comprehensive performance of the ORC. In the present study, a thermo-economic-environmental analysis and optimization methodology is proposed for the design of a waste heat driven ORC. A multi-objective mathematical programming model integrating the environmental impact and thermo-economic performance is formulated for the simultaneous optimization of the component configurations and operation parameters for a waste heat driven ORC. The objective functions include the minimization of the environmental impact and the maximization of the net power output. The specific investment cost is used to evaluate the economic performance of the ORC. A previous developed solution strategy is applied to solve the single objective optimization problem and the ε-constrained method is applied to solve the multi objective optimization model. A case study is elaborated to test the proposed methodology and the formulated model. The single objective optimization results demonstrate the contradiction between the environmental objective and the thermo-economic objective. The trade-off solutions are achieved by multi-objective optimization. The Pareto-frontier is elaborated to show how the material allocation, component configuration, and operation parameters are influenced by the objective functions. Finally, a sensitivity analysis of the life cycle inventory of raw materials on the optimization results is conducted.

Key Words: Environmental impact, Organic Rankine cycle, Life cycle assessment.

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THERMOECONOMIC MULTI-OBJECTIVE OPTIMIZATION OF AN ORGANIC RANKINECYCLE (ORC) ADAPTED TO AN EXISTING SOLID WASTE POWER PLANT

Paper ID -1193

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Abstract

In this paper, thermodynamic and thermo economic analyses, and also optimization of an organic Rankine cycle (ORC) were performed. The system was adapted to an existing solid waste power plant with a 5.66MW installed power capacity in order to produce additional power from the exhaust gas. The actual operating data of the plant were utilized during all stages of the analyses. The originality of this paper is based on the analysis of the possibility of the energy conversion of an exhaust gas with a temperature of 566 °C into the electricity by utilizing an ORC system in the concept of waste-to-energy. Four different working fluids: toluene, octamethyltrisiloxane (MDM), octamethyl cyclotetrasiloxane (D4) and n-decane were considered and analyzed for the current system. This is also another novelty of this study due to lack of such a study, in the open literature, that deals with an ORC utilized for a typical municipal solid waste power plant. According to the thermo economic analyses, toluene was found to be the optimum working fluid with the maximum power output of 584.6 kW and the exergy efficiency of 15.69%. The optimization of the cycle was performed by using the non-dominated sorting genetic algorithm method (NSGA-II) in MATLAB software environment. The optimization results were compared and the deviations of the net power output and the total cost rate were evaluated as −5.89%, −3.51 $/h for toluene; 0.96%, −3.60 $/h for MDM; 8.45%, −2.04 $/h for D4 and 2.00%, −5.54 $/h for n-decane, respectively.

Key Words: Waste heat recovery, Organic Rankine cycle, Organic fluid, Genetic algorithm.

THERMO-ECONOMIC OPTIMIZATION OF SOLAR ORGANIC RANKINE CYCLE BASED ON TYPICAL SOLAR RADIATION YEAR

Paper ID -1194

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Abstract

The thermo-economic optimization of a solar organic Rankine cycle (SORC) should consider the features of fluctuations in solar radiation based on local historical solar radiation. However, the use of historical solar radiation is inconvenient for thermo-economic optimization because it involves considerable computational effort for simulation. To overcome this inconvenience, we propose the thermo-economic optimization of SORC by using typical solar radiation year (TSRY). TSRY is a synthesis of typical solar radiation on the basis of historical solar radiation, indicating that TSRY can reflect the typical features of fluctuations in solar radiation in a specific area. Afterward, the multi-objective genetic algorithm (GA) is selected to optimize the dynamic performance of a small-scale SORC by using the TSRY. In GA, the evaporation temperature and capacity of thermal energy storage are taken as optimization parameters, and the power output and fluctuation in power output are optimization goals. Accordingly, Pareto frontiers that optimize the SORC performance can be obtained. The effect of different parameter combinations in the Pareto frontiers and the scale of the SORC on thermo-economic are further analyzed using annual net profit as an indicator. Our analysis shows that a minimum SORC scale for profitability is set for a given location, and the profit growth rate increases as the system scale increases.

Keywords: Organic Rankine cycle, solar energy, TSRY, Annual net profit.

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FORMAL DESIGN AND ANALYSIS OF A GEAR CONTROLLER: AN INDUSTRIAL CASE STUDY USING UPPAAL

Paper ID -1195

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Abstract

In this paper, we report on an application of the validation and verification tool kit Uppaal in the design and analysis of a prototype gear controller, carried out in a joint project between industry and academia. The gear controller is a component in the control system operating in a modern vehicle, implementing the gear change algorithm. We give a detailed description of the formal model of the gear controller and its surrounding environment, and its correctness formalized in 46 logical formulas according to the informal requirements delivered by our industrial partner of the project. The second contribution of this paper is a solution to the problem we met in this case study, namely how to use a tool like Uppaal, which only provides reachability analysis to verify bounded response time properties e.g. if f1 (a request) becomes true at a certain time point, then f2 (a response) must be guaranteed to hold within a given time bound. We present a logic and a method to characterize and model{check such properties for networks of timed automata by syntactical transformation and reachability analysis. The advantage of this approach is that we need no additional implementation work to extend the existing model {checker, but simple manual syntactical manipulation on the system description. The method has been demonstrated in verifying the correctness of the gear controller design. It takes 2.99 seconds to check the 46 logical formulas by Uppaal installed on a Pentium 75MHz PC equipped with 24 MB of primary memory.

Keywords: prototype gear controller, validation and verification tool kit Uppaal, implementing the gear.

MODAL AND STRESS ANALYSIS OF GEAR TRAIN DESIGN IN PORTAL AXLE USING FINITE ELEMENT MODELING AND SIMULATION

Paper ID -1196

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Abstract

The portal axle is a gearbox that is specially designed for off-road driving conditions. It is installed between the wheel and the axle shaft to give higher ground clearance to the vehicle. The modeling and simulation of spur gears in portal axle is important to predict the actual motion behavior. However, gear train design in portal axle is difficult to study comprehensively due to their relatively low cost and short product life cycle. In this study, modal analysis of portal axle is simulated using finite element method (FEM). Modal analysis is simulated on three different combinations of gear train system commonly designed for portal axle. The three gear trains being analyzed are gear train without idler gear, one idler gear and two idler gears. FEM static stress analysis is also simulated on three different gear trains to study the gear teeth bending stress and contact stress behavior of the gear trains in different angular positions from 0° to 18°. The single and double pair gear teeth contact are also considered. This methodology serves as a novel approach for gear train design evaluation, and the study of gear stress behavior in gear train which is needed in the small workshop scale industries.

Keywords: Portal axle; Spur gears; Stress analysis; Modal analysis; Angular position; Gear train.

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DESIGN AND CHARACTERISTIC ANALYSIS OF ECCENTRIC HELICAL CURVE-FACE GEAR

Paper ID -1197

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Abstract

A composite motion eccentric helical curve-face gear pair consisting of a helical non-circular gear and an eccentric helical curve-face gear is put forward based on the combination of eccentric gear and curve-face gear. This new gear pair can implement the rotation of intersected axes as well as the movement of output axe. Based on the spatial coordinate transformation theory, the coordinate system of eccentric helical curve-face gear pair is obtained and the pitch curve of eccentric helical curve-face gear is designed. The meshing equation and the tooth surface equation of eccentric helical curve-face gear are derived based on the spatial gear engagement theory and the conjugate surface theory. By changing the different parameters of eccentric helical curve-face gear pair, the influencing factors and variation of transmission ratio, pressure angle and kinematics are analyzed. According to the motion relationship of the gears and the method of generation, the establishment of solid model for the eccentric helical curve-face gear is presented with the application of SolidWorks. Furthermore, the correctness of the design theory of eccentric helical curve-face gear pair is verified by using the motion simulation and the experimental verification.

Key words : Composite motion, Eccentric helical curve-face gear, Characteristic analysis, Verification analysis.

STRUCTURAL ANALYSIS OF COMPOSITE MATERIAL HELICAL GEAR UNDER DIFFERENT LOADING CONDITION

Paper ID -1198

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Abstract

Gearing is one of the most critical components in a mechanical power transmission system, and in most industrial rotating machinery. In recent years it is required to operate machines at varying load and speed. Gear teeth normally fail when load is increased above certain limit. Therefore it is required to explore alternate materials for gear manufacturing. Composite materials provide adequate strength with weight reduction and they have emerged as a better alternative for replacing metallic gears. In this work an attempt has been made to replace the metallic gears of steel alloy with the composites. The composites consider were the Aluminum Silicon carbide composite Carbon fiber epoxy composites and carbon fiber silicon carbide ceramic composite. Efforts have also been carried out for modeling of the transmitting power gear assembly on creo 3.0 and fem based structural behavior of different material were studied. Ansys 14.0 is used the analysis tool in the present work to determine the total deformation, von misses stress and the natural frequencies at various mode. Composite gears offer improved properties over steel alloys and these can be used as better alternative for replacing metallic gears.

Keywords: Gearing, Aluminum silicon carbide , Carbon Epoxy, Carbon fibre silicon carbide ,ANSYS.

DESIGN AND ANALYSIS OF AN INTEGRATED HALBACH-MAGNETIC-GEARED PERMANENT-MAGNET MOTOR FOR ELECTRIC VEHICLES

Paper ID -1199

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Abstract

This paper proposes an integrated Halbach-magnetic-geared permanent-magnet (PM) motor to meet the new demands arising from electric vehicles. It can offer the advantages of lightweight, compact size and low-speed high-torque operation. The key is to newly incorporate the Halbach arrays into the coaxial magnetic gear (MG) in such a way that the PM motor field and the MG field are decoupled. In addition, because the adoption of Halbach arrays can enhance the effective harmonic components as well as suppress the useless harmonic components of the magnetic field, the torque transmission performance of the outside MG can be improved. Moreover, the iron losses can also been reduced. Simulation results based on the time-stepping finite element method are given to verify the validity of the proposal.

Keywords: magnetic gear, permanent magnet, halbach array, torque transmission.

DEVELOPMENT OF COMPUTER-BASED MODEL FOR DESIGN AND ANALYSES OF WORM GEARING MECHANISM

Paper ID -1200

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Abstract

Current computer software for designing gear systems have limited flexibility and few offer multiple gearing design options. The objective of this study was to develop an interactive package for the design and analyses of worm gearing mechanisms. The worm gears were designed based on full-depth involute teeth. Mathematical models were developed to compute geometry factors for surface durability of single enveloping worm gearing cases which were extracted from established American Gear Manufacturers Association (AGMA) standards. Maximum percentage errors from the geometry features, bending loads and wear loads are 0.97%, 3.27% and 1.77% respectively and insignificant. A software capable of computing geometry parameters, bending and wear loads, and selecting appropriate materials for worm mechanisms with good accuracy has been developed.

Keywords: Single Worm; Gear Design; Bending Loads; Wear Loads.

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DESIGN AND STRUCTURAL ANALYSIS OF MAIN LANDING GEAR FOR LOCKHEED T-33 JET TRAINER AIRCRAFT

Paper ID -1201

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Abstract

This work is mainly focused on structural design and analysis of the main landing gear for a jet trainer aircraft, that is economical and possess the high strength to weight ratio but still simple in design. An attempt is made to graphically synthesis and understands the kinematics of the mechanism. ADAMS is used to verify the mobility of the design. Computer 3D modeling of the assembly is done in Unigraphics NX 10 and finite element analysis is performed to analyze stresses developed during landing at the rate of descending. The linear static analysis is carried out to compute the deflections of the main landing gear and to estimate the internal stresses with the help of finite element program ANSYS Workbench. The simulation results are discussed in this paper.

Key Words: Main Landing Gear, Gear Mechanism, Mobility, Stress analysis.

DESIGN AND ANALYSIS OF CROWN PINION OF A DIFFERENTIAL GEAR BOX FOR REDUCED NUMBER OF TEETH TO IMPROVE TORQUE TRANSMITTED

Paper ID -1202

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Abstract

Bevel gears are widely used because of their suitability towards transferring power between nonparallel shafts at almost any angle or speed. Spiral bevel gears, in comparison to straight or zerol bevel gears, have additional overlapping tooth action which creates a smoother gear mesh. This smooth transmission of power along the gear teeth helps to reduce noise and vibration that increases exponentially at higher speeds. Currently the bolero pickup vehicle of Mahindra Company is running with a pinion present in the differential gear box having 11 numbers of teeth. By reducing number of teeth on pinion, we can increase the torque. So we carried out this work to design a new pinion suitable to fit in the bolero pickup vehicle. Only the number of teeth are reduced by keeping all other dimensions same to fit the new pinion in the same housing.

Keywords: Spiral bevel gear, Pinion, Differential gear box.

DESIGN AND STRUCTURAL ANALYSIS OF HIGH SPEED HELICAL GEAR USING ANSYS

Paper ID -1203

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Abstract

In the gear design the bending stress and surface strength of the gear tooth are considered to be one of the main contributors for the failure of the gear in a gear set. Thus, the analysis of stresses has become popular as an area of research on gears to minimize or to reduce the failures and for optimal design of gears In this paper bending and contact stresses are calculated by using analytical method as well as Finite element analysis. To estimate bending stress modified Lewis beam strength method is used. Pro-e solid modeling software is used to generate the 3-D solid model of helical gear. Ansys software package is used to analyze the bending stress. Contact stresses are calculated by using modified AGMA contact stress method. In this also Pro-e solid modeling software is used to generate contact gear tooth model. Ansys software package is used to analyze the contact stress. Finally these two methods bending and contact stress results are compared with each other.

Keywords: Bending stress, Contact stress, Gear, Helical gear, FE method.

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DESIGN AND ANALYSIS AIRCRAFT NOSE AND NOSE LANDING GEAR

Paper ID -1204

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Abstract

Tri-cycle arrangement landing gear is extensively used as it is simple; convenient both structurally as well as aerodynamically. Though it is advantageous over other configuration is has its own draw backs. Factors like its weight drag, sudden application of load, acoustics, fatigue etc tend to slow down its performance and life. Among main landing gear and nose landing gear; the former carries about 85% of total weight of aircraft and latter carries around 12-15% of weight. The nose landing gear is also a source of noise and its effect is prominent when compared to main landing gear. In this project the executive jet aircraft are studied thoroughly and a nose landing gear similar to those of executive jets is modeled using CATIA. The same geometry is imported to ANSYS ICEM and flow on the body is analyzed for different angle of attack. Pressure variation, temperature, density and velocity distribution around the body is noted and then Coefficient for Lift and Drag are plotted against angle of attack for obtained results. It is also important to check the strength and stiffness of designed landing gear. Hence using ANSYS APDL and Explicit; Static structural and Impact test has been carried out for designed geometry. Stress distribution and deformation was noted for two distinct materials such as steel and aluminum alloy and primary results of acoustics has been compared with the available data.

Keywords: Angle of attack; Deformation; Flow over body; Coefficient of lift; Coefficient of drag Impact landing; Nose landing gear; Stress distribution; Acoustics.

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DYNAMIC ANALYSIS OF WIND TURBINEGEARBOX COMPONENTS

Paper ID -1205

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Abstract

This paper studies the dynamic response of a wind turbine gearbox under different excitation conditions. The proposed 4 degree-of-freedom (DOF) dynamic model takes into account the key factors such as the time-varying mesh stiffness, bearing stiffness, damping, static transmission error and gear backlash. Both the external excitation due to wind and the internal excitation due to the static transmission error are included to represent the gearbox excitation conditions. With the help of the time history and frequency spectrum, the dynamic responses of wind turbine gearbox components are investigated by using the numerical integration method. This paper explains under which conditions the fretting corrosion, as one of the wind turbine gearbox failure modes, may occur. Furthermore, it is observed that the external excitation fluctuation has large influence on the dynamic responses of both the gears and bearings.

Keywords: wind turbine; gearbox; dynamic responses; excitation conditions; time-varying mesh stiffness; static transmission error; damping; gear backlash.

STRESS ANALYSIS OF THIN RIMMED SPUR GEAR WITH ASYMMETRIC TROCHOID

Paper ID -1206

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Abstract

Involute spur gears are widely used machine element in many industrial areas. Thin-rimmed spur gears are popular in applications where low weight design and high power transmission are required. The stress occurred on thin-rimmed spur gears are different from standard spur gears due to deformations on rim. For this reason, rim thickness is key parameter for stress analysis of thin-rimmed gears. As rim thickness decreases, the value of maximum bending stress increases and the location of maximum stress is moved bottom of tooth which results in fatigue life reduction. In this study, to decrease maximum bending stress and to move upper the critical point; asymmetric trochoid profile is proposed. Asymmetry is constituted with using rack cutter has different tip radius on sides. This allows using larger tip radius on one side. Firstly, 3D design of spur gear with thin rimmed is realized in CATIA precisely. Then gears are imported to ANSYS package for finite element analysis. Normal force is applied on HPSTC. The rim surface is not fixed to allow rim deformations. The effects of using asymmetric trochoid on value and location maximum bending stress of thin rimmed spur gears is obtained with conducted case studies.

Keywords: Thin rimmed, involute spur gear, asymmetric trochoid.

FINITE ELEMENT ANALYSIS OF CONTACT AND BENDING STRESSES IN HELICAL GEAR PAIR

Paper ID -1207

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Abstract

In gear design, excessive tooth contact stresses and bending stresses are one of the prime gear failure factors; therefore, its analysis is very important in order to shorten the possibility of gear tooth failure. In the present work, the tooth bending stresses and contact stresses in a helical gear pair is calculated using AGMA theory and finite element analysis (FEA). The modelling of helical gear pair is carried out in CREO and ANSYS is used for FEA. It is observed that the bending stresses and contact stresses, both decreases with an increase in the helix angle if pressure angle remains constant. However, the error in the calculation by AGMA and FEA is higher for the bending stresses than the contact stresses and bending stresses.

Key words: Helical gear pair, Bending stresses, Contact stresses.

DESIGN AND ANALYSIS OF STEERING GEAR AND INTERMEDIATE SHAFT FOR MANUAL RACK AND PINION STEERING SYSTEM

Paper ID -1208

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Abstract

Manual rack and pinion steering systems are commonly used due to their simplicity in construction and compactness. The main purpose of this paper is to design and analyze the rack and pinion steering system. In this paper analyzed the two components of the steering system. Firstly, this paper investigates the characteristics of a rack and pinion gear system mainly focused on bending and contact stresses of the pinion gear and rack bending stress using analytical and finite element analysis. To estimate the contact stress, the-dimensional solid models for different materials are generated by SolidWorks software and the numerical solution is done by ANSYS, which is a finite element analysis package. The analytical investigation is based on Lewis stress formula. This paper also considers the study of contact stresses induced between two gears. Present method of calculating gear contact stress uses AGMA equation. To determine the contact stresses between two mating gears the analysis is carried out on the equivalent contacting cylinders. The results obtained from ANSYS are presented and compared with theoretical values. This paper also deals with the stress analysis of the rack. By using FEM a stress analysis has been carry out. Steering rack deflection and bending stresses are found. This stresses are compared with analytical result. Secondly, Fatigue analysis of intermediate steering shaft is done to find the life of the intermediate steering shaft in cycles and determined the factor of safety of the shaft. The Software results, mathematical and logical calculation implementation in a research will increase the performance and efficiency of a design.

Key words: Rack and Pinion Steering Gear, Contact Stress, Rack Bending Stress, Steering Intermediate Shaft, Life Cycle, Safety Factor, ANSYS Software.

DESIGN AND ANALYSIS OF SPLIT FIXTURE FOR GEAR HOBBING MACHINE

Paper ID -1209

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Abstract

Compared to the conventional gear hobbing fixtures, split fixture can effectively reduce job set-up time during the manufacturing process. This paper investigates the behaviour and analysis of split fixture under varying static loading conditions. Design of the part was established by considering the ability of the split fixture to carry jobs of various diameters. In order to validate the design, Static structural analysis was carried out on two positional configurations of the split fixture. A load of 1 ton was applied on the resting face of the fixture to simulate the effect of holding the job. The analysis included a study of the Stress, Deformations, and Modal analysis at different resonating frequencies to check for failure of design. By applying varying loads similar to practical conditions, it was observed that the design successfully withstood the applied forces without failure and a factor of safety of 142 was achieved in a critical loading case. Investigating the effect of dynamic loads on the Split Fixture and including auxiliary assembly components in design analysis.

Keywords: Gear hobbing, Modal analysis, Split fixture, Static structural analysis.

DESIGN AND STRUCTURAL ANALYSIS OF SKID LANDING GEAR

Paper ID -1210

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Abstract

The undercarriage or landing gear in aviation is the structure that supports an aircraft on the ground and allows it to taxi, takeoff and land. A helicopter is an aircraft that can take off and land vertically also called a rotary aircraft, it can hover and rotate in the air and can move sideways and backwards while aloft. Here the type of landing gear is studied and the designing process is done through CATIA (Computer Aided Three Dimensional Interactive Application). The results from analyzing the stress strain state for the skid landing gear with regards for the physically and geometrically nonlinear scheme of deformation were compared.

Keywords: The Skid Landing Gear, Composites, Designing, Structural Analysis, landing.

DYNAMIC CONTACT ANALYSIS AND TOOTH MODIFICATION DESIGN FOR EMU TRACTION GEAR

Paper ID -1211

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Abstract

A series of problems arise when a gear pump operates at high speed, including instability of the rotor, deformation of the chamber, and wear of the journal bearing. Among all failure modes, journal bearing wear is the most serious. The wear of journal bearings of a circular arc gear pump that operates at high speed is thus presented in this article. A journal bearing that offsets the unbalanced radial force is designed by analysis of the fluid and determination of eccentricity of the gear shaft. Experiments show that the wear of the new journal bearing is effectively reduced.

Keywords: Circular arc gear pump, journal bearing, unbalances radial force.

DESIGN AND STRUCTURAL ANALYSIS OF CERAMIC COATED PETROL ENGINE PISTON USING FINITE ELEMENT METHOD

Paper ID -1212

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Abstract

Piston is made of aluminium alloys is a crucial part in internal combustion engine. When the combustion of fuel take place insides the engine cylinder, high pressure and high temperature will be developed as the engine will operate at high load and at high speed. As a result of this high thermal and high structural stresses in the piston is produced inside the engine cylinder and if these stresses exceeds the designed values, the failure of piston take place. To avoid the failure of the piston thermal and structural intensity should be reduced to safe allowable limits. In this work an attempt is made to reduce the thermal and structural stress intensity by coated the piston with ceramic material. The zirconia-based ceramic coatings are used as thermal barrier coatings owing their low conductivity and their relatively high coefficient of thermal expansion. Firstly the structural and thermal stresses analyses are investigated on a conventional (uncoated) piston made of aluminum alloy namely A2618. Secondly the structural and thermal analyses are performed on the piston coated with zirconium material using the ANSYS software. The effects of coating on the thermal behaviours of the piston are investigated. The main objective is to investigate and analyse the structural and thermal stress distribution of the piston at the real engine condition during combustion process. The analysis is carried out to reduce the stress concentration on the upper end of the piston .i.e. piston head/crown and piston skirt and sleeve using ANSYS software. The result obtained is compared to select the better material for piston manufacturing.

Keywords: Engine piston, thermal analysis, structural analysis, FE analysis.

DESIGN AND ANALYSIS OF PISTON OF INTERNAL COMBUSTION ENGINE ON DIFFERENT MATERIALS USING CAE TOOL ANSYS

Paper ID -1213

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Abstract

The modern trend is to develop IC Engine of increased power capacity. One of the design criteria is the endeavor to reduce the structures weight and thus to reduce fuel consumption. This has been made possible by improved engine design. In the internal combustion engine there are many reciprocating parts which are responsible for giving the motion to the engine. The piston is "Heart" of the engine and its working condition is the worst one of the key parts of engine in the working environment. So it is very important for design and structural analysis of the piston. There are lots of research works proposing, for engine pistons, new geometries, materials and manufacturing techniques, and this evolution has undergone with a continuous improvement over the last decades and required thorough examination of the smallest details. Notwithstanding all these studies, there are a huge number of damaged pistons. Damage mechanisms have different origins and are mainly wear, temperature, and fatigue related. In this study work the analysis of the piston consists of mainly design and analysis. Design the model of the piston in giving design specification on the modeling like PRO-E. Then giving it the constrains which are act on the working condition of the piston after the model of the piston into the analysis software ANSYS in IGES format. Then the analysis becomes completed on the different parameters (temperature, stress, deformation) and easily analysis the result. The different material Al alloy 4032, AISI4340 Alloy Steel & Titanium Ti-6A1-4V. After the analysis of the different material piston it analyzed that the Al alloy is suitable for I.C.Engine piston.

Keywords: Design of Piston, Ansys, Pro-E.

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DESIGN ANALYSIS OF PISTON FOR FOUR STROKE SINGLE CYLINDER ENGINE USING ANSYS

Paper ID -1214

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Abstract

In this study, structural analysis is investigated on conventional piston made of Al alloy A2618. Secondly analysis are performed on piston made of Al-GHY1250 and Al-GHS1300.The material used for the design of piston should have light weight, low cost, structurally and thermally withstand at very high pressure and temperature condition that will occur in combustion process. In this project, it has been decided to study a particular piston design and its capability for maximum gas pressure. In this work, initial planning is to make piston model using solid modeling software Creo / Pro 5.0. It has been decided to mesh the geometry analyze using ANSYS. For the analysis of piston input conditions and process of analysis, a lot of literature survey has been done. High combustion gas pressures will act as a mechanical loads and causes major stresses in the critical region of the piston. Detailed static structural analysis is carried out for various loading conditions like maximum gas pressure load. Comparative study is done to select best material.

Keywords: A2618, Al-GHY1250, Al-GHS1300, Creo/ Pro 5.0.

NUMERICAL INVESTIGATION INTO THE EFFECT OF FINS ON FLUID NATURAL CONVECTION IN COAXIAL ANNULI

Paper ID -1215

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Abstract

This paper attempted to numerically examine the involvement of serrated fins on natural convection heat transfer between coaxial cylinders. The outer channel of annular cylinders was circular, while the inner channels involved three cross-sections including circular, square and triangular. As two geometric constraints, the area of annular cylinders and the diameter of outer channel were assumed to be identical in each scenario explored in this study. The fins had equal areas placed on the inner surface, so as to compare their effects on thermal properties of annular cylinders under constant temperature boundary within the range of Rayleigh numbers from 105 to 108. The results indicated that higher a Rayleigh number is directly correlated with higher convection heat transfer coefficient of surfaces. However, the inclusion of fins reduced the rate near the fins, thus mitigating the heat transfer coefficient of inner channel. This trend intensified at higher Rayleigh numbers. Therefore, the involvement of fins at lower Rayleigh numbers brings about greater efficiency in heat transfer. The comparison of fins in terms of efficiency revealed that maximum heat is transferred when the fins have been mounted on a circular channel.

Keywords: Coaxial Annular Cylinders, Natural Convection, Fins, Numerical Simulation.

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ASSESSMENT OF CONVERGENT-DIVERGENT FINS PERFORMANCE IN NATURAL CONVECTION MOSTAFA M. AWAD

Paper ID -1216

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Abstract

Convergent-divergent fins are suggested to be used as a heat sink because of their higher surface area and the ability of air natural draught due to their shape. The performance of convergent-divergent fins is compared with those of other types of fins. To carry out this comparison, natural convection heat transfer in air from different type surface is investigated experimentally with consideration of the effects of radiant heat transfer. Plate-fins (Parallelogram fins), cylindrical solid/hollow pin fins and convergent-divergent fins are tested. From now, the plate fins will be termed as straight fins to distinguish from plain plate which is the array base plate. The solid /hollow pin fins and convergent-divergent fins are arranged in staggered and inline arrangements. The experiments have been performed for different values of heat flux. The results show that, the solid pin fins in an inline arrangement increases the rate of heat transfer considerably when compared to the straight and convergent-divergent fins at Ra□2×107 while straight fins increase the rate of heat transfer at Ra□2×107. The solid pin fins enhance more the average temperature compared to the other fin types at heat fluxes higher than 800 W/m2. The comparison shows that among the three cylindrical fins, the solid pin fins have the highest heat transfer performance, hollow pin fins have the lowest, while the convergent-divergent fins locate somewhere in between. The heat transfer performance for heat sinks with an array of inline fins was better than that of a staggered arrangement.

Keywords: Natural convection, Pin fins, Convergent-divergent fins, Surface augmentation, Experimental heat transfer.

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NONLINEAR NUMERICAL ANALYSIS OF CONVECTIVE-RADIATIVE FIN USING MLPG METHOD

Paper ID -1217

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Abstract

A mathematical model describing nonlinear and transient heat transfer through a straight insulated tip fin with temperature-dependent heat transfer coefficient has been addressed by the meshless local Petrov- Galekin (MLPG) method. Moving least square approximants are used to approximate the unknown function of temperature T(x) with Th (x).These approximants are constructed by using a linear basis, a weight function and a set of non-constant coefficients. Essential boundary conditions are imposed by penalty method. An iterative predictor-corrector scheme is used to handle nonlinearity and two-level method for temporal discretization. The accuracy of MLPG method is verified by comparing the results for the simplified versions of the present model with an exact analytical solution. Once the accuracy of MLPG method is established, the method is used to generate results for the complex heat transfer problems formulated here. Temperature variation along the fin length over the discrete time range till the attainment of steady state, under convective and convective-radiative environment has been demonstrated.

Keywords: Convective- radiative Fin, MLPG Method, Penalty method, Nonlinear Fin Analysis, Transient Analysis.

EXPERIMENTAL AND COMPUTATIONAL ANALYSIS OF VARIOUS TYPES OF FINS

Paper ID -1218

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Abstract

Fins are the extended surfaces which are used to dissipate the heat by means of conduction and convection mode of heat transfer. Fins are the cheapest mode of heat transfer compared to heat exchanger. Mostly rectangular fins are designed and used as heat transfer equipment whereas when there is requirement of less heat transfer and material reduction. We can switch over to other type of fins instead of rectangular design. In this project rectangular, circular and pin fins are attached to circular rod separately. Then, these three models were subjected to experimental, analytical and computational analysis. In experimental analysis three models were heated to 100c then they were allowed for natural convection at room temperature. The temperature distributions were measured and viewed using thermocouple. In analytical method, the amount of heat transfer is calculated and plotted graphically. In computational analysis, these three models were analyzed ANSYS 14.0. The temperature distribution will be compared by both experimental and computationally.

Keywords: heat transfer, material reduction, computational analysis, room temperature.

FINITE ELEMENT ANALYSIS OF TRANSIENT THERMAL PERFORMANCE OF A CONVECTIVE-RADIATIVE COOLING FIN: EFFECTS OF FIN TIP CONDITIONS AND MAGNETIC FIELD

Paper ID -1219

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Abstract

The wide range of applications of cooling fins are evident in heat transfer enhancements for various thermal systems and also, for the control and prevention of thermal damages in mechanical and electronic equipment. In this work, nonlinear thermal behaviour of convective-radiative cooling fin with convective tip and subjected to magnetic field is analyzed using Galerkin finite element method. The numerical solutions are verified by the exact analytical solution of the linearized models using Laplace transforms method. Based on the numerical investigations, it is established that increase in Biot number, convective, radiative and magnetic parameters increase the rate of heat transfer from the fin and consequently improve the efficiency of the cooling fin. Also, the study shows that for a relatively short cooling fin operating for prolonged periods of time or steady state, the adiabatic/hypothetical condition (or negligible heat transfer) at the tip can be assumed without any significant loss in accuracy or equality as compared to the convective condition at the tip. However, for a long cooling fin of finite length operating in a transient state, especially for short period of time, the assumption of insulated tip produces significant different results as compared to the results of the convective tip. Therefore, for transient thermal studies of fins, the assumption that no heat transfer takes place at the fin tip should be taken with caution for a long cooling fin of finite length operating within a relatively short period of time. It is hope that the present study will enhance the understanding of transient thermal response of the solid fin under various factors and fin tip conditions.

Keywords: cooling fins, thermal systems, radiative, magnetic parameters.

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EFFECT OF FIN PARAMETERS IN CYLINDRICAL AND DIVERGENT DUCT UNDER NATURAL CONVECTION

Paper ID -1220

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Abstract

In this paper we propose a numerical study of the natural convective heat transfer flow in a three dimensional cylindrical and divergent annular duct. The inner cylinder subjected to a volumetric heat generation is fitted with longitudinal fins. The governing equations of mass, momentum and energy equation for both the fluid and the solid are solved by the finite volume method, using the commercially available CFD software Fluent. The effect of the inclination angle ϕ of the divergent and the fin parameters on the profiles and the contour fields of temperature and velocity as well as the average Nusselt number ratio were investigated for ϕ=0°,15°,23° and 45°and a number of fins, N=1,2,3 and 4. The Simulations were carried out in the range of Rayleigh numbers (Ra = 100 to Ra=6.3x104). The results reveal that the increasing of the inclination angle of the divergent and the number of fins enhances the heat transfer.

Keywords: Fin; Annular space; Divergent duct; Heat sink.

NUMERICAL ANALYSIS TO THE NON-LINEAR FIN PROBLEM

Paper ID -1221

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Abstract

In this paper a numerical analysis is carried out to obtain the temperature distribution within a single fin. It is assumed that the heat transfer coefficient depends on the temperature. The complete highly non-linear problem is solved numerically and the variations of both, dimensionless surface temperature and dimensionless surface temperature gradient as well as heat transfer characteristics with the governing non-dimensional parameters of the problem are graphed and tabulated.

Key words: Fins,, Numerical solution, Heat transfer, etc.

NUMERICAL ANALYSIS TO THE NON-LINEAR FIN PROBLEM

Paper ID -1222

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Abstract

In this paper a numerical analysis is carried out to obtain the temperature distribution within a single fin. It is assumed that the heat transfer coefficient depends on the temperature. The complete highly non-linear problem is solved numerically and the variations of both, dimensionless surface temperature and dimensionless surface temperature gradient as well as heat transfer characteristics with the governing non-dimensional parameters of the problem are graphed and tabulated.

Key words: Fins, Ordinary differential equations (ODEs), Numerical solution, Heat transfer.

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EffECT OF SURFACE RADIATION ON NATURAL CONVECTIVE flOWS AND ONSET OF flOW REVERSAL IN ASYMMETRICALLY HEATED VERTICAL CHANNELS

Paper ID -1223

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Abstract

Numerical solutions on the influence of surface radiation on the laminar air flow induced by natural convection in vertical, asymmetrically-heated channels are discussed. Variable property effects are accounted for in a full-elliptic mathematical formulation. The density variation is determined from the state equation for ideal gas. The experimental design and data reported in Webb and Hill [1] are taken as the base cases for carrying out the computations. The occurrence of flow reversals is first considered and revisited for pure natural convection, and the Nusselt number correlations derived from the numerical results are favorably compared with those reported in [1]. It is shown that the general effect of surface radiation is to delete the onset of pocket like recirculations at the top part of the channel, to reduce the heated wall temperatures, and to increase the facing wall temperatures. Comparisons with usual methods used for decoupling the surface radiation effects are discussed. In the range of parameters investigated, increases in differences between inlet and maximum wall temperatures up to 200K are shown to have small influences on the flow field and negligible effects on heat transfer performances.

Keywords: Natural convection, surface radiation, vertical channels, flow reversal, variable property effects, numerical simulations.

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HEAT TRANSFER IN A POROUS CAVITY DIVIDED BY A SOLID WALL

Paper ID -1224

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Abstract

Heat transfer is investigated in a porous medium divided into two sections by a solid block at the center of the cavity. The medium and solid. The boundary conditions are maintained in such a way that the left-hand surface of the cavity is at hot isothermal temperature and the right-hand surface at cold isothermal temperature Tc. The flow of fluid is governed by Darcy's law. The governing equations are solved using the finite element method

Keywords: Porous Cavity, Conjugate.

THERMAL ANALYSIS OF POROUS PIN FIN USED FOR ELECTRONIC COOLING

Paper ID -1225

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Abstract

The present work investigates the temperature distribution, performance parameters and heat transfer rate through a porous pin fin in natural convection condition. This study is based on finite-length fin with insulated tip. To formulate the heat transfer equation for the porous fin, the energy balance and Darcy's model are used. An analytical technique called A domain decomposition method (ADM) is proposed for the solution methodology. To validate the analytical results, a numeric scheme, namely, finite difference method is adopted. The results indicate that the numerical data and analytical approach are in agreement with each other. The effects of various geometric and thermo physical parameters on the dimensionless temperature distribution and fin performance are studied that may help in optimum design analysis of a porous pin fin. Finally, the increase in heat transfer is noticed by selecting porous medium condition in the fin.

Keywords: porous surface; convection; performance; electronic cooling; pin fin.

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EXPERIMENTAL, NUMERICAL AND ANALYTIC STUDY OF UNCONSTRAINED MELTING IN A VERTICAL CYLINDER WITFOCUS ON MUSHY REGION EFFECTS

Paper ID -1226

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Abstract

The enthalpy-porosity method is widely used in solving solid-liquid phase change problems that involve convection in the melt; however the influence of the required mushy zone parameter on the melting process has been largely overlooked. In this paper, further investigation of the mushy zone parameter is presented. The enthalpy-porosity method is the default model in Fluent for melting simulations. A comprehensive discussion of previously reported mushy zone parameter values is presented with a comparison to numerical and experimental results. In this paper, based on experimental validations of melting times, it is found that mushy zone parameters can be optimized based on relevant driving temperature differences. And despite the fact that the model cannot capture bulk solid sinking behaviors, numerical solid sinking behaviors by Fluent are still widely reported in the literature. Explanations and supporting numerical analysis are given for this seeming contradiction. Finally, an analytic solution for unconstrained sinking is developed. With the introduction of a tuning parameter to modify the viscosity of the mushy region in the bottom liquid layer, good agreement between the analytical model and experimental results is achieved. A linear correlation for the tuning parameter based on driving temperature differences is given.

Key words: Methods, solid, liquid, etc

MIXED CONVECTIVE HEAT TRANSFER FROM A PERMEABLE SQUARE CYLINDER: A LATTICE BOLTZMANN ANALYSIS

Paper ID -1227

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Abstract

The flow and heat transfer characteristics at the Prandt l number value of 0.71 (air) is compared for three different values of Richardson number (Ri) i.e. 0, 0.5 and 1. The numerical experiments in this study are carried out by using Lattice Boltzmann technique with two distribution functions. The BGK collision operator with Darcy-Forchheimer and Bossiness force terms are added to the LB collision equation. Mach number annealing process is also carried out to accelerate the simulations. Flow and heat transfer characteristics are found to be a function of non-dimensional permeability (Da), buoyancy condition and Reynolds number. It is observed that a monotonous reduction occurs in the wake length and drag coefficient values at higher permeability levels. Whereas, aiding buoyancy depicts a pronounced reduction in wake length and an increment in drag coefficient values. The heat transfer enhancement ratio for all surfaces of the cylinder and mean Nusselt number were calculated to compare the thermal behavior at various Ri and Da values. A significant augmentation in heat dissipation is reported for increasing values of Ri and/or Da. The percentage increment in mean Nusselt number at Re = 40, Da ¼ 10 ^{2} is found to be 18% and 34% for Ri = 0.5 and 1, respectively with reference to the forced convection case. Also, heat transfer is maximum at Da ¼ 10 ^{2} and Ri = 1 for the flow regime considered in this study. Correlations for mean Nusselt number, valid for the range of parameters considered in the pre-sent study, are also provided. The key results obtained from this study can be helpful for further research in different realms of engineering sciences, especially thermal engineering, aided by porous media modeling approach.

Keywords: heat transfer, parameters, distribution, thermal behavior.

THERMAL ANALYSIS OF PCM CONTAINING HEAT EXCHANGER ENHANCED WITH NORMAL ANNULAR FINES

Paper ID -1228

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Abstract

In this study, the effect of fins' height and Stefan number on performance of a shell and tube heat exchanger which contains a phase change material is investigated numerically and experimentally. Melting time, solidification time, liquid mass fraction, melting and solidification front and temperature distribution in different directions (longitudinal, radial and angular) are among criteria for the heat exchangers' comparison. In order to generalize the comparison, melting and solidification fronts are studied for different sections of the shell, fin section and mid-section, for different fins' height during charging and discharging processes. The results show that, these two parameters play important roles in the heat exchanger performance. Increasing Stefan number, the melting time reduces; which exhibits a descending trend in rate when the fins are heightened. In addition, investigating both processes, it can be figured out that increasing fins' height influences the solidification time more significantly than melting.

Keywords: effect of fins, Melting, temperature, parameters.

HEAT TRANSFER ANALYSIS ON A TRIANGULAR FIN

Paper ID -1229

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Abstract

Heat transfer by convection between a surface and the fluid surrounding can be increased by attaching to the surface called fins. The heat conducting through3solids, walls, or boundaries has to be continuously dissipated to the surroundings or environment to maintain the system in a steady state condition. In many engineering applications large quantities of heat needed to be dissipated from small areas. The fins increase the effective area of a surface thereby increasing the heat transfer by convection. Rectangular fin and triangular fins are straight fins. Triangular fins are attractive, since for an equal heat transfer it requires much less volume rectangular fin. Hence the fins have practical importance because it gives maximum heat flow per unit mass with ease of manufacture. In an air-cooled engine, rectangular and triangular fins are provided on the periphery of engine cylinder. Heat transfer analysis is carried out by placing rectangular and then triangular fins. Analysis is carried out by varying temperatures on the surface of the cylinder from 200 ºC to600ºC and varying length from 6 cm to 14 cm. Input parameters such as density, heat transfer coefficient, thermal conductivity and thickness of fin are taken and output parameters such as rate of heat flow, heat flow per unit mass, efficiency and effectiveness are determined. Comparisons are presented with rectangular fins.

Keywords: Rectangular fin, Triangular fin, Heat flow rate, coefficient, Efficiency and Effective.

A STRATEGY GOVERNOR OF HYBRID SOLAR-WIND ENERGY GENERATION SYSTEM

Paper ID -1230

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Abstract

Synchronization in the energy generated by renewable energy sources is one of the significant issue associated with the converter used in the system module. The presented paper concentrates on the design aspect of a PV and wind power input to a DC-DC converter which can be practically useful in hybrid renewable energy power systems. In this regard, the proposed converter can be utilized to obtain a smooth regulated output voltage from the given input renewable energy power sources. The proposed converter can be efficiently work under critical conditions having very few ripple in current waveform of input or output. A major advantage with this type of converter is the simple circuit with respect to the conventional converters in some critical situations. At the end, the result based on the simulation exercise and various experiments, performance of the converter in different situations is presented so that the efficiency of the designed converter arrangement is accepted.

Key words: distributed PV/wind power system, double-input DC-DC converter, etc.

AN EVALUATION ON VERTICAL AXIS WIND SOLAR HYBRID POWER SYSTEM

Paper ID -1231

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Abstract

Energy is essential for the economic growth and social development of any country. The quality of life is closely related to energy consumption, which has continuously increased over the last few decades in developing countries. The design of a hybrid electric power generation system utilizing both wind and solar energy for remote area is today's need. Wind power is the conversion of wind energy into a useful form of energy. Wind power, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation and uses little land. The effects on the environment are generally less problematic than those from other power source. The solar energy is available throughout year and it is free and clean sources of energy. The solar PV cells absorb the radiation of sun and converting it into the electrical power. The wind mill is capable to extracted energy in day and night time while the solar PV cell is capable to extracted the power only during day hours. The combination of this hybrid system will be beneficial in future aspects.

Keyword: Hybrid Renewable Energy, Solar Energy, Vertical Axis Wind Turbine.

HYBRID POWER GENERATION

Paper ID -1232

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Abstract

Energy today, is the need of 21st century. The renewable energy resources therefore are used in tremendous amount as they are easily available and cost free. But these energies in standalone forms have disadvantages such as unpredictability, availability in all time etc. which can be overcome by hybrid energy systems. They are basically consists of combinations of number of renewable energy resources. They provide efficient response against voltage and frequency fluctuations, harmonic measures and power issues in standalone systems. Hybrid power system provide reduction in complexity, maintain lowest unit cost, energy fluctuations due to DPSP (deficiency of power supply probability), with the help of proper design, advanced fast response, good optimization and control feasibility. There are various research has been done and continuously achieve new technologies and idea in this system. The paper report will discuss the different system to organize the generation of renewable sources and combining them with present energy plant into hybrid energy conversion project. This paper also gives the idea about the various properties and various conditions to construct the wind farms with their Global wind power cumulative capacity and their location.

Keywords: grid, hybrid generation energy, solar power, wind power etc.

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PERFORMANCE ANALYSIS OF HYBRID RENEWABLE POWER SYSTEM WITH SIMULATION

Paper ID -1233

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Abstract

This project depicts the performance analysis of a renewable energy based hybrid power system for improving power quality because optimal utilization of primary energy sources will increase the level of supply reliability. According to increase demand of energy in world the science is developing the different energy generation systems, which can supply energy to the world under economic and environmental friendly conditions .So that, in society to ensure the quality of life the energy is an essential requirement. In this project we are going to design and simulate the power system containing more than two conventional energy forms i.e. solar, wind, diesel, fuel energy are combined together for the economic operation of energy generation. By using various graphs, we can analyse that the power output of new hybrid model is higher and more efficient than the power output of the wind/PV hybrid model.

Keywords- Hybrid Power System, Wind Power System, Fuel Cell.

SOLAR PV-WIND HYBRID POWER GENERATION SYSTEM

Paper ID -1234

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Abstract

Renewable energy sources i.e. energy generated from solar, wind, biomass, hydro power, geothermal and ocean resources are considered as a technological option for generating clean energy. But the energy generated from solar and wind is much less than the production by fossil fuels, however, electricity generation by utilizing PV cells and wind turbine increased rapidly in recent years. This paper presents the Solar-Wind hybrid Power system that harnesses the renewable energies in Sun and Wind to generate electricity. System control relies mainly on micro controller. It ensures the optimum utilization of resources and hence improve the efficiency as compared with their individual mode of generation. Also it increases the reliability and reduces the dependence on one single source. This hybrid solar-wind power generating system is suitable for industries and also domestic areas.

Keywords: Solar energy, Wind energy, Renewable energy, PV cell, Hybrid power system.

HYBRID WIND SOLAR SYSTEM FOR EFFICIENT POWER GENERATION

Paper ID -1235

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Abstract

The most popular renewable energy technology is Hybrid Power System consisting of wind and solar energy sources because the system is reliable and complimentary in nature. Wind / PV Hybrid system is commonly used in Distributed generation (DG). This paper proposes a new solution for improved voltage stability with quality power output. In this system voltage out from wind energy conversion system(WECS) and Photo voltaic panels are given to separate DC DC converters, independently controlled and connected to a common DC bus and from there it is inverted. In the proposed controller the voltage stability is obtained by applying adaptive Honey Bee Optimization (HBO) algorithm along with a PI controller. The implementation of the proposed method is done by using Simulink platform. The performance of the suggested coordinate control system is analyzed by comparing the computer simulation results with and without using controllers and it shows that the proposed system is more efficient.

Keywords- Hybrid Power System, Distributed Generation (DG), Honey Bee algorithm, PI, Wind and solar energy.

POWER QUALITY ANALYSIS OF HYBRID RENEWABLE ENERGY SYSTEM

Paper ID -1236

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Abstract

An hybrid renewable energy sources consisting of solar photovoltaic, wind energy system, and a microhydro system is proposed in this paper. This system is suitable for supplying electricity to isolated locations or remote villages far from the grid supply. The solar photovoltaic system is modeled with two power converters, the first one being a DC-DC converter along with an maximum power point tracking to achieve a regulated DC output voltage and the second one being a DC-AC converter to obtain AC output. The wind energy system is modeled with a wind-turbine prime mover with varying wind speed and fixed pitch angle to drive anself excited induction generator (SEIG). Owing to inherent drooping characteristics of the SEIG, a closed loop turbine input system is incorporated. The microhydro system is modeled with a constant input power to drive an SEIG. The three different sources are integrated through an AC bus and the proposed hybrid system is supplied to R, R-L, and induction motor loads. A static compensator is proposed to improve the load voltage and current profiles; it also mitigates the harmonic contents of the voltage and current. The static synchronous compensator is realized by means of a three-phase IGBT-based current- controlled voltage source inverter with a self-supporting DC bus. The complete system is modeled and simulated using Matlab/Simulink. The simulation results obtained illustrate the feasibility of the proposed system and are found to be satisfactory.

Keywords- Hybrid Power System, Distributed Generation (DG), Honey Bee algorithm, PI, Wind and solar energy.

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STANDALONE WIND-SOLAR HYBRID POWER GENERATION SYSTEMS FOR DOMESTIC APPLICATIONS

Paper ID -1237

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Abstract

Nowadays the power generation using renewable energy resources has gained more attraction and it plays a vital role in energy generation of every nation at present scenario. This work is a development of an indigenous technology hybrid Solar - Wind Power system that harnesses the renewable energies in Sun and Wind to generate electricity. This paper deals with the hybrid model of a solar - wind, which is using battery as its storage system. It comprises photovoltaic array, wind turbine, asynchronous (induction) generator, controller, lead-acid storage batteries, and an inverter unit to convert DC power to AC power. The perfect solution is to combine these two forms of energy sources to create a constant energy flow. Main objective of this paper is to implement stand-alone solar-wind hybrid power system and to maximize use of renewable energy generation system while minimizing the total system cost towards powering up the rural areas.

Keywords: Renewable energy, rural electrification, solar power system, standalone system, wind power system.

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WIND AND SOLAR MOBILE CHARGER

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Abstract

Charging of mobile phone is a big problem when travelling a long distance journey or where power supply is not available. This paper proposes a universal mobile charger which can work on wind as well as solar energy. This charger is highly efficient and very economical as it uses nonconventional energy sources of power. It comprises photovoltaic array, wind turbine, asynchronous (induction) generator, controller, lead-acid storage batteries, and an inverter unit to convert DC power to AC power. But the energy generated from solar and wind is much less than the production by fossil fuels, however, electricity generation by utilizing PV cells and wind turbine increased rapidly in recent years. This paper presents the Solar-Wind hybrid Power system that harnesses the renewable energies in Sun and Wind to generate electricity. System control relies mainly on micro controller. It ensures the optimum utilization of resources and hence improve the efficiency as compared with their individual mode of generation. Also it increases the reliability and reduces the dependence on one single source. This hybrid solar-wind power generating system is suitable for industries and also domestic areas.

Keywords: Universal mobile charger, economical mobile charger, mobile charger, mobile phones.

DESIGN AND ANALYSIS OF CAM SHAFT IN AUTOMOBILES USING FEM

Paper ID -1239

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Abstract

Camshaft is used in the engine for transfers' motion to inlet & exhaust valve. If transfer of motion is not proper then the strokes of the engine will not do in proper way. It also effects on performance of engine. To make work of camshaft in precise way, it is require in order designing a good mechanism linkage of camshaft. In four strokes engine one of the most important component is camshaft, such a important part and that over the years subject of extensive research. In this study, Design of Camshaft is done as per power stroke and suction stroke and its model is done in CATIA and Static and Model Analysis is carried in Ansys Work bench. By varying Materials like Cast Iron & Nickel chromium molybdenum steel and find out which is best material Suits for design.

Keywords: Cam Shaft, Design, Ansys etc.

DESIGN & ANALYSIS OF CAMSHAFT

Paper ID -1240

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Abstract

Camshaft is one of the key parts or components in the engines of automobile and other vehicles. The goal of the project is to design cam shaft analytically, its modeling and analysis under FEM. In FEM, behaviour of cam shaft is obtained by analyzing the collective behaviour of the elements to make the cam shaft robust at all possible load cases. This analysis is an important step for fixing an optimum size of a camshaft and knowing the dynamic behaviours of the camshaft. Initially the model is created by the basic needs of an engine with the available background data such as power to be transmitted, forces acting over the camshaft by means of valve train while running at maximum speed

Keywords: FEM, Camshaft, Automobile, Design etc

DESIGN AND ANALYSIS OF PRESSURE VESSEL ASSEMBLY FOR TESTING OF MISSILE CANISTER SECTIONS UNDER DIFFERENTIAL PRESSURES.

Paper ID -1241

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Abstract

In this work, a pressure vessel is designed to simulate differential pressure conditions on components of missiles and canisters. This design mainly concerned with two pressure chamber mounted concentrically, out of which outer chamber experiences internal pressure and the other experiences external pressure. The operating pressure conditions are 45×10^5 Pa external and 10×10^5 Pa internal. The chamber is designed for 100×10^5 Pa external and 50×10^5 Pa internal pressure with consideration of safety issues involved in the operation. Primarily, the design is based on IS 2825 unfired pressure vessel code and materials are chosen as per the standard ASTM A516 Gr. 70 pressure vessel steels. The other mounting fixtures, supporting channels and beams are as per the standard and all the other materials are of IS 2062 structural steel. The design is iterated many times to satisfy the desired requirements. The equivalent stresses and strain energy stored in the critical location of both pressure vessels are calculated. The fatigue life of the entire system are also estimated based on the stress and strain based designs with consideration of the fully reversed and zero based loading conditions.

Keywords: Pressure Vessel, Assembly, Design etc.

DESIGN AND COMPARATIVE ANALYSIS OF CONNECTING ROD USING FINITE ELEMENT ANALYSIS

Paper ID -1242

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Abstract

Connecting rod is an intermediate link which connects the piston and the crankshaft in an internal combustion engine, the main work of connecting rod is to convert the linear motion of the piston (thrust force) into rotary motion of the crankshaft. In this study, an attempt has been made to analyze and understand the connecting rod structure using Finite Element Analysis method. An invariable model of connecting rod is modelled using NX 6.0 and on this model static structural analysis is carried out by using ANSYS14.5 simulation tool. Further analysis was carried out by considering different materials to understand the variations of equivalent von-mises stress, strain, total deformation and factor of safety.

Keywords: connecting rod, design of connecting rod, etc.

DESIGN ANALYSIS AND OPTIMIZATION OF PISTON USING CATIA AND ANSYS

Paper ID -1243

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Abstract

Design, Analysis and optimization of piston which is stronger, lighter with minimum cost and with less time. Since the design and weight of the piston influence the engine performance. Study Design: Analysis of the stress distribution in the various parts of the piston to know the stresses due to the gas pressure and thermal variations using with Ansys. Methodology: The Piston of an engine is designed, analyzed and optimized by using graphics software. The CATIA V5R16, CAD software for performing the design phase and ANSYS 11.0 for analysis and optimization phases are used. Brief Results: The volume of the piston is reduced by 24%, the thickness of barrel is reduced by 31%, width of other ring lands of the piston is reduced by 25%, Vonmisses stress is increased by 16% and Deflection is increased after optimization. But all the parameters are well with in design consideration.

Keywords: Piston, Piston Design, Analysis of Piston etc.

DESIGN OF FIXTURE FOR MANUFACTURING OF PITMAN ARM

Paper ID -1244

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Abstract

Pitman Arm is very important part of Steering system. It should be accurately machined with the acceptable tolerance. At present scenario productivity and economics of machining work pieces in a large quantity is greatly affected with the use of work holding devices like fixtures. This device reduce the production cost and ensure interchangeability of machined work pieces This project is about the design and fabrication of fixture which is used in the manufacturing of Pitman Arm of steering system. The design of fixture is done by using software CATIAV5R21.The purpose of the fixture is to provide strength, holding, accuracy and interchangeability in the manufacturing of product. The main purpose of a fixture is to locate and in the cases hold a work piece during an operation. Our research methodology aims at optimal design and fabrication of fixture.

Keywords: fixture, CATIA, Pitman Arm, Clamps, Locators, Supports.

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FINITE ELEMEMNT ANALYSIS OF PITMAN ARM

Paper ID -1245

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Abstract

Steering system control the front wheels movement in response to driver inputs in order to provide overall directional control of the vehicle. Thus, Steering system plays key role in vehicle handling characteristics. Pitman arm plays a vital role in steering system as it transmits the steering movement to the wheel. The Pitman arm is a linkage attached to the sector shaft of the steering box and track rod, which converts the angular motion of the sector shaft into the linear motion needed to steer the wheels. The Pitman arm is supported by the sector shaft and supports the drag link or center link with a ball joint. It transmits the motion it receives from the steering box into the drag (or centre) link, causing it to move left or right to turn the wheels in the appropriate direction. Performance study is carried out followed by static structural analysis of the pitman arm under steering load done by numerical method and there by check the stress values comparison to prove the boundary conditions, and verified the FEA with hand calculation and proved the feasibility for topology optimization of the pitman arm by comparison of FEA stress value with yield strength of the material.

Key Words: Linkage; Pitman arm; Steering System; Structural analysis etc.

VIBRATIONAL ANALYSIS, LIFE PREDICTION AND OPTIMIZATION OF PITMAN ARM USING FEM

Paper ID -1246

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Abstract

Steering system is used to steer the front wheels corresponding to the inputs provided by the driver in order to achieve overall directional control of the vehicle. Thus, in vehicle handling characteristics steering system plays very important role. Pitman arm transmits the steering movement to the wheel. The Pitman arm is a linkage attached to the steering box, sector shaft, which converts the angular motion of the sector shaft into the linear motion needed to steer the wheels. The Pitman arm is supported by the sector shaft on one side and on the other side to the drag link or center link with a ball joint. It transmits the motion it receives from the steering box into the drag (or center) link, causing it to move left or right to turn the wheels in the appropriate direction. A performance study will be carried to analyze fatigue life and vibrational behavior of pitman arm using FEA tools. The structural optimization will be done on the pit man arm using Optistruct, changing the structure of pitman arm by adding ribs or slots to the structure which will increase its strength. The meshing and boundary conditions will be applied using Hypermesh 12.0 and analysis will be carried out using ANSYS. The testing of Pitman arm is carried out for fatigue analysis and the result will be validated with the simulation results.

Keywords: Ansys, Catia, Fatigue analysis, Modal analysis, Pitman arm.

DESIGN AND ANALYSIS OF I.C. ENGINE PISTON AND PISTON-RING ON COMPOSITE MATERIAL USING CREO AND ANSYS SOFTWARE

Paper ID -1247

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Abstract

In this Paper the stress distribution is evaluated on the four stroke engine piston by using FEA. The finite element analysis is performed by using FEA software. The couple field analysis is carried out to calculate stresses and deflection due to thermal loads and gas pressure. These stresses will be calculated for two different materials. The results are compared for all the two materials and the best one is proposed. The materials used in this project are aluminium alloy, and SiC reinforced ZrB2 composite material. In this project the natural frequency and Vibration mode of the piston and rings were also obtained and its vibration characteristics are analyzed. With using computer aided design (CAD), CREO software the structural model of a piston will be developed. Furthermore, the finite element analysis performed with using software ANSYS. SiC reinforced ZrB2: Silicon carbide reinforced Zirconium diboride is a ceramic matrix composite (CMC) material is also used**.**

Keywords: four stroke engine piston, FEA software, gas pressure, analysis.

DESIGN AND ANALYSIS OF I.C. ENGINE PISTON AND PISTON-RING ON COMPOSITE MATERIAL USING CREO AND ANSYS SOFTWARE

Paper ID -1248

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Abstract

In this Paper the stress distribution is evaluated on the four stroke engine piston by using FEA. The finite element analysis is performed by using FEA software. The couple field analysis is carried out to calculate stresses and deflection due to thermal loads and gas pressure. These stresses will be calculated for two different materials. The results are compared for all the two materials and the best one is proposed. The materials used in this project are aluminum alloy, and SiC reinforced ZrB2 composite material. In this project the natural frequency and Vibration mode of the piston and rings were also obtained and its vibration characteristics are analyzed. With using computer aided design (CAD), CREO software the structural model of a piston will be developed. Furthermore, the finite element analysis performed with using software ANSYS. SiC reinforced ZrB2: Silicon carbide reinforced Zirconium diboride is a ceramic matrix composite (CMC) material is also used. Frequency, Vibration mode, Computer aided design (CAD), Ceramic m atrix composite (CMC) material, Ansys

Keywords: Stress distribution, four stroke engine piston, analysis of stresses etc.

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ANALYSIS AND OPTIMAL DESIGN OF A PRODUCER CARBURETOR

Paper ID -1249

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Abstract

Design of a carburetor for producer gas application with special reference for reduced loss of pressure is taken up to generate the optimal fuel–air mixture to meet different load conditions of the engine as well as for varying operating conditions of producer gas reactor. The differential pressure controller based carburetor includes an optimally designed mixing chamber with tuned orifices to get stable stoichiometric mixture working at near–to–ambient conditions. The hardware built has been tested for an engine simulation of 25 kWe capacity. The carburetor design has been studied comprehensively with detailed analysis for its mixing and operations with CFD modeling. The CFD simulations and the experiments carried out are used with their results to complement each other in optimising the design and to validate the analysis at the all stages. The results show a consistency in the experimental data and the CFD modeling that has provided a better insight of the flow details and has allowed for carrying out the optimization to a great extent, and to get a good mixing. Figures included give out a highlight of the relevant data of the analysis.

Keywords: computational fluid dynamics, producer gas, carburetor, air/fuel ratio, and biomass gasification.

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DESIGN AND ANALYSIS OF VERTICAL PRESSURE VESSEL USING ASME CODE AND FEA TECHNIQUE

Paper ID -1250

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Abstract

In this project we are designing a pressure vessel using ASME section VIII and Division 2, designing a closed container to find the required thickness of the shell, head, nozzle and leg support. Uniform thickness assigned to the entire vessel, Modeling of the pressure vessel is carried out using Pro-e 2.0; meshing is carried out using Hyper mesh 6.1. Here we used 2D Quad element for the meshing, Analysis is carried out using ANSYS Software 11 for two different cases, working pressure and Maximum operating pressure, fatigue analysis is carried out, and the result is 10^6. Finally, theoretical validation is carried out for the entire model, and the results are within the limit.

Key Words: Pressure Vessel, Design of Pressure vessel, Analysis etc.

DESIGN AND ANALYSIS OF PROPELLER SHAFT

Paper ID -1251

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Abstract

Substituting composite structures for conventional metallic structures has many advantages because of higher specific stiffness and strength of composite materials. This work deals with the replacement of conventional two-piece steel drive shafts with a single-piece e-glass/ epoxy, high strength carbon/epoxy and high modulus carbon/epoxy composite drive shaft for an automotive application. The design parameters were optimized with the objective of minimizing the weight of composite drive shaft. The design optimization also showed significant potential improvement in the performance of drive shaft. The main concept of our project is to reduce the weight of automotive drive shaft with the utilization of composite material. Composite materials have been used in automotive components because of their properties such as low weight, high specific stiffness, corrosion free, ability to produce complex shapes, high specific strength and high impact energy absorption etc .As the automotive drive shaft is a very important component of vehicle. The modeling of the drive shaft assembly was done using SOLIDWORKS software. A shaft has to be designed to meet the stringent design requirements for automotives. In automobiles the drive shaft is used for the transmission of motion from the engine to the differential. An automotive propeller shaft, or drive shaft, transmits power from the engine to differential gears of rear wheel-driving vehicle. In present work an attempt has been to estimate deflection, stresses under subjected loads & natural frequencies using Ansys software.

Keywords: propeller shaft, Design, Ansys etc.

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A REVIEW ON THE DESIGN AND ANALYSIS OF COMPOSITE DRIVE SHAFT

Paper ID -1252

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Abstract

In current scenario, the most important component in any power transmission application is the drive shaft. Drive shaft is a mechanical component used to connect the drive train components which are not connected due to the distance between them. Drive shafts are used for transmitting torque and power which subjects the drive shafts to high torsional and shear stress. Composite materials are having high specific stiffness, strength, specific modulus, corrosion resistance, wear resistance, fatigue life and light weight properties. Automobile industries are exploring composite materials usage by replacing the conventional one because of light weight properties reduces the vehicle weight without compromising the quality and reliability. The literature raises the issue on torsion, buckling, natural bending frequency and the weight of the drive shaft. The objective of the paper is to review: (a) the work carried out on the composite drive shafts which are used in the automotive applications; (b) fabrication techniques and materials used in the fabrication of composite shafts (c) finite element analysis on composite shaft and steel shaft.

Keywords: Power transmission, Composite drive shaft, Filament winding Finite element analysis.

DESIGN AND ANALYSIS OF SPUR GEAR

Paper ID -1253

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Abstract

Gear is the one of the important machine element in the mechanical power transmission system. Spur gear is most basic gear used to transmit power between parallel shafts. Spur gear generally fails by bending failure or contact failure. This paper analyses the bending stresses characteristics of an involute spur gear tooth under static loading conditions. The tooth profile is generated using Catia and the analysis is carried out by Finite element method using ANSYS software. The stresses at the tooth root are evaluated analytically using existing theoretical models. The theoretical and FEM results are compared. The results obtained theoretically are in good agreement with those obtained from software. Also an attempt is made to introduce Stress and displacement characteristics of tooth under dynamic loading conditions.

Key words: Ansys, Bending stress & Deflection by FEA, Dynamic analysis, Static analysis, Spur gear.

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DESIGN AND ANALYSIS OF GEAR-BOX USING SPUR GEAR AND ELIMINATING THE DIFFERENTIAL UNIT

Paper ID -1254

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Abstract

A gear is a rotating machine part having a cut tooth, which meshes with another toothed part in order to transmit torque. Gears are mainly typed like spur gears, helical gears, double helical gears, bevel gears, crown gears, hypoid gears, worm gears, rack and pinion, epi cyclic gears etc. This paper presents the stress analysis of mating teeth of spur gear to find maximum contact stress in the gear teeth. The results obtained from Finite Element Analysis (FEA). For the analysis, 15NiCr1Mo15 and SCM415 are used as the materials of the spur gear. The spur gears are designed in the Creo Parametric and the .iges file is exported to ANSYS. As Finite Element Method (FEM) is the easy and accurate technique for stress analysis, FEA is done in finite element software ANSYS 14.0. Also, deformation for 15NiCr1Mo15 and SCM415 is obtained as the efficiency of the gear depends on its deformation. The results show that the maximum contact stresses and induced bending stresses obtained from Finite Element Analysis are very less and well under the safe limit. The deformation patterns of 15NiCr1Mo15 and SCM415 gears depict that the difference in their deformation is negligible.

Key words: Bending Stress, Contact Stress, ANSYS, Finite Element Analysis, Spur Gear.

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A REVIEW ON DESIGN, ANALYSIS AND SHAPE OPTIMIZATION OF SPUR GEARS OF THE GEAR-BOX REDUCTION OF THE WORKING WHEEL OF THE EXCAVATOR SCHRS 1300 24/5.0 USING CAD/CAE SOFTWARE

Paper ID -1255

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Abstract

Gears are one of the most important components in mechanical power transmission systems. The bending and surface strength of the gear tooth are considered to be one of the main contributors for the failure of the gear in gear set. The three dimensional solid model can be generated in CAD software, in this case we have created model in Autodesk Inventor 2015. This model of the spur gears are imported in ANSYS software and then contact stress and bending stress can be calculated in ANSYS. The paper presents the results of calculation of pair spur-gears that it used in the gear-box reduction of the working wheel of the Excavator located in open-cast coal mines in "BardhiiMadh - FushëKosovë" , and after that will be optimized the shape of the spur gear with usage of ANSYS software. To be more specific, how much material can be removed from the gear body.

Keywords: CAD/CAE software, FEM, Stress-Strain Analysis, Spur-Gear, Shape Optimization CAD-Computer Aided Design, CAE-Computer Aided Engineering, FEM-Finite Element Method.

DESIGN AND STATIC STRUCTURAL ANALYSIS OF BEVEL GEAR

Paper ID -1256

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Abstract

Gears are fundamental asset for power transmission in automation industry. Bevel gears are used to transmit the power between two intersecting shafts at almost any angle or speed. In this present work an attempt is made to design the bevel gear for compact MIG welding robot and static structural analysis using ANSYS. A pair of bevel gear while transmitting the power generally subjected to two types of Failure. The bending failure due to bending stresses and pitting failure due to contact stresses. Various forces acting on the gear has been calculated. The bending stress equation by using Lewis bending stress equation and bending stress value determined for straight teeth bevel gear and carried out comparison between analytical value and value obtain by the ANSYS Workbench 15.0.

Keywords: Bending Stress, Straight Bevel Gear, ANSYS, Moment.

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MODELING, DESIGN & ANALYSIS OF STRAIGHT BEVEL GEAR AND PINION BY FEM, SOLID WORKS & ANSYS BENCHWORK 14.0

Paper ID -1257

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Abstract

In this research developing an analytical approach, modeling and analysis to evaluate stress distribution, natural frequencies and predict the life of the gear and pinion under the platform of ANSYS 14.0 with the help of solid works modeling. The function of gears to provide proper gearing for transmission. These gears must typically operate at extremely high rotational speeds and carry high power level Bevel gears are used to transmit the power between two intersecting shafts at almost any angle or speed. Various forces acting on the gear has been calculated. The purpose of this work is to analyze and validate the stress distribution in bevel gears using contemporary FEM program and ANSYS 14.0 the design of the gear housing should incorporate a methodology for dealing with factors causing vibrations and to promote scientific means to minimize the effect of frequencies. This vibration analysis is done by using ANSYS 14.0 software as a computational technique and validation Keywords natural frequencies, stress distribution, ANSYS 14.0

Keywords: Modeling, ANSY, BEVEL, etc.

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DESIGN & ANALYSIS OF BEVEL GEAR FOR DYNAMIC AND WEAR LOADING USING GEOMETRICAL PROGRAMMING

Paper ID -1258

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Abstract

This paper is a proficient approach for solving the problem of design and analysis for Dynamic and Wear load of Bevel gear, principally to aid the industries and designers. Surrounded by the diverse optimization techniques the approach breaks new era by utilizing Geometrical Programming Technique, because this is one of the proficient and enhanced techniques to resolve non-linear equations of the complex and sensible design problems. The research deals with the design of bevel gear train for lowest dynamic load and wear load. The load capacity of bevel gears is based on either bending or wears capacity whichever is lesser. The tangential force for passing on utmost power has been found by lowering the dynamic load or wear load as per the necessity. The arbitrary nature of design variables has been given appropriate deliberation and probability of fulfilling constraints equation has also been taken care of. A clarifying instance of bevel gear train design has been considered. The bevel gears are designed and optimized using Geometric Programming technique, considering the nature of parameters, proper values are given to convince constraints. The problem taken is solved for optimization by lowering dynamic load on the gear as well as to lower the wear load on the gear. The manually computed results are compare for the diverse values achieved from the software implemented.

Keywords: Gear, Bevel Gear, Geometrical programming.

DESIGN AND ANALYSIS OF A CRANK SHAFT

Paper ID -1259

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Abstract

Crankshaft is one of the critical components for the effective and precise working of the internal combustion engine. In this paper a static simulation is conducted on a crankshaft from a single cylinder 4- stroke diesel engine. A three - dimension model of diesel engine crankshaft is created using Pro-E software. Finite element analysis (FEA) is performed to obtain the variation of stress magnitude at critical locations of crankshaft. Simulation inputs are taken from the engine specification chart. The static analysis is done using FEA Software ANSYS which resulted in the load spectrum ap lied to crank pin bearing. This load is applied to the FE model in ANSYS, and boundary conditions are applied according to the engine mounting conditions. The analysis is done for finding critical location in crankshaft. Stress variation over the engine cycle and the effect of torsion and bending load in the analysis are investigated. Von-mises stress is calculated using theoretical y and FEA software ANSYS. The relationship between n the frequency and the vibration modal is explained by the modal and harmonic analysis of crankshaft using FEA software ANSYS.

Keywords: Crankshaft, Design, Analysis, FEA etc.

STRESS ANALYSIS IN DOUBLE ENVELOPING WORM GEARS BY FINITE ELEMENT METHOD

Paper ID -1260

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Abstract

A method and a corresponding computer program are developed for stress analysis in the worm and the gear of double enveloping worm gears by finite elements. By using this program stress distributions in the worm thread and the gear tooth are calculated, and the influence of the design parameters and of the load position on deflections and stresses is investigated. On the basis of the obtained results, by using regression analysis and interpolation functions, equations are derived for the calculation of deflections and stresses in the worm thread and in the gear tooth of double enveloping worm gears.

Keywords: Gears, finite elements, worm thread etc.

CFD ANALYSIS OF SHELL AND TUBE HEAT EXCHANGER FILLEDWITH POROUS MEDIUM

Paper ID -1261

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Abstract

Latest developments in the manufacturing technology have led to development of advance lightweight materials for thermal applications. Heat transfer through porous materials has gained significance in industrial as well as academic research. In this paper thermal performance including heat transfer and pressure drop through porous material, i.e. metal foam heat exchanger, has been presented. The experimental data has been used to calculate and present graphically various performance parameters such as effectiveness, friction factor, Reynolds number and Nusselt number. The effectiveness of the heat exchangers was compared at u = 0.5–7 m/s fluid velocity, it was found that the best performance is exhibited by heat exchanger at effectiveness (ε = 30%, u = 0.2 m/s). Maximum heat transfer occurs at Reynolds number of 900. For further investigation advance methods such as artificial neural networks, fuzzy logic and genetic algorithm can be used.

Keywords: Forced Convection, Heat Exchanger, Heat transfer, Pressure drop.

USING POROUS MATERIAL FOR HEAT TRANSFER ENHANCEMENT IN HEAT EXCHANGERS: REVIEW

Paper ID -1262

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Abstract

The increase in energy cost and energy consumption has required more effective use of energy. The problem of dissipating high heat fluxes has received much attention due to its importance in applications such as heat exchanger. The heat transfer duty of heat exchangers can be improved by heat transfer enhancement techniques. In recent years, Considerable efforts have been made to increase heat transfer rates in heat exchangers by implementing passive enhancement methods that require no direct consumption of external power. On the basis of a theoretical and experimental analysis the conclusion derived was that the best heat transfer enhancement can be reached by the use of porous material as an inexpensive technique to extend the heat transfer area, improve effective thermal conductivity, and mix fluid flow. This paper presents a brief discussion on the application of using porous media to heat exchangers by means of heat transfer enhancement.

Keywords: Heat Transfer Enhancement, Heat Exchanger, Porous Media, Porous Heat Exchanger.

HEAT TRANSFER ENHANCEMENTS IN HEAT EXCHANGERS FITTED WITH POROUS MEDIA PART I: CONSTANT WALL TEMPERATURE

Paper ID -1263

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Abstract

This work investigates heat transfer enhancement for a flow in a pipe or a channel fully or partially filled with porous medium. The porous layer inserted at the core of the conduit. Forced, laminar flow is assumed and the effects of porous layer thickness on the rate of heat transfer and pressure drop were investigated. The Darcy number (permeability) is varied in the range of 10−6 to 10.0. Developing and fully developed flow conditions are considered in the analysis. It is found that the plug flow assumption is not valid for Da > 10−3. The effect of varying the inertia term (Forchheimer term) is also investigated and it is found that the inertia term is not that important for Da < 10−4 for the range of the parameters investigated. Partially filling the conduit with porous medium has two advantages: it enhances the rate of heat transfer, and the pressure drop is much less than that for a conduit fully filled with a porous medium.

Keywords: heat transfer, flow in a pipe, pressure, parameters.

A MODEL FOR FLOW AND HEAT TRANSFER THROUGH POROUS MEDIA FOR HIGH HEAT FLUX APPLICATIONS

Paper ID -1264

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Abstract

Fusion power plant studies have found helium to be an attractive coolant based on its safety advantages and compatibility with structural materials at high temperature. However, gas coolants in general tend to provide modest heat transfer performance due to their inherently low heat capacity and heat transfer coefficient. Innovative techniques have been proposed previously using porous metal heat transfer media infiltrated by the coolant. The general design strategy is to minimize the coolant flow path length in contact with the porous medium, and to minimize the friction factor in that zone while simultaneously maximizing the heat transfer coefficient. In this work we seek to develop a comprehensive thermo-fluid model including all key heat transfer processes to help in assessing and optimizing a helium-cooled porous media configuration for plasma facing component application.

Keywords: coolant, temperature, component, application, friction factor.

MODELLING OF CONVECTIVE HEAT TRANSFER IN POROUS MEDIA

Paper ID -1265

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Abstract

This thesis details the process taken for the computational modeling of convective heat transfer in porous media with the objective of improving the accuracy of porous continuum models. CFD simulations were performed to predict convective heat transfer resulting from forced flow through highly conductive porous blocks. For the pore-level predictions, an idealized geometric model for spherical-void-phase porous materials was used to generate several domains over a range of porosity and pore diameter typical of graphitic foams. Simulation on these domains was conducted using the commercial software ANSYS CFX. Similar simulations were conducted using an in-house conjugate domain solver wherein porous regions are modelled using a porous continuum approach. These results were compared to the pore-level results and indicate that a modification to the conductivity of the solid phase of the porous material must be included to account for the tortuosity, or complexity of the solid structure. The tortuosity is shown to appear naturally in the derivation of the volume-averaged energy equation for the solid-phase constituent, and has not previously been considered when calculating the effective solid phase conductivity. The implementation of this modification resulted in a closer match of the heat transfer predicted by the in-house porous continuum model when compared to results generated by commercial CFD software. Subsequent simulations were performed to show that the tortuosity was purely a geometric function – depending only on the solid phase structure.

Keywords: computational modeling, CFD simulations, ANSYS CFX, solid phase structure.

USING POROUS MEDIA TO ENHANCEMENT OF HEAT TRANSFER IN HEAT EXCHANGERS

Paper ID -1266

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Abstract

According to increasing human needs for energy and to avoid energy waste, researchers are struggling to increase the efficiency of energy production and energy conversion. One of these methods is increasing heat transfer and reducing heat dissipation in heat exchangers. Using porous materials in the fluid flow is one of the passive methods to increase heat transfer in heat exchangers. The existence of porous media in the flow path, improve the matrix of thermal conductivity and effective flow thermal capacity and also matrix of porous solid increase radiation heat transfer, especially in two phase flow (gas-water) systems. In this paper, recent studies on the effect of using porous media on enhancement the amount of heat transfer in heat exchangers has been investigated via using porous media with difference porosity percentage, material and geometric structure in the flow path in numerical simulations and laboratory studies.

Keywords: Porous media, Heat transfer enhancement, Heat exchanger.

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HEAT TRANSFER IMPROVEMENT IN HEAT EXCHANGER USING POROUS MEDIUM: A REVIEW

Paper ID -1267

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Abstract

The present study is to investigate the heat transfer enhancement in a cylindrical heat exchanger using porous media. The heat exchanger is modelled by a cylindrical cavity (Shell) with inlet and outlet thermally insulated ports and five tubes which contain hot water and cold water flows in the shell. The effect of porosity on heat transfer enhancement is studied at the different mass flow rate. The study about the effect of porosity on heat transfer enhancement is done by both experimentally and CFD based and the results are compared with the simple heat exchanger. By decreasing the porosity, the heat transfer rate increases and the mean outlet temperature of the fluid increases for different mass flow rate.

Keywords: Porous medium, Heat exchanger, CFD, porosity, mass flow rate.

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ANALYTICAL SOLUTIONS OF FLUID FLOW AND HEAT TRANSFER IN A PARTIAL POROUS CHANNEL WITH STRESS JUMP AND CONTINUITY INTERFACE CONDITIONS USING LTNE MODEL

Paper ID -1268

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Abstract

Forced convection heat transfer is analytically performed in a channel partially filled with porous media located at two inner walls under local thermal non-equilibrium (LTNE) condition. A constant heat flux is imposed at the channel walls. The Brinkman extended Darcy model is applied in the porous region and the stress jump and continuity conditions are employed at the interface. Exact solutions are obtained for velocity, pressure drop, the fluid and solid temperatures and Nusselt number. The effects of pertinent parameters on the fluid flow and heat transfer are conducted. Furthermore, the solution for the Nusselt number is compared to that by applying the local thermal equilibrium (LTE) assumption and the validity of the LTE is examined. It is shown that by applying LTNE model for different solid to fluid effective thermal conductivity ratios (K) and Biot numbers (Bi), hollowratioincludethreetypesofcurves,whicharemaximizedNusseltnumberoccursatasmalloptimum hollow ratio, Nusselt number monotonically decreases by increasing hollow ratio and a minimized Nusselt number occurs at a small hollow ratio, respectively. For high K, a small critical value of S at which the Nusselt number reaches to LTE Nusselt number occurs and it lowers with the increase of Bi number and the decrease of Darcy number; while follow, the LTNE Nunumber versus hollow ratio is almost the same with LTE Nu number and therefore the LTE is valid. The stress jump at the interface is found to have negligible effect on the Nusselt number and the pressure drop, except in a high Darcy number with a low stress jump coefficient where the calculation of pressure drop need to account for the stress jump effect at the interface and the Nusselt numbers for both LTE and LTNE models slightly differs from the case of stress continuity interface condition.

Keywords: porous media, velocity, pressure, heat transfer.

REVIEW OF FLUID FLOW AND HEAT TRANSFER THROUGH POROUS MEDIA HEAT EXCHANGERS

Paper ID -1269

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Abstract

Latest developments in the manufacturing technology have led to development of advance lightweight materials for thermal applications. Investigation of thermal properties for such materials is desirable. On the other hand, it is recognized that there are different thermal management issues. Heat transfer through porous materials has gained significance in industrial applications based research. In this paper the research on heat transfer through porous material, mostly metal foam heat exchanger, has been reviewed. This paper aims to acquire state of the art knowledge and information in the field of porous materials as well as various research carried out on heat transfer and fluid flow through porous materials. The forced convection has been reviewed extensively. At the end, aspects which require further research have been identified.

Keywords: Forced Convection, Porous Media, Porosity, Permeability, Heat Transfer.

AN EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER PERFORMANCE FOR FORCED CONVECTION OF WATER IN A HORIZONTAL PIPE PARTIALLY FILLED WITH A POROUS MEDIUM

Paper ID -1270

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Abstract

In this paper, heat transfer in porous media under forced convection of water flow has been studied experimentally. A total of 36 sets of heat transfer experiments by varying the porosity, area and position have been conducted. cycle averaged local nusselt numbers and pressure drop are obtained by measuring the bulk temperature and pressure at the inlet and outlet cross sections. The porous inserts used in this study is made of packed steel balls. The primary purpose of conducting this experiment was to find out how the Nusselt number varies with porosity, area and position. Maximum Augmentation in heat transfer with minimum pressure drop was observed for core of diameter 55mm with porosity 0.44 which was around 4.6 times higher as compared to clear flow case where no porous materials are used. On calculations, the 43.5mm diameter core insert with 0.45 porosity (6.35mm steel balls) had a ΔP/Nu value equal to 159.14 N\m2. This was the least ΔP/Nu value of all the different combinations of area, porous insert design and porosity

Keywords: Heat Transfer, Porous Media, Nusselt Number.

EFFECT OF HEAT TRANSFER IN THE THERMALLY DEVELOPING REGION OF THE CHANNEL PARTIALLY FILLED WITH A POROUS MEDIUM: CONSTANT WALL HEAT FLUX

Paper ID -1271

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Abstract

Laminar forced convection in the thermally developing region of parallel plate channels porous material has been studied numerically. The parallel plates are subjected to constant wall heat flux. Porous insert is attached to both the walls of the channel with equal thickness. The flow field is assumed to be fully developed. The system is characterized by the parameters, Darcy number, Da and a porous fraction, γp defined as ratio of the porous insert thickness to the channel wall spacing. Numerical solutions have been obtained for $0 \leq \gamma p \leq 1.0$, for Da=0.001, 0.005, 0.01, 0.05 and 0.1. The non-dimensional temperature at the wall attains maximum values at a certain porous fraction. The local Nusselt number has been obtained on the porous side of the parallel plate channel.

Keywords: parallel plate channels, parameters, porous fraction.

POTENTIALS OF POROUS MATERIALS FOR ENERGY MANAGEMENT IN HEAT EXCHANGERS – A COMPREHENSIVE REVIEW

Paper ID -1272

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Abstract

Heat exchangers are recognized as popular thermal devices with various and important applications in industrial energy systems. Many techniques were employed in order to manage the energy in these devices. Among these techniques, porous materials with high potentials for the energy management and enhancing the thermal performances in heat exchangers were employed widely. This paper reviews recent developments and utilisation of different types of porous materials in the heat exchangers. Both simulation and experimental works were briefly explained. The gaps in current literatures and designs were investigated and solutions for them were discussed.

Keywords: thermal devices, applications, industrial energy, heat exchangers.

ANALYSIS OF POROUS FILLED HEAT EXCHANGERS FOR ELECTRONIC COOLING

Paper ID -1273

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Abstract

An innovative porous filled heat exchanger is modelled to investigate the cooling effectiveness and temperature distribution at its base subject to a high heat flux. The effects of different Nano fluid coolants (5% titanium dioxide (TiO_2) in water, 1% alumina in water, 0.03% multi walled carbon nanotubes (MWCNT) in water, and 1% diamond in 40:60 ethylene glycol/water), different porous materials (copper and annealed pyrolytic graphite (APG)), and porosity values are investigated. The coolant enters from an inlet channel normal to the base, moves through the porous medium, and leaves the heat exchanger through wo opposite exit channels parallel to the base. The effects of the inclination angle of the foam filled channel, inlet velocity value, and heat flux value are also studied. In addition, the effect of the inlet cross section is investigated by studying two different designs. One of the designs has a rectangular cross sectional inlet channel (extended all along the transverse direction) and the other design has a square one. The results indicate the importance of the utilization of a high conductive porous material. Utilization of APG porous matrix improves the cooling effectiveness at the base of the heat exchanger, for all studied coolants of pure water and water based Nano fluids. The results also show that utilizing titanium dioxide Nano fluids (TiO_2) as coolant for both copper and APG porous matrices at low and high porosity structures, and for both square and rectangular inlet cross sections improves the cooling efficiency and temperature uniformity over the base. Investigation of the effect of inlet channel geometry, i.e., square and rectangular, indicates that employing a square cross section inlet channel would result in lower temperature values along the stream wise direction while higher temperature values are observed far from the centre in transverse direction.

Keywords: Nano fluid, heat exchanger, coolants, Utilization of APG porous.

A CRITICAL REVIEW ON HEAT TRANSFER AUGMENTATION OF PHASE CHANGE MATERIALS EMBEDDED WITH POROUS MATERIALS/FOAMS

Paper ID -1274

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Abstract

Phase change material (PCM) is promising media for thermal energy storage owing to its extensive value of latent heat (140–970 KJ/Kg). However, thermal conductivity of PCMs is too low which obstructs energy storage and retrieval rate. In recent days, thermally enhanced PCMs are considered promising materials for efficient heat transfer in many applications. This article designates the review on improved thermal properties and heat transfer of PCMs by using porous materials. Enhanced heat transfer of PCMs can be achieved using extended surfaces (triangular, conical, square, and rectangular fins), heat pipes, and addition of highly conductive Nano particles (e.g. Cu,Al2O3, Au, SiC,SiO2 andTiO2).Major focus of this article is to study the enhanced heat transfer of PCMs through metallic (copper, nickel, and aluminium) and carbon based (carbon, graphite and expanded graphite) porous materials/foams. Effects of porosity and pore density on heat transfer, thermal conductivity, specific heat, latent heat and charging/discharging time are critically reviewed. Porous materials/foams are reported to be efficient for heat transfer/thermal conductivity enhancement by 3–500 times. Furthermore, correlations to find the effective thermal conductivity of PCM/foam are reported. Important applications of PCM/foam reported by different researchers are also discussed in this paper. Finally, conclusions and recommendations are presented to highlight the research gap in this area.

Keywords: Phase change materials Porous materials Heat transfer enhancement Thermal conductivity enhancement Thermal management Energy storage.

HEAT TRANSFER AUGMENTATION IN TWO-PHASE FLOW HEAT EXCHANGER USING POROUS MICROSTRUCTURES AND A HYDROPHOBIC COATING

Paper ID -1275

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Abstract

In this study, we improved the thermal performance of a slightly inclined tube for a two phase flow heat exchanger by means of surface modification techniques. The exchanger condenses pure steam inside the tube while boiling takes place outside the tube in a pool of saturated water. First, appropriate surface modification techniques for each boiling and condensation surface were separately investigated. An electroplating technique with hydrogen bubbles was utilized to create porous microstructures as cavities on a boiling surface, which remarkably promoted heterogeneous bubble nucleation and resulted in significant enhancement on average 107% in the boiling heat transfer coefficient. Hydrophobic thin films of Teflon were coated on a condensation surface, which considerably enhanced heat transfer on average 100% by promoting drop wise condensation. Secondly, the selected surface modification techniques were applied to outer boiling and inner condensation surfaces of a single-tube two-phase flow heat exchanger and remarkable improvement in heat transfer performance (>60%) due to the surface treatments was experimentally demonstrated.

Keywords: boiling; condensation; hydrophobic coating; porous microstructure; two-phase flow heat exchanger.

THERMAL-HYDRAULIC PERFORMANCE OF SMALL SCALE MICRO-CHANNEL AND POROUS-MEDIA HEAT-EXCHANGERS

Paper ID -1276

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Abstract

Fluid flow and forced convection heat transfer in micro-heat-exchangers with either micro-channels or porous media have been investigated experimentally. The influence of the dimensions of the micro-channels on the heat transfer performance was analyzed numerically. Based on these computations, deep micro-channels were used for the experimental studies reported here. The measured performance of both micro-channel and porous-media micro-heat exchangers are compared with those of similar heat-exchangers tested by other researchers. It is shown that the heat transfer performance of the micro-heat-exchanger using porous media is better than that of the micro-heat-exchanger using micro-channels, but the pressure drop of the former is much larger. Over the range of test conditions, the maximum volumetric heat transfer coefficient of the micro-heat-exchanger using porous media was 86.3 MW/(m3 K) for a water mass flow rate of 0.067 kg/s and a pressure drop of 4.66 bar. The maximum volumetric heat transfer coefficient of the micro-heat-exchanger using deep micro-channels was 38.4 MW/(m3 K) with a corresponding mass ¯ow rate of 0.34 kg/s and a pressure drop of 0.7 bar. Considering both the heat transfer and pressure drop characteristics of these heat-exchangers, the deep micro-channel design offers a better overall performance than either the porous media or shallow micro-channel alternatives.

Keywords: Micro-heat-exchangers; Micro-channels; Porous media; Volumetric heat transfer coefficient; Pressure drop.

DESIGN AND SIMULATION OF HEAT EXCHANGER FITTED WITH CU POROUS MEDIA AND RIDGES

Paper ID -1277

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Abstract

Simulations using the k–epsilon model have been carried out to investigate the fluid flow and heat transfer characteristics in the Heat Exchanger with copper porous media. In designing heat exchanger, copper ridges are made on the surface in order to enhance the heat transfer. The parameters studied include the Reynolds number (Re<2000), pressure drop, temperature, thickness of the porous media used by maintaining the porosity e = 0.8. The comparison analysis is done between the computational work and existing heat exchanger with same boundary condition. Results show that newly designed heat exchanger enhance the heat transfer up to 150C.

Keywords: Heat Exchanger; Finite volume; Heat Transfer; Pressure Drop; Temperature; Simulation; k-epsilon model; copper ridges.

EXPERIMENTAL STUDY OF FORCED CONVECTION HEAT TRANSPORT IN POROUS MEDIA

Paper ID -1278

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Abstract

The present study is aimed at extending this thematic issue through heat transport experiments and their interpretation at laboratory scale. An experimental study to evaluate the dynamics of forced convection heat transfer in a thermally isolated column filled with porous medium has been carried out. The behaviour of two porous media with different grain sizes and specific surfaces has been observed. The experimental data have been compared with an analytical solution for one-dimensional heat transport for local non thermal equilibrium condition. The interpretation of the experimental data shows that the heterogeneity of the porous medium affects heat transport dynamics, causing a channeling effect which has consequences on thermal dispersion phenomena and heat transfer between fluid and solid phases, limiting the capacity to store or dissipate heat in the porous medium.

Keywords: heat transfer, experimental data, thermal dispersion.

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MECHANISM OF HEAT TRANSFER ENHANCEMENT IN THE CORE FLOW OF A TUBE AND ITS NUMERICAL SIMULATION

Paper ID -1279

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Abstract

The principle of heat transfer enhancement in the core flow of a tube has been proposed, in this paper, to make fluid temperature uniform in the core region of a tube and decrease flow resistance, which is different from heat transfer enhancement in the boundary flow of a tube. Two new models, representing heat transfer enhancement in the laminar and turbulent tube flow, have been established and numerically analysed. Theoretical and numerical results indicate that heat transfer enhanced components designed according to the principle proposed in this paper will be benefit for increasing convective heat transfer coefficient, reducing flow resistance and raising the PEC value of a heat transfer enhanced tube. The presented principle, therefore, may help developing new type of heat transfer unit and designing heat exchanger with high heat transfer coefficient and low flow resistance.

Keywords: Heat transfer enhancement, core flow, tube, flow resistance.

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NUMERICAL SIMULATION OF TRANSPIRATION COOLING THROUGH POROUS MATERIAL

Paper ID -1280

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Abstract

Transpiration cooling using ceramic matrix composite (CMC) materials is an innovative concept for cooling rocket thrust chambers. The coolant (air) is driven through the porous material by a pressure difference between the coolant reservoir and the turbulent hot gas flow. The effectiveness of such cooling strategies relies on a proper choice of the involved process parameters such as injection pressure, blowing ratios, material structure parameters, to name only a few. In view of the limited experimental access to the subtle processes occurring at the interface between hot gas flow and porous medium, reliable and accurate simulations become an increasingly important design tool. In order to facilitate such numerical simulations for a carbon/carbon material mounted in the side wall of a hot gas channel that are able to capture a spatially varying interplay between the hot gas flow and the coolant at the interface, we formulate a two dimensional model for the porous medium flow of Darcy-Forchheimer type. A finite element solver for the corresponding porous media flow is presented and coupled with a finite volume solver for the compressible Reynolds averaged Navier-Stokes equation. The results at Mach number Ma = 0.5andhotgastemperature Thg = 540K for different blowing ratios are compared with experiments.

Key Words: Transpiration cooling, porous media flow, Darcy-Forchheimer equation, coupled finite element-, finite volume schemes, numerical tests.

NUMERICAL SIMULATION AND EXPERIMENTAL INVESTIGATION ON A SOLAR REFRIGERATORWITH INTERMITTENT ADSORPTION CYCLE

Paper ID -1281

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Abstract

This work deals with a new design of a solar driven adsorption-refrigerator. The solar refrigerator uses a single bed adsorbed-collector and works with silica gel/water as a sorption pair. The novelty of this work is in the use of low cost and effective techniques that permitted to palliate to the problem of days with low solar radiation. In addition to that, a model with a minimum of constraining hypothesis was proposed. The model was implemented in a MATLAB-program and showed a good prediction accuracy during several tests with different operating conditions. This paper aims to put into evidence the impact of an enhancement with four external reflectors. The influences of the mass of the load as well as the influence of the initial mass of the refrigerant are also highlighted. Tests that were effectuated in the region of Sfax-Tunisia, resulted in a maximal *COPsolar* valuing 0.078 and maximal cooling capacity of 777.96 kJ. The proposed refrigerator was also able to make the temperature of a9 kg water-load decrease to reach 0 °C during a partially cloudy day.

Key word: Design, Refrigerator, solar, etc.

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EXPERIMENTAL AND SIMULATION ANALYSIS OF THE COMBINED ADSORPTION SYSTEMDRIVEN BY 80–140 °C HEAT SOURCE

Paper ID -1282

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Abstract

The shortage of fossil fuel, greenhouse gases emission, air pollution and global warming have attracted more and more researchers' attention on the adsorption technology, which utilizes low temperature thermal heat of solar thermal energy and waste heat. Moreover, the usage of natural materials as refrigerant such as water and methanol adds to its advantage. However, the low coefficient of performance and specific cooling power limits its further application. This paper proposes a novel combined adsorption system, which can provide the functions of air conditioning/refrigeration/heat pump heating and ammonia/organic expanding power generation. In addition, the consolidated advanced adsorbent is used in this system, the effect of which is investigated. The author also analyzed the most suitable organic for organic Rankine cycle in this system. The results reveal that the organic of N-Butane has the highest potential exergy and the most appropriate work pressure. The cooling exergy efficiency in the working modes of air conditioning, refrigeration and heat pump heating are about 0.18, 0.13and 0.24, respectively. The simulation results indicate that, compared to the system with only cooling effect, the total exergy efficiency of the combined system can be improved from 0.15 to 0.31, because of the additional expanding power generation effect.

Key words: Fuel, Gases, Pollution, etc.

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EXPERIMENTAL INVESTIGATION OF AN ADSORPTION REFRIGERATION PROTOTYPEWITH THE WORKING PAIR OF COMPOSITE ADSORBENT-AMMONIA

Paper ID -1283

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Abstract

A 4-valve adsorption refrigeration prototype, which utilizes the composite adsorbent of calcium chloride/activated carbon and the refrigerant of ammonia, is developed and tested. System reliability is significantly improved because the integrated adsorbers are adopted, the closed circulation for heating and cooling processes is designed, and the system operation is optimized. Experiments showed that the prototype can start quickly, and the operation of the system is very stable. The influences of mass recovery time, cycle time, heating temperature, evaporating temperature and cooling water temperature on system performance have been studied. Experimental results indicate that for the -5 ºC evaporating temperature, 130 ºC heating temperature, 25 ºC cooling water temperature, the optimized cycle time is 50 min with a mass recovery time of 120 s. The optimal coefficient of performance (COP), specific cooling power (SCP) and cooling capacity of this prototype are 0.197, 205.2 W/kg and 1.64 kW, respectively.

Key words: Refrigerator, prototype, cooling, power.

EXPERIMENTAL STUDY ON A NEW SOLAR REFRIGERATOR WITH INTERMITTENTADSORPTION CYCLE

Paper ID -1284

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Abstract

This paper presents experimental results for a proto type intermittent solar adsorption ice-maker using water as the refrigerant and silica gel as the adsorbent. Four external flat reflectors made of polished stainless steel were used to enhance the performance. On a cloudy day, without reflectors, a minimum temperature of 7 ◦C was reached, so no ice was made. With reflectors 0.5 kg of ice was made from a 9 kg load. Increasing the load of water tended to increase the solar COP. The effect of the initial mass of refrigerant was also investigated.

Key words: solar, Refrigerator, prototype, cooling, power, etc.

EXPERIMENTAL STUDY ON ADSORPTION CAPACITY OFACTIVATED CARBON BASED ADSORPTION WATER CHILLER

Paper ID -1285

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Abstract

The objective of this study was to evaluate the adsorption capacity of working pair for adsorption water chiller. Activated carbon fiber-methanol, activated carbon fiber-ethanol and activated carbon pallet-ethanol were used as an adsorbent-adsorbate pair in this study. The experiment was conducted using a stainless steel adsorber, 110 mm diameter by 150 mm height, filled with adsorbent and transparent plastic evaporator, 100 ml capacity, filled with adsorbate. The experiment was performed by isobaric adsorption in the temperature range of10-100º C at the evaporator temperature of 20°C (water chiller). Experimental investigation showed that Activated carbon fiber- methanol pair has highest adsorption capacity (0.44kg/kg) compared to activated carbon fiber- ethanol and activated carbon pallet- ethanol pair. The finding revealed that uniform structure and large surface area of adsorbent as well low boiling point and large latent heat of adsorbate had highly significant effects on adsorption capacity. The effect of time and adsorber temperature on adsorption capacity is also discussed in this study.

Key words: Refrigerator, prototype, cooling, power.

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INVESTIGATION OF THE HEAT TRANSFER PROPERTIES OF GRANULAR ACTIVATED CARBONWITH R723 FOR ADSORPTION REFRIGERATION AND HEAT PUMP

Paper ID -1286

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Abstract

This paper investigates the heat transfer coefficient of the wall to packed carbon contact *(h)* and the thermal conductivity of the packed bed *(λ)* by using parameters estimation method. A numerical heat conduction method was used in conjunction with an iterative process of minimizing the Mean Square Error *(MSE)* between both experimentally measured and model predicted temperatures in order to estimate *h* and *λ* parameters simultaneously. Experimental work was carried out by measuring the wall and centre temperatures of the sample reactor when suddenly submerged in a temperature controlled water bath at around 90 °C. Four samples with packed bed density ranging from 600 kgm−3 to 750 kgm−3 were tested. The results for the GAC-R723 refrigerant pair show a quasi-linear increase in both thermal conductivity *(λ)* and wall contact heat transfer coefficient *(h)* with packed bed density. The thermal conductivity of GAC-R723 refrigerant varies between0.77W/mKand1.36W/mK (about three times the values without R723 refrigerant) while the wall contact heat transfer coefficient varied between 390Wm−2 K−1 and 735Wm−2 K (up to 30% better than values without R723).

Key words: Refrigerator, prototype, cooling, power.

OPTIMISATION OF ECOFRIENDLY ADSORPTION REFRIGERATION SYSTEM

Paper ID -1287

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Abstract

Adsorption cooling system can be classified into two main types, namely, intermittent adsorption system and continuous adsorption system. In this paper, attention has been focused on the intermittent adsorption refrigeration system. Continuous adsorption system requires a pump, which requires electricity, and more heat exchangers and more than one adsorbent bed, which increases the cost. Intermittent adsorption system can be operated without electricity. This vapour adsorption refrigeration system is optimised to reduce the product cost through Evaluation and Optimization method.

Keywords: cooling, system, method, optimization, etc.

ADSORPTION COOLING CYCLE USING SILICA-GEL PACKED IN OPEN-CELL ALUMINUM FOAMS

Paper ID -1288

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Abstract

Effective thermal conductivity of a silica-gel/water adsorption packed bed is significantly enhanced by placing silica-gel particles in a high-porosity aluminum (AL) foam. The enhancement leads to several folds increase in the specific cooling power (SCP), cooling capacity per unit volume (CPv) and coefficient of performance (COP) of an adsorption cooling (AC) chiller. The thermal response and adsorption kinetics of various silica-gel/AL foam beds under typical operating conditions are investigated experimentally and numerically. Effect of pores per inch (PPI) of the foam, silica-gel particle size, bed height and adsorption isotherm of different types of silica-gel on the bed performance are investigated. The results reveal that the AL foam with 20 PPI is recommended for adsorption cooling applications due to its high surface area and small cell size. 20 PPI AL foam can deliver a SCP of 827 W/kg, a CPv of 517 W/m3 and a COP of 0.75.

Keywords: CPV, cooling, system, method, optimization, etc.

PERFORMANCE EVALUATION OF SILICA GEL-WATER ADSORPTION BASED COOLING SYSTEMFOR MANGO FRUIT STORAGE IN SUB-SAHARAN AFRICA

Paper ID -1289

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Abstract

Refrigeration is generally recognised as a key tool for successful marketing of fresh produce. However, such sophisticated cooling systems are unavailable or non-existent for African smallholder farmers due to financial constraints and lack of electricity supply. The application of low cost silica gel-water adsorption based cooling systems has attracted attention for on-farm storage. However, the drawback till now was low cooling performance. Therefore, this work focused on evaluating the cooling performance of adsorption based cooling refrigerator (prototype) at different cooling cycle times of 30, 60, 90 and 120 min with regeneration cycles fixed to 30 min and various hot water regeneration temperatures of 60, 70 and 80 °C. The study reveals that the cooling cycle time influences the reduction in storage temperature most, while both increasing hot water temperature and cooling cycle time enhance the cooling capacity of the prototype. Additionally, the adsorption based cooling system prototype was examined on its capability of storing fresh mangoes which resulted in 3% mass loss of fruits at average inside air temperature of 15 °C and relative humidity of 90%. These results suggest that the new energy saving storage technology, can be adopted for storage of fresh commodities in Sub-Saharan African countries.

Keywords: tool, temperature, technology, etc.

PHYSICAL PROPERTIES AND ADSORPTION KINETICS OF SILICA-GEL/WATER FOR ADSORPTION CHILLERS

Paper ID -1290

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Abstract

The choice of a suitable adsorbate/adsorbent pair is critical for an adsorption cooling cycle. The surface characteristics and thermo-physical properties of the adsorbent, and the adsorption rate of adsorbate are key parameters in making the choice. Through literature review, it is found that there are disagreements among the experimental measurements and various equations/models used to describe adsorption isotherms and surface diffusivity of water in silica-gel. In this work, an experimental set-up is built to measure the isotherms and kinetics of vapor adsorption for any working pair. Using the newly measured data, those from the manufacturers and from the literature, these inconsistencies are eliminated by utilizing the Dubinin- Astakhov (D-A) model to fit the entire adsorption isotherm curve. The Brunauer-Emmett-Teller (BET) method is used to calculate the surface area, pore volume and pore diameter of two different types of silica-gel. Based on the adsorption rate and the adsorbent temperature measured simultaneously, a new approach is proposed to measure the surface diffusivity in the temperature and pressure ranges typical of those during the operating conditions of adsorption cooling systems. Analysis of the results indicates that the surface diffusivity follows the Arrhenius-form equation. The calculated activation energy at different adsorption conditions varies from 40.0 to 41.2 kJ/mol and the pre exponential factor varies from 2.5×10^{-4} to $2.8\times10^{-4} m^2/s$. These values are close to those previously reported in the literature. Thus, the proposed approach can be used to measure the surface diffusivity in Nano porous materials.

Keywords: absorbate, BET, Diffusivity, etc.

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A NOVEL SOLAR-POWERED ADSORPTION REFRIGERATION MODULE

Paper ID -1291

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Abstract

This paper presents the description and operation of a simple structure, low cost solar-powered adsorption refrigeration module with the solid adsorption pair of local domestic type charcoal and methanol. The module consists of: a—modified glass tube having a generator (sorption bed) at one end and a combined evaporator and condenser at the other end and, b—simple arrangement of plane reflectors to heat the generator. The testing of the module is mainly focused on the sorption bed, therefore, four types(1–4) of bed techniques and four reflector arrangements (A–D) to heat the sorption bed had been proposed and tested under climatic condition of Cairo (30_ latitude). The angles of inclination of the reflectors are varied every month to receive maximum solar energy at noon time. Glass shell is also used to cover the beds in winter. Test results show that, the module composed of the bed technique Type 4 and reflector's arrangement Type C gives best performance. The time duration during which the bed temperature is above 100 _C was found to be 5 h, with a maximum temperature of 120 _C in winter. In summer, the corresponding values 6 h and 133 _C. During cooling, the minimum bed temperature recorded in either winter or summer time is very close to the ambient temperature due to the absence of bed insulation. The daily ice production is 6.9 and 9.4 kg/m2 and net solar COP is 0.136 and 0.159 for cold and hot climate respectively.

Key words: glass, temperature, time, etc.

ACTIVATED CARBON AND GRAPHENE NANOPLATELETS BASED NOVEL COMPOSITE FOR PERFORMANCE ENHANCEMENT OF ADSORPTION COOLING CYCLE

Paper ID -1292

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Abstract

Adsorption cooling systems powered by low-grade thermal or renewable energy are considered as a potential alternative to the vapor compression systems. To improve the performance and compactness of the system, this study focuses on the synthesis and characterization of activated carbon (AC) composite employing graphene nanoplatelets (GNPs) namely H-grade and C-grade, and polyvinyl alcohol. The influence of GNPs on the porous properties, thermal conductivity, and ethanol adsorption characteristics of composites has been experimentally investigated. Porous properties results show that the studied composites possess high surface area and pore volume with microporous nature. The C-grade contained composite shows the higher porous properties compared to H-grade, however, thermal conductivity for the later one is the highest. The highest thermal conductivity is found to be 1.55Wm−1 K−1 for H-grade (40 wt%) contained composite which is 23.5 times higher than that of powder AC. Ethanol adsorption characteristics on studied composites are conducted gravimetrically at adsorption temperatures 30–70 °C. Experimental data are also fitted with Tóth and Dubinin-Astakhov (D-A) isotherm models within±5% RMSD and found 23% improvement of effective volumetric uptake for H25 (20 wt %) composite compared to parent AC. The instantaneous ethanol adsorption uptake onto composites has also been presented for adsorption temperature 30 °C and evaporator pressure at 1.8 kPa.

Key words: Grade, Data, Power, etc.

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ADSORPTION COOLING SYSTEMS FOR HEAVY TRUCKS A/C APPLICATIONS DRIVEN BY EXHAUST AND COOLANT WASTE HEATS

Paper ID -1293

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Abstract

Water coolant and exhaust gases are the main waste heat sources of heavy trucks engine that can be used in driving adsorption cooling systems (ACS) for air conditioning and refrigeration demands. Due to the differences in heat source thermodynamic conditions, adsorbent materials and heating/cooling fluid flow loops of the exhaust and coolant driven ACS, identifying the higher performance system in terms of efficiency and cooling capacity under different operating conditions is not a trivial matter. In this study, considering an identical absorbent bed heat exchanger and ambient conditions, the performances of the coolant and exhaust driven systems with the working pairs of silica gel-water and zeolite13x-water, respectively, are investigated by means of a detailed numerical model. Parametric studies show that the exhaust driven system at different operating conditions is more capable of meeting the cooling demands in comparison with the coolant driven system at its practical operating conditions. In addition, the evaluation of both systems performance at higher ambient temperatures indicates that the increase in ambient temperature leads to an almost linear performance drop in both systems, however, that is more considerable in the coolant driven ACS. Finally, the design of both systems and their challenges are briefly discussed.

Key words: Gas, Engine, ACS, Drop, etc.

EVALUATING THE POTENTIAL OF USING ETHANOL /WATER MIXTURE AS AREFRIGERANT IN ADSORPTION COOLING SYSTEM BY USING ACTIVATED CARBON -SODIUM CHLORIDE COMPOSITE ADSORBENT

Paper ID -1294

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Abstract

Thermal properties and adsorbent - refrigerants compatibility, influence heat and Mass transfer dynamics in adsorption cooling systems (ACS). Activated carbon (AC) +NaCl (10-35.7% w/v) composite adsorbents were paired with either high purity (99.7%) or low-grade ethanol (60% ethanol/ 40% water) refrigerants to assess the potential of ethanol/water mixture as a refrigerant. The ACS with activated carbon-sodium chloride (AC+ NaCl)composites adsorbent had a coefficient of performance and specific cooling power of up to0.091 and 79 Wkg-1, respectively, when paired with high purity ethanol, which increased to about 0.146 and 150 Wkg-1, respectively, when paired with low-grade ethanol. About 16 -25 MJ per cycle was needed for evaporation of refrigerants in AC+NaCl composites adsorbent when paired with the low-grade ethanol, whereas more energy, 27 MJ per cycle, was required to evaporate low-grade ethanol when paired with unmodified AC in ACS. The study has shown that the thermal and mass transfer performances of AC+NaCl composites adsorbents superseded that of unmodified AC providing the potential for low-grade ethanol to be used as a potential alternative refrigerant in ACS especially in areas where pure ethanol is limited.

Key words: Cooling, ACs, NACL, low, etc.

EXPERIMENTAL STUDY ON PERFORMANCE CHANGE WITH TIME OF SOLAR ADSORPTIONREFRIGERATION SYSTEM

Paper ID -1295

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Abstract

Under the solar heating condition, the performance of the adsorption refrigeration system using SAPO-34 zeolite and water as the working pair was tested practically. The experiment provided insights into the dynamic change of the temperature and pressure in the adsorption bed, as well as the effect of the cycle time on the system performance. By analyzing the relationship between the solar energy input and the cooling output, the optimal cycle time of the system was identified. It was revealed that both the performance coefficient COP and the specific cooling power SCP presented a maximum value with respect to the adsorption time as the system was evaluated by the whole cycle time. However, the COP and the SCP did not share the same adsorption time for their maximum values. The characteristic for the bed to decrease the adsorption rate with the time is considered to be responsible to interpret the optimal cycle time of the system. The overlong time of adsorption did not help to improve the cooling performance of the system.

Keywords: solar, COP, SCP, etc.

HEAT TRANSFER PERFORMANCE INVESTIGATION ON A FINNED TUBE ADSORBENT BED WITH ACOMPOUND PARABOLIC CONCENTRATOR (CPC) FOR SOLAR ADSORPTION REFRIGERATION

Paper ID -1296

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Abstract

In this work, activated carbon-methanol was used as the working pair in a solar adsorption refrigeration system (SAR). The thermal conductivity of the activated carbon was very poor, resulting in performance delays of the system. To improve the performance of the heat transfer for the adsorbent bed, a new adsorbent bed with finned tubes was designed and studied using commercial computational fluid dynamics (CFD) software. Two-dimensional (2D) numerical models of two kinds of adsorbent tubes (finned and smooth tubes) were constructed and simulated. The two different 2D numerical models had similar cell numbers and the same boundaries and initial conditions. An experiment for a grid verification model of the designed finned tube was conducted, and the model of the finned tube was validated via comparison between the numerical and experimental results. In addition, the heat performances of the newly designed finned tube and the smooth tube were compared in this paper. The temperature gradients of the activated carbon in the smooth and finned tubes were approximately 28.1 °C and 4 °C during isosteric heating, respectively. The conclusions are that the fins had a large effect on the thermal performance of SAR, and the possibility that the methanol was adsorbed again by the activated carbon of the lower temperature part in the finned tubes during isobaric heating was decreased greatly. Moreover, the radial heat loss of the finned tube wall was also less than the smooth tube, which may be an important factor for improving the performance of the system effectively.

Key words: SAR, temperature, CFD, etc.

STUDY ON SOLAR DRIVEN COMBINED ADSORPTION REFRIGERATION CYCLES IN TROPICAL CLIMATE

Paper ID -1297

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Abstract

This paper presents the theoretical analysis of the performance of solar powered combined adsorption refrigeration cycles that has been designed for Singapore and Malaysia and similar tropical regions using evacuated tube solar collectors. This novel cycle amalgamates the activated carbon (AC)-R507A as the bottoming cycle and activated carbon-R134a cycle as the topping cycle and delivers refrigeration load a slow as _10 _C at the bottoming cycle. A simulation program has been developed for modeling and performance evaluation for the solar driven combined adsorption refrigeration cycle using the meteorological data of Singapore and Malaysia. The results show that the combined cycle is in phase with the weather. The optimum cooling capacity, coefficient of performance (COP) and chiller efficiency are calculated in terms of cycle time, switching time, regeneration and brine inlet temperatures.

Keywords: R507, Evaluation, COP, etc.

THERMODYNAMIC ANALYSIS AND PERFORMANCE OF AN ADSORPTION REFRIGERATION SYSTEMDRIVEN BY SOLAR COLLECTOR

Paper ID -1298

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Abstract

This paper presents the operating and performance of an adsorption refrigeration system driven by a solar collector. The thermodynamic cycle and the working principle of the system are based on the adsorption phenomena at a steady temperature. The system operates with activated carbon (AC)-methanol as a working pair, and Dubinin-Astakhov (D-A) equation was used to describe this phenomena. Comparative study between different types of Caravels that the one based on stone coal had an optimal performance coefficient (COP) equal to 0.73 whereas a total energy input to the system is 18740.05kJ and a total daily ice production of 13.65kg at -3°C. The studied case indicates that the optimal performance of the system can be obtained for low ambient and condensation temperature with high evaporation temperature. Ice produced can also be improved when the initial water temperature is low.

Key words: Refrigeration, energy, input, Ice, etc.

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ADSORPTION STUDY OF SILICA GEL PARTICLE FOR IMPROVEMENT IN DESIGN OFADSORPTION BEDS USED IN SOLAR DRIVEN COOLING UNITS

Paper ID -1299

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Abstract

Simulations using Ansys Fluent 6.3.26 have been performed to look into the adsorption characteristics of a single silica gel particle exposed to saturated humid air streams at Re=108& 216 and temperature of 300K. The adsorption of the particle has been modeled as a source term in the species and the energy equations using a Linear Driving Force (LDF) equation. The interdependence of the thermal and the water vapor concentration field has been analysed. This work is intended to aid in understanding the adsorption effects in silica gel beds and in their efficient design.

Key words: Fluent, LDF, silica, etc.

A CASE STUDY OF A LOW POWER VAPOUR: ADSORPTION REFRIGERATION SYSTEM

Paper ID -1300

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Abstract

Industrial refrigeration is one of the most energy consuming sector. In conventional Vapor Compression refrigeration system, compressor is the major power consuming element. Vapor Adsorption refrigeration system is one of the best replacement for the Vapor Compression refrigeration system. Our main objective is to analyze, design and develop a Vapor Adsorption refrigeration system which is cost effective and environment friendly. A prototype model that is capable of producing a temperature drop in closed evaporator chamber was designed, fabricated and tested. Activated carbon/Methanol pair is chosen as Adsorbent/Refrigerant pair. The system is analyzed in ANSYS 14.5 using the inlet conditions obtained from the experimental setup. The performances and effectiveness of the unit was studied by determining Refrigeration Effect (RE), Coefficient of Performance (COP) and operational issues of the unit are explained. The results obtained from the analysis and experiments have marginal difference in COP i.e. with an error percentage of 5.94%. The overall COP obtained is 0.34 through experiments and from analysis the COP obtained is approximately 0.32.

Key words: NADYS, COP, Vapour, etc.

NUMERICAL INVESTIGATION OF SMALL-SCALE ADSORPTIONCOOLING SYSTEM PERFORMANCE EMPLOYING ACTIVATEDCARBON-ETHANOL PAIR

Paper ID -1301

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Abstract

Absorber heat exchanger design has great importance in increasing the performance of the adsorption-based cooling system. In this study, a transient two-dimensional axisymmetric Computational Fluid Dynamics (CFD) model has been developed for the performance investigation of finned tube type absorber using activated carbon and ethanol as the working pair. The operating conditions of the cooling system were 15, 20 and 80 for evaporation, cooling and heating temperatures, respectively. The simulated temperature profiles for different adsorbent thicknesses were validated with those from experimental data measured in our laboratory. Moreover, the errors in mass and energy balance were 3% and 7.88%, respectively. Besides, the performance investigation has been performed for cycle time ranging from 600 s to 1400 s. The optimum cycle time was 800 s and the corresponding evaluated specific cooling power (SCP) and coefficient of performance (COP) were found to be 488 W/kg and 0.61, respectively. The developed CFD model will be used for fin height and fin pitch optimization and can be extended to other adsorbent-adsorbate based adsorption cooling system.

Key words: CFD, COP, SCP, etc.

PARAMETRIC STUDY AND SIMULATION OF A HEAT-DRIVEN ADSORBER FOR AIRCONDITIONING SYSTEM EMPLOYING ACTIVATED CARBON–METHANOL WORKINGPAIR

Paper ID -1302

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Abstract

Objectives: This paper aims to present a parametric study to compare with the experimental results obtained previously for a typical activated carbon–methanol, adsorption air-conditioning system powered by exhaust heat. The main objective is to study the effect of wall thickness on the desorption temperature and the cooling performance.
Methods: The current study is a simulation/parametric investigation employing computational fluid dynamics (CFD) simulation technique.
Results: It is found that the CFD result is close to the experimental works. In this CFD investigation, an input exhaust gas of 200 _C would have bed temperature around 120 _C while employing 20 mm thick of wall made by stainless steel. The absorber took around 10 min to heat up and decrease to room temperature around the same period. This set of data produce a cooling power of 0.65 kW and COP around0.25 with cycle time of 1200 s.
Conclusion: It is concluded that higher input temperature would have relatively longer cycle time but it is able to produce higher cooling power in return. While in design, it proves that an optimal wall thickness should be 15–20 mm of stainless steel that offer lower heat transfer rate to maintain the system under functional Tdes at all time.
Practice implications: This paper proves that adsorption air-conditioning system is technically applicable; however wall thickness of the adsorber should be considered seriously as one of the important parameters for suitable heat transfer and improved adsorption–desorption rate of the system.

Key words: COP, time, absorber, etc.

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EXPERIMENTAL STUDY ON VAPOR ADSORPTION REFRIGERATIONSYSTEM WITH CARBON-METHANOL PAIR

Paper ID -1303

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Abstract

Adsorption systems may find its application in refrigeration and air-conditioning, ice-making, water chiller etc. In conventional vapor compression refrigeration system, compressor is the main power consuming component. A vapor adsorption system can be feasible replacement for vapor compression refrigeration system. The main objective of this project is to design, fabricate and test a cost effective and laboratory scale vapor adsorption refrigeration system. An intermittent type vapor adsorption system is fabricated using some common stainless steel utensils, copper tube, an electric heater and a laboratory vacuum pump. The Refrigeration effect and COP of the system is determined from basic thermodynamic relations. Though COP is ~0.175 but it's able to bring down temperature of circulating water by more than 10^{o}C.

Keywords: Vapour, absorber, pump, etc.

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RECENT ADVANCES IN ADSORPTION HEAT TRANSFORMATION FOCUSING ON THE DEVELOPMENT OF ADSORBENT MATERIALS

Paper ID -1304

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Abstract

Adsorption heat transformation (AHT) is an environmentally friendly energy-saving process applied for air conditioning purposes, that is, either for cooling (including also ice making and refrigeration), or heating. AHT is based on the cycling adsorption and desorption of a working fluid in a porous material. When the working fluid is driven to evaporation by the active empty sorbent material, the required heat of evaporation translates into useful cooling in thermally driven adsorption chillers. Driving heat regenerates the empty sorbent material through desorption of the working fluid. The heat of adsorption in the sorbent material and the heat of condensation of the working fluid can be used in the adsorption heat-pumping mode. Thus, adsorption heat transformation contributes to energy-saving technologies. Adsorbent development plays a critical role for the improvement of AHT technologies. Besides silica gel and zeolites as adsorbent materials, which are up to now used in the commercially available AHT devices; especially metal-organic frameworks (MOFs) are getting more attentions in recent years. Composite materials from salts with silica gels, zeolites and MOFs as well as activated carbons have also been researched to contribute to AHT technologies. Reduction of installation/production cost and enhancement of the efficiency of AHT devices need to be achieved to increase the wider usage of AHT.

Key words: AHT, MOF, refrigerator, etc.

ANALYSIS AND OPTIMIZATION OF A METHANOL REACTOR WITH THE ADSORPTIONOF CARBON MONOXIDE AND WATER

Paper ID -1305

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Abstract

Methanol is generally produced in adiabatic or Lurgi type catalytic reactors from syngas or pure carbon dioxide and hydrogen. In this research, an innovative methanol reactor is analyzed and optimized, because sorbents for the capture of carbon monoxide and water are used. In particular, zeolite molecular sieves having high $SiO2/Al2O3$ are used to capture carbon monoxide while zeolites 4A are implemented to adsorb water molecules. No sorbents for the capture of carbon monoxide are suggested before. In this system, the two reactions in methanol production are both favored, then it is possible to increase them ethanol yield, reducing the outlet reaction temperature, compared to a traditional adiabatic reactor. An ANOVA analysis and a response surface methodology are also developed. Results show that the capture fraction is the most important factor with the aim to improve the methanol yield and to reduce the reaction temperature. Optimal operating conditions are found in order to have a nearly-isothermal system (493 K) maximizing the methanol yield (37%): the capture fraction, recycle of gases, inlet temperature and reaction pressure must be respectively equal to 80%, 79.7%, 493.32 K and 55 bar. In the future work, an experimental reactor can be realized to verify the obtained results.

Keywords: carbon dioxide, Sio, Al2o3, etc.

ENHANCEMENT OF HEAT TRANSFER IN ADSORPTION BED OF VACUUM-TUBE WITH FINS

Paper ID -1306

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Abstract

To improve the heat transfer in the adsorption bed that was applied in a solar adsorption cooling system, an experimental study was conducted on the finned adsorption bed with the SAPO-34 zeolite–water as the working pair. In windless and sunny weather conditions, the performance of the system was investigated for different cases of the fin number changing from 2 to 8, given a fixed fin height and fin thickness. The experimental results revealed that not only the cooling capacity, but also the coefficient of the performance (COP) as well as the specific cooling power (SCP) of the system, were improved obviously with the increment of the fin number. With the heat transfer enhancing effect of the inserted fins, the bed cooling time following the desorption process was greatly reduced. Although the solar energy input in the preheating and the desorption process was increased for the fin-enhancing cases, the comprehensive result of the cycle performance was revealed to be profitable.

Keywords: SCP, COP, SAPO, etc.

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DESIGN AND EXPERIMENTAL STUDY OF A SMALL SCALE ADSORPTION DESALINATOR

Paper ID -1307

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Abstract

Adsorption desalinator produce potable water from seawater using low-grade heat at 50–90 °C. The technology has been proven using several experimental systems, but their sizes are too large to allow efficient further development by testing novel adsorption materials and components. In this study, we introduce the world's most compact adsorption desalinator with a bed size of 0.2 kg silica gel. The system achieves a Specific Daily Water Production of 7.7 kg water per kg silica-gel and day. The performance is comparable to the best performing system to date proving that the downscaling is not detrimental. Moreover, the tests demonstrate the benefits of simple heat integration between the adsorbed bed, which reduces energy consumption by 25% and increases the Performance Ratio to 0.6. The importance of heat integration is further highlighted in an unprecedented thermal response experiment, which evaluates the partition of energy input in terms of sensible heat and heat of desorption.

Key words: Heat, ratio, performance, etc.

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EXPERIMENTAL INVESTIGATION ON THE PERFORMANCE OF AN ADSORPTIONSYSTEM USING MAXSORB III+ ETHANOL PAIR

Paper ID -1308

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Abstract

The performance of an adsorption system using Maxsorb III + ethanol pair is investigated for practical heat pump applications. An adsorption system using a single bed with a single evaporator/condenser is employed and the performance of the system is assessed for various regeneration temperatures (80°C, 70°C and 60°C). The impact of the adsorption time on the performance of the selected pair is further evaluated. The potential application of the present adsorbent + adsorbate pair is the automobile air-conditioning system where the exhaust waste heat will be recovered to operate the adsorption system. Thus, antifreeze fluid is employed as the heat transfer medium for the adsorber and the evaporator/condenser heat exchanger. A mathematical model is developed to estimate the uptake amount. The sensible heat change (thermal mass), the superheating of the refrigerant in the adsorber, the adsorber heat leak and the heat rejection to the heat transfer medium are accounted for. The uptake amount is further verified using the classical p-T-q diagram. For operation using 30° C adsorber coolant inlet and 15° C chilled water inlet, the cooling capacity of the present system ranges from 15 to 35W for the adsorption times of 600 s and 300 s, respectively. It is observed that the regeneration temperature significantly influences the net uptake of the system. The maximum net uptake is recorded to be about 0.995 kg/kg for the regeneration temperature of 80° C. The system is further assessed using the ratio of the cooling capacity to the adsorption heat.

Key words: Heat, ratio, performance, temperature, etc.

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EXPERIMENTAL INVESTIGATION OF A SOLAR-POWERED ADSORPTION REFRIGERATION SYSTEM WITH THE ENHANCING DESORPTION

Paper ID -1309

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Abstract

The paper proposes a novel solar adsorption refrigeration system employing an active enhancing mass transfer method based on the typical basic cycle. In essence, the new method is to drop the internal pressure of the system in the desorption process. The working principle of the hypothesis and the cycle description are explained in detail and analyzed by laboratory experiments. The novel solar adsorption refrigeration system prototype with activated carbon-methanol as working pair was designed and built. Some different comparative tests under different weather conditions were conducted to prove the hypothesis and evaluate the performance of the novel adsorption refrigeration system. The experimental results show that the system employing an active enhancing mass transfer method will increase the mass of desorbed refrigerant by about 20% if compared with a natural desorption refrigeration system. It was also proved that the novel method is very effective for low adsorbent temperature operation, which may help to obtain a COP solar increase of at least 16.4%. And about one and half-hours can be saved by enhancing desorption refrigeration system to get the same desorbed refrigerant with the natural desorption refrigeration system. The results of experiments show that the novel system has improvements in the coefficient of performance, the mass of desorption and desorption rate, and the characters of the solar adsorption refrigeration system can be a benefit to further application.

Key words: COP, solar, Cycle, etc.

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PERFORMANCE COMPARATIVE STUDY OF A SOLAR-POWERED ADSORPTION REFRIGERATORWITH A CPC COLLECTOR/ADSORBENT BED

Paper ID -1310

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Abstract

Solar adsorption refrigeration has many advantages. However, solar radiation has a relatively low energy density and requires much time to heat an adsorbent bed. In addition, the coefficient of performance (COP) of an adsorption refrigeration system is relatively low. In this paper, a new solar adsorption refrigeration prototype, which uses a compound parabolic concentrator (CPC) adsorbent bed with activated carbon-methanol as the working pair, was proposed and built to shorten the cycle time and improve performance. Laboratory experiments were conducted to evaluate and compare its performance and characteristics to those of a conventional solar adsorption refrigeration system. The experimental results show that the speed of the temperature increase of the adsorbent bed was boosted by employing CPC collectors. Compared with a conventional refrigeration system, the desorption period of the new system was reduced by one-third over one cycle. The desorption rate of the adsorption refrigeration cycle was notably improved. By using the CPC collector in a solar adsorption refrigeration system, the COP increased by 27%. The experimental results also show that applying solar concentrating technology in adsorption refrigeration is a promising approach for improving solar adsorption refrigeration performance and achieving a fast and continuous refrigeration cycle.

Key words: COP, solar, Cycle, refrigerate, etc.

SYNTHESIS AND CHARACTERIZATION OF SILICA GEL COMPOSITE WITH POLYMER BINDERS FOR ADSORPTION COOLING APPLICATIONS

Paper ID -1311

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Abstract

The motivation of the present paper is to synthesis high packing density and thermal conductivity consolidated composite using silica gel powder (SGP) almost without affecting its porous properties. The effect of packing density, binder type and amount on porous properties as well as thermal conductivity was studied. Four types of binder, namely Hydroxy ethyl cellulose (HEC), Polyvinyl alcohol (PVA), Polyvinyl pyridine (PVP) and gelatin were chosen. SGP composite with PVP 2wt% as binder showed better performance for both porous and thermal properties. Thermal conductivity for PVP 2wt% composite was found 32% higher than SGP. Adsorption uptake of water onto SGP and PVP 2wt% composite at 30 to 70 ºC adsorption temperatures were measured using gravimetric method. To the equation is found suitable to fit the isotherm data. Results showed that there is no change in water adsorption uptake between SGP and PVP 2wt% composite whereas the volumetric uptake increased by 12.5% for the composite. The studied composites were found to be suitable for designing high performance adsorption cooling systems.

Key words: SGP, PVP, HEC, Cycle, etc.

ANALYSIS OF HEAT TRANSFER CHARACTERISTICS WITH TRIANGULAR CUT TWISTED TAPE (TCTT) AND CIRCULAR CUT TWISTED TAPE (CCTT) INSERTS

Paper ID -1312

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Abstract

The paper represents the numerical investigation of heat transfer characteristics in a pipe provided with twisted tape inserts is analyzed. The heat transfer was analyzed in a swirling flow conditions using CFD simulation. A commercial CFD package was used for analyze twisted tape for circular tube fitted with triangular cut twisted tape and circular hole cut twisted tape inserts. The twisted tape system allows a significant increase of convective heat transfer coefficient by introducing the swirl flow motion. The swirl flow motion provides greater heat transfer rate extracted from the solid surface of the tube. The depth of cuts for triangular cut 5 mm and depth of hole cut 5 mm twisted tapes were used for simulation generation. In this paper CFD analysis was used for enhancement of heat transfer rate of fluid of laminar flow. The experimental investigation were conducted in double pipe heat exchanger and these value of plain twisted tape, triangular twisted tape and circular hole cit twisted tape were taken for used simulation analysis. The performance of heat transfer rate was enhanced 1.1–1.3 times compared that the plain twisted tape and circular cut twisted tape. The data obtained from the simulation correlations for triangular cut twisted tape and circular hole cut twisted tape; and these data were correlated with plain twisted tape.

Keywords: Circular cut twisted tape, Triangular cut twisted tape, Computational.

CFD SIMULATION OF HEAT TRANSFER ENHANCEMENT IN CIRCULAR TUBE WITH TWISTED TAPE INSERT BY USING NANOFLUIDS

Paper ID -1313

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Abstract

Heat transfer enhancement using Nano-fluids has gained significant attention over the past few years. Nano-fluids are potentially applicable as alternative coolants for many areas such as electronics, automotive, air conditioning, power generation and nuclear applications. Heat transfer coefficient and the friction factor characteristics of SiC/water Nano fluid will have been numerically investigated using ANSYSFLUENT 14.0. The Nano fluid was employed in a circular tube equipped with modified Horizontal Wing Twisted Tapes (HWTT) with different twist ratio (y = 2.0, 4.4, 6.0) were used for simulation and compared with Plain Twisted Tapes (PTT). The results of CFD investigations of heat transfer Coefficient and friction characteristics are presented for the HW-TT with Different twist ratio in comparison with the P-TT case.

Keywords*:* Plain Twisted Tapes, Horizontal wing twisted tapes Nano fluids Heat exchanger, CFD.

ENHANCEMENT OF HEAT TRANSFER IN SIX-START SPIRALLY CORRUGATED TUBES

Paper ID -1314

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Abstract

The utilization of corrugation for improvement in heat transfer is increasingly becoming interesting recently due to its combined advantages such as extended surfaces, tabulators as well as roughness. This study employed the use of both numerical as well as experimental settings on the water flowing at lower Reynolds numbers in a corrugated tubes with spiral shape to evaluate the performance of heat in a newly designed corrugation style profile. The total performance of the heat for the corrugation tubes were determined and the mathematical information generated from both the Nusselt number and the factors of friction were equated with those of the experimentally generated outcome for both standard smooth as well as the corrugated tubes. Analysis of the data generated revealed improvements in heat transfer ranges of (2.4–3.7) times those obtained from the smooth tubes with significant increase in the friction factors of (1.7–2.3) times those of the smooth tubes. Based on the findings of study, it was concluded that for extended period and extensive range use, tubes with severity index values at36.364×10–3 could produce better heat performance (1.8–3.4) at Reynolds numbers ranging from 100 to 1300. This was an indication that the geometric expression with spiral corrugation profile could significantly enhance the efficiency of heat transfer with significantly increased friction factors.

Keywords: Enhancement of heat transfer, Spirally corrugated tube, Six–starts, Friction factor etc.

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EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER IN A TUBE HEAT EXCHANGER WITH AIRFOIL-SHAPED INSERT

Paper ID -1315

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Abstract

In this present study, the novel insert for heat exchanger is presented. The airfoil-shaped insert, Modified NACA0024, is chosen to improve the heat transfer performance in the tube. This experiment is performed to study and investigate the thermal and fluid flow behaviors. The straight tape which Modified NACA0024 are mounted on the both sides generates the longitudinal vortices in the tube. The Reynolds number based on tube diameter of 4196 to 8125 are selected to be the desired test range. Main major parameter, inclination angle (IA=0°, 30° and 45°), is considered. The experimental investigation indicates that maximum values of heat transfer ratio, friction ratio, and heat transfer enhancement performance can be found at Reynolds number of4196. The Modified NACA0024 with inclination angle of 45° can present the best heat transfer augmentation approximately 3 times over the plain tube and the maximum heat transfer enhancement performance (HTEP) of 1.45.

Keywords: Airfoil shape, Straight tape, Modified heat transfer enhancement.

NANO-ENHANCEMENT OF PHASE CHANGE MATERIAL IN A SHELL AND MULTI-PCM-TUBE HEAT EXCHANGER

Paper ID -1316

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Abstract

The fundamental defect of PCMs in discharging process is their low conductivity which results in long solidification time. In this study distribution of a PCM in a multi-tube heat exchanger is conducted numerically to reduce the solidification time. Therefore, the PCM mass is distributed in the inner and outer tubes between which a heat transfer fluid (HTF) passes through. Various volume fractions of copper nanoparticles are added to the PCM and the consequences of the conductivity enhancement is observed. Moreover, the variation of Stefan number (Ste) is considered to evaluate the effect of this parameter on the solidification process. In addition, it is shown that the distribution of the PCM is greatly effective on the heat transfer enhancement. Proper PCM mass distribution leads to 62% reduction in the solidification time. Results also indicates that by increasing the Nano particles volume fractions to 4% and Set to 0.45, the solidification time reduces 15% and 26%, respectively in the best case.

Keywords: Solidification, Phase change material, Mass distribution, Nano particle Shell and tube heat exchanger.

EXPERIMENTAL STUDY ON THE EFFECT OF TIO2–WATER NANOFLUID ON HEAT TRANSFERAND PRESSURE DROP

Paper ID -1317

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Abstract

An experimental study performed to investigate the effect of nanoparticle volume fraction on the convection heat transfer characteristics and pressure drop of TiO2 (30 nm)–water Nano fluids with nanoparticle volume fraction between 0.002 and 0.02, and Reynolds number between 8000 and 51,000. The experimental apparatus is a horizontal double tube counter-flow heat exchanger. It is observed that by increasing the Reynolds number or nanoparticle volume fraction, the Nusselt number increases. Meanwhile all Nano fluids have a higher Nusselt number compared to distilled water. By use the Nano fluid at high Reynolds number (say greater than 30,000) more power compared to low Reynolds number needed to compensate the pressure drop of Nano fluid, while increments in the Nusselt number for all Reynolds numbers are approximately equal. Therefore using Nano fluids at high Reynolds numbers compared with low Reynolds numbers, have lower benefits.

Keywords: TiO2–water Nano fluid, Nanoparticles diameter, Nusselt number, Pressure drop, Turbulent flow.

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HEAT TRANSFER PERFORMANCE OF A NANO-ENHANCED PROPYLENE GLYCOL: WATER MIXTURE

Paper ID -1318

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Abstract

Propylene glycol: water mixtures are usually employed as heat transfer fluids because of their protection against low freezing temperatures and non-toxicity. They are used as working fluids in different applications, like those based on renewable sources such as solar thermal or geothermal energy. In this work, the convection heat transfer coefficients and the pressure drops of various functionalized grapheme Nano platelet Nano fluids with a propylene glycol: water mixture at 30:70% mass ratio as base fluid have been experimentally determined. Thus, the heat transfer performance of Nano additive mass concentrations up to 1.0% at different working temperatures from (298.15–313.15) K and flow rates from (0.2–0.7) m3 · h−1 has been evaluated by means of an experimental setup whose main element is a double pipe heat exchanger of stainless steel. Enhancements of the convection heat transfer coefficient reaching 15.3% have been found for the 0.75% mass concentration. Furthermore, a dimension less analysis has been carried out and new correlations were provided in order to predict Nusselt number and friction factor as a function of other dimensionless parameters. Maximum deviations for Nusselt number and friction factor of 2.5% and 1.5% were achieved, respectively. Finally, thermal performance factors were also obtained for each condition with the aim of evaluating the thermal effectiveness of all the prepared Nano fluids with respect to the base fluid.

Keywords: Nano fluid, Propylene glycol-water, Grapheme Nano platelets, Heat transfer etc.

AN EXPERIMENTAL INVESTIGATION ON HEAT TRANSFER CHARACTERISTICS OF GRAPHITE-SIO2/WATER HYBRID NANOFLUID FLOW IN HORIZONTAL TUBE WITH VARIOUS QUADCHANNEL TWISTED TAPE INSERTS

Paper ID -1319

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Abstract

Turbulent heat transfer characteristics of Graphite-SiO2/Water hybrid Nano fluid flow in a horizontal smooth tube with and without quad-channel twisted tape (QCTT) inserts is investigated experimentally. The hybrid Nano fluid is obtained using two different nanoparticles: Silicium dioxide (60%) and Graphite (40%) with pure water as base fluid. Experiments are conducted for two different volume concentrations, 0.5% and 1%, respectively. The length of quad-channel twist tape inserts are between 0 and 42 cm with constant twist ratios of 5.The Reynolds number is varied from 3400 to 11,000. According to the results, Nusselt number of the case with hybrid Nano fluid increased with increasing mass flow rate and volume concentration. Also, heat transfer coefficient increased with increasing length of twisted tape insert. Moreover, friction factor increases with increasing volume concentration for increasing Reynolds number whereas and friction factor increases with increasing the length of tape inserts. Pressure drop increases with increasing mass flow rate and increasing volume concentration. Finally, the regression equations are found to be well-matched with the experimental data within the deviation band of±5% for Nusselt number and ± 10% for friction factor, respectively.

Keywords: Hybrid Nano fluid, twisted tape insert, Friction factor etc.

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LAMINAR FORCED CONVECTION PERFORMANCE OF NON-NEWTONIAN WATER-CNT/FE_3O_4 NANO-FLUID INSIDE A MINICHANNEL HAIRPIN HEAT EXCHANGER: EFFECT OF INLET TEMPERATURE

Paper ID -1320

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Abstract

This numerical study aims to focus on the effect of difference between the inlet temperatures of working fluids on the hydrothermal characteristics of a counter-current mini channel hairpin heat exchanger. The water flows in the annulus side and the water based hybrid Nano-fluid containing Fe_3O_4 and carbon nanotubes (CNTs) passes through the tube side of heat exchanger. Temperature-dependent thermal conductivity and viscosity are considered for the non-Newtonian hybrid Nano-fluid. The effects of Fe_3O_4 and CNT volume fractions as well as the Reynolds number on the performance metrics of the heat exchanger are also assessed. The results revealed that the increase of difference between the inlet temperatures of working fluids leads to the augmentation of heat transfer rate, overall heat transfer coefficient (except at Reynolds number of 500), heat exchanger effectiveness and PEC; while the pumping power diminishes with the increase of inlet water temperature.

Keywords*:* Hybrid Nano-fluid, Hairpin heat exchanger, Heat transfer, Inlet temperature, Carbon nanotube.

IDENTIFICATION OF THE OPTIMAL CONVERTER TOPOLOGY FOR SOLAR WATER PUMPING APPLICATION

Paper ID -1321

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Abstract

This paper envisages identifying an optimal topology of DC-DC converter for the solar pump application, by comparing the performance indices of the three advanced non-isolated converters namely Landsman converter, Luo converter and Zeta converter. The identified best topology of the non-isolated DC-DC converter, which basically operates in the mode of buck-boost converters cascaded to a three phase voltage source inverter (VSI), which is connected to a permanent magnet brushless DC (PMBLDC) motor. The whole system is front ended to a PV panel. In order to obtain the maximum power transfer to the load, a popular maximum power point tracking (MPPT) technique, Perturb and Observe (P&O) has been implemented. The whole system is simulated under the environment of PSIM.

Keywords: PV system, Perturb and Observe, MPPT, PMBLDC, DC-DC converter.

CFD MODELING OF TURBULENT FORCED CONVECTIVE HEAT TRANSFER AND FRICTION FACTOR IN A TUBE FOR FE_3O_4 MAGNETIC NANOFLUID IN THE PRESENCE OF A MAGNETIC FIELD

Paper ID -1322

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Abstract

Computational fluid dynamics (CFD) tool is used to study numerically a Nano fluid mixture of water and Fe 3 O 4 with MHD effect. The simulation is performed in order to determine the turbulence forced convection heat transfer in a circular tube. This is implemented by using the single and two phase mixture approaches with assumption that the particles are spherical and diameter equal to 36 nm. The simulation output data compared with an experimental literature data from other study and found matching. The result shows that Nu and friction factor at fixed Reynolds number is proportional to the magnetic field.

Keywords: CFD Convective heat transfer Turbulent Magnetic Nano fluid.

HEAT TRANSFER AUGMENTATION BY NANO-FLUIDS AND SPIRAL SPRING INSERT IN DOUBLE TUBE HEAT EXCHANGER – A NUMERICAL EXPLORATION

Paper ID -1323

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Abstract

The efficiency of the most of the thermal devices can be improved by increasing the heat transfer. Some process industries like power plant, automobile demand the heat transfer augmentation in either heating or cooling or evaporation on the devices like air conditioning, radiators, refrigerators, condensers etc. The available methods can be classified in to two category namely passive and active techniques. The objective of the research to improve the heat transfer in double pipe heat exchanger by passive techniques. The fluid mediums like water, titanium dioxide Nano-fluid, Beryllium oxide or beryllium Nano-fluid, zinc oxide Nano-fluid and copper oxide nano-fluids are considered for analysis with the aim of increasing the thermal conductivity of fluid medium. The Spiral Spring insert used for offering the flow resistance and spread the fluid to surface to enhance the heat transfer. The numerical study is investigating the thermal and flow fields utilizing various types of Nano-fluids with Spiral Spring insert in the double pipe heat exchanger. The Finite volume method employed for solve the continuity, momentum and energy equations the ANSYS 15.0 employed for conducting the numerical analysis.

Keywords: Numerical analysis, Heat transfer, Titanium dioxide Nano-fluid, etc.

HYBRID NANOFLUID TO ENHANCE HEAT TRANSFER UNDER TURBULENT FLOW IN A FLAT TUBE

Paper ID -1324

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Abstract

The heat transfer enhancement by utilizing hybrid Nano fluid is a new class of heat transfer enhancement. In this paper, CFD model with commercial software adopting the finite volume method and SIMPLE algorithm has been conducted. Mixture of Aluminum Nitride (AlN) and alumina (Al2O3) nanoparticles into water as a base fluid is considered as a new concept of hybrid Nano fluid for enhancing heat transfer. It was performed the simulation procedures with the volume fraction (1, 2, 3 and 4%) and Reynolds number are changing from 5000 to 17000. The heat flux applied along the elliptical tube is 7000 w/m2 and the nanoparticles size diameter is fixed at 35 nm. The validation of computational results has been performed with experimental data available in the literature. The results indicated that the hybrid nanoparticles of AlN - Al2O3suspended in water as a base fluid tends to enhance heat transfer significantly.

Keywords: Hybrid, Nano fluid, Performance, Turbulent, CFD ANSYS.

NANOPARTICLE-ENHANCED PHASE CHANGE MATERIALS (NEPCM) WITH GREAT POTENTIAL FOR IMPROVED THERMAL ENERGY STORAGE

Paper ID -1325

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Abstract

Improved functionality of phase change materials (PCM) through dispersion of nanoparticles is reported. The resulting nanoparticle-enhanced phase change materials (NEPCM) exhibit enhanced thermal conductivity in comparison to the base material. Starting with steady state natural convection within a differentially-heated square cavity that contains a Nano fluid (water plus copper nanoparticles), the Nano fluid is allowed to undergo solidification. Partly due to increase of thermal conductivity and also lowering of the latent heat of fusion, higher heat release rate of the NEPCM in relation to the conventional PCM is observed. The predicted increase of the heat release rate of the NEPCM is a clear indicator of its great potential for diverse thermal energy storage applications.

Keywords: Nanoparticles, Nano fluids, Phase change, Thermal storage, Natural convection, Freezing.

COMPARATIVE ANALYSIS OF HEAT TRANSFER AND PRESSURE DROP IN HELICALLY SEGMENTED FINNED TUBE HEAT EXCHANGERS

Paper ID -1326

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Abstract

Four different semi-empirical models of heat transfer and pressure drop for helically segmented finned tubes in staggered layout were analyzed. The performance of a Helically Segmented Finned Tubes Heat Exchanger on an industrial scale was obtained and the predictions were compared with experimental data. The method used for thermal analysis is the Logarithmic Mean Temperature Difference (LMTD).Comparisons between predictions and experimental data show a precision greater than 95% in heat transfer for a combination between the Kawaguchi and Gnielinski models at a flue gas Reynolds number, based on the outside bare tube, of about 10,000. In the case of pressure drop, there is a precision of approximately 90% for the Weierman model at a Reynolds number, based on the outside bare tube, of about 10,000. And so, the results show that the best flow regime in which heat transfer and pressure drop are optimum, is for a Reynolds number (based on the outside bare tube) of about 10,000.

Keywords: Experiment, Compact heat exchangers, Segmented fins, Pressure drop, Heat transfer coefficient.

CFD ANALYSIS ON HEAT TRANSFER AND PRESSURE DROP CHARACTERISTICSOF TURBULENT FLOW IN A TUBE FITTED WITH TRAPEZOIDAL-CUT TWISTEDTAPE INSERT USING FE3O4 NANO FLUID

Paper ID -1327

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Abstract

Heat transfer and friction factor characteristics of a circular tube fitted with full length twisted tape trapezoidal cut were studied for the Reynolds number range of 2000–12,000. The secured experimental data from plain tube were validated with standard correlations to make sure the authorization of experimental results. The thermal performance of trapezoidal cut twisted tape increase significantly than the plain tube. Performance ratio is more than unity is reasonable for trapezoidal cut twisted tape. Eventually twisted tape with water as the working fluid was compared with Fe3O4 Nano fluid as working fluid at a volume concentration of 0.06%.

Keywords: CFD analysis, Twist ratio Trapezoidal, cut Augmentation, Friction factor Performance ratio.

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CFD ANALYSIS ON HEAT AND FLOW CHARACTERISTICS OF DOUBLE HELICALLY COILED TUBEHEAT EXCHANGER HANDLING MWCNT/WATER NANOFLUIDS

Paper ID -1328

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Abstract

Double helically coiled tube heat exchangers are used in different heat transfer utilization due to higher heat transfer capabilities and with their compactness. The double helically coiled tube heat exchanger increases the turbulence and enhances the maximum heat transfer rate than the straight tubes. In this investigation, the heat transfer and pressure drop of the double helically coiled heat exchanger handling MWCNT/water Nano fluids have been analyzed by the computational software ANSYS 14.5 version. The computational analysis was carried out under the laminar flow condition in the Dean number range of 1300–2200. The design of new shell and double helically coiled tube heat exchanger was done by using standard designing procedure and 3D modeling was done in Cre-O 2.0 parametric. The Finite Element Analysis software ANSYS Workbench 14.5 was used to perform CFD analysis under the standard working condition. The MWCNT/water Nano fluids at 0.2%, 0.4%, and 0.6% volume concentrations have been taken for this investigation. The major factors like volume concentrations of Nano fluids and Dean Number are considered for predicting the heat transfer rate and pressure drop. The simulation data was compared with the experimental data. It is studied that the heat transfer rate and pressure drop increase with increasing volume concentrations of MWCNT/water Nano fluids. It is found that the Nusselt number of 0.6%MWCNT/water Nano fluids is 30% higher than water at the Dean number value of 1400 and Pressure drop is 11%higher than water at the Dean number value of 2200. It is found that the simulation data hold good agreement with the experimental data. The common deviation between the Nusselt number and pressure drop of CFD data and the Nusselt number and pressure drop of experimental data are found to be 7.2% and 8.5% respectively.

Keywords: Nanotechnology, Computational mathematics, Volume concentration of nanoparticle.

A CFD INVESTIGATION OF HEAT TRANSFER ENHANCEMENT OF SHELL AND TUBE HEAT EXCHANGER USING AL2O3-WATER NANOFLUID

Paper ID -1329

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Abstract

A multi pass shell and tube heat exchanger with 3 tubes modeling is done using CATIA and meshing has done using ICEM CFD software, simulations has done by using CFD-FLUENT software. Using Fluent, computational fluid dynamics software the pressure drop, heat transfer characteristics of Al2O3-water Nano fluid, and distilled water are analyzed under turbulent flow condition. Nano fluid such as Al2O3-H2O is used as cooling medium instead of Distilled water. Finally the CFD simulated results are compared with experimental results. The effects of Peclet number, volume concentration of suspended nanoparticles, and particle type on the heat transfer characteristics were investigated. Based on the results, adding of nanoparticles to the base fluid (Distilled water) causes the significant enhancement of heat transfer characteristics.

Keywords: Catia, multipass shell and tube exchanger, CFD fluent , Al_2O_3-water Nano fluid.

EXPERIMENTAL AND NUMERICAL INVESTIGATION ON AIR-SIDE PERFORMANCEOF FIN-AND-TUBE HEAT EXCHANGERS WITH VARIOUS FIN PATTERNS

Paper ID -1330

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Abstract

Air-side heat transfer and friction characteristics of five kinds of fin-and-tube heat exchangers, with the number of tube rows (N = 12) and the diameter of tubes (Do = 18 mm), have been experimentally investigated. The test samples consist of five types of fin configurations: crimped spiral fin, plain fin, slit fin, fin with delta-wing longitudinal vortex generators (VGs) and mixed fin with front 6-row vortex-generator fin and rear 6-row slit fin. The heat transfer and friction factor correlations for different types of heat exchangers were obtained with the Reynolds numbers ranging from 4000 to 10000. It was found that crimped spiral fin provides higher heat transfer and pressure drop than the other four fins. The air-side performance of heat exchangers with the above five fins has been evaluated under three sets of criteria and it was shown that the heat exchanger with mixed fin (front vortex-generator fin and rear slit fin) has better performance than that with fin with delta-wing vortex generators, and the slit fin offers best heat transfer performance at high Reynolds numbers. Based on the correlations of numerical data, Genetic Algorithm optimization was carried out, and the optimization results indicated that the increase of V Gattack angle or length, or decrease of VG height may enhance the performance of vortex-generator fin. The heat transfer performances for optimized vortex-generator fin and slit fin at hand have been compared with numerical method.

Keywords: Fin-and-tube heat exchanger, Evaluation criteria, GA optimization.

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EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER COEFFICIENT AND FRICTION FACTOROF ETHYLENE GLYCOL WATER BASED TIO2 NANOFLUID IN DOUBLE PIPE HEAT EXCHANGER WITH AND WITHOUT HELICAL COIL INSERTS

Paper ID -1331

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Abstract

Heat transfer coefficient and friction factor of TiO2 Nano fluid flowing in a double pipe heat exchanger with and without helical coil inserts are studied experimentally. The experiments are conducted in the range of Reynolds number from4000 to 15,000 and in the volume concentration range from 0.0004% to 0.02%. The base fluid is prepared by considering 40% of ethylene glycol and 60% of distilled water. The heat transfer coefficient and friction factor get enhanced by 10.73% and 8.73% for 0.02% volume concentration of Nano fluid when compared to base fluid flowing in a tube. Heat transfer coefficient and friction factor further get enhanced by 13.85% and 10.69% respectively for 0.02% Nano fluid when compared to base fluid flowing in a tube with helical coil insert of P/d = 2.5. The measured values of heat transfer coefficient and friction factor are compared with the published literature. Based on the experimental data, generalized correlations are proposed for Nusselt number and friction factor. The results are presented in graphical and tabular form. Uncertainty analysis is also carried out and the experimental error is in the range of ±10%.

Keywords: Heat transfer, Friction factor, Helical coil inserts,TiO2 Nano fluid .

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THERMAL CONDUCTIVITY ENHANCEMENT OF AL2O3 NANOFLUID IN ETHYLENE GLYCOL AND WATER MIXTURE

Paper ID -1332

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Abstract

The ability of Nano fluids that exhibits enhanced thermal performance is acknowledged by researchers through studies since decades ago. However, the observation of thermal properties for Nano fluids in water and ethylene glycol based is not fully explored yet. Hence, this paper presents the thermal conductivity of water and ethylene glycol (EG) basedAl2O3 Nano fluid. The 13 nm sized Al2O3 nanoparticles were dispersed into three different volume ratio of water: E Gsuch as 40:60, 50:50 and 60:40 using a two-step method. The measurement of thermal conductivity was performed using KD2 Pro Thermal Properties Analyzer at working temperatures of 30 to 70 oC for volume concentration of 0.5to 2.0 %. The results indicate that the thermal conductivity increases with the increase of Nano fluid concentration and temperature. While the percentages of ethylene glycol increase, the range of thermal conductivity decreases due to ethylene glycol properties. The measurement data of the Nano fluids give maximum enhancement of thermal conductivity at condition 2.0 % volume concentration, temperature of 70 oC and for all base fluid.

Keywords: Nano fluid, aluminum oxide, thermal conductivity enhancement, water: EG mixture.

NUMERICAL STUDY TO PREDICT OPTIMAL CONFIGURATION OF FIN AND TUBE COMPACT HEAT EXCHANGER WITH VARIOUS TUBE SHAPES AND SPATIAL ARRANGEMENTS

Paper ID -1333

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Abstract

The study aims at numerically evaluating the thermal hydraulic performance of fin tube heat exchangers with circular, oval and flat tubes having inline and staggered arrangement. Three performance evaluation criteria (PECs), namely, area goodness factor (PEC1), heat transfer rate per unit fan power consumption (PEC2) and heat transfer rate per unit total power consumption (PEC3) are considered. Furthermore, the MOORA (multi-objective optimization on the basis of ratio analysis) method is employed to obtain the order of performance and that order is compared with the conventional PECs (performance evaluation criteria), showing good agreements. From the overall optimization study finally, it has been observed that the oval tube having highest axes ratio is the optimum configuration based on the considered PECs. It shows an increase in heat transfer coefficient by 13.99% at lower airside Reynolds number of (Re = 400)and 4.99% at higher airside Reynolds number (Re = 900). Also, the pressure drop is reduced by 39.94% at higher Reynolds number (Re = 900) compared to the circular tube shape with the inline arrangement.

Keywords: Compact heat exchanger, Pressure drop penalty, Hydraulic performance, MOORA Optimization.

MODIFICATION OF MICROENCAPSULATED PHASE CHANGE MATERIALS (MPCMS) BY SYNTHESIZING GRAPHENE QUANTUM DOTS(GQDS) AND NANO-ALUMINUM FOR ENERGY STORAGE AND HEAT TRANSFER APPLICATIONS

Paper ID -1334

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Abstract

MPCMs and their suspensions, acting as the thermal storage, heat transfer or temperature constancy mediums, have gained concerns in various energy related sectors. However, problems involving high super cooling degree, low thermal conductivity and suspensions instability are barriers for their energy storage applications. The present study focuses on such properties by adding GQDs/Nano-aluminum into MPCMs particles. Paraffin was selected as core material and urea melamine formaldehyde polymer as shell to prepare 10 MPCMs samples (no modifiers, GQDs, Nano-aluminum, GQDs & Nano-aluminum) via in situ polymerization. The morphology, thermal conductivity, thermal property and MPCM/suspensions stability were characterized. It was found, the selected modifiers didn't impact on the microcapsules morphology, but GQDs can make particle size smaller and distribution more uniform. Adversely, the mean particle size can be increased by Nano-aluminum. GQDs are much more effective than nanoaluminumin improving thermal conductivity. GQDs can suppress super cooling effectively, however, Nano-aluminum has no obvious effect on super cooling suppression. The MPCMs suspension modified bythe selected amount of GQDs and Nano-aluminum (Al-GQDs(4.5e2)) achieved a high physical stability. No structure instability of modified MPCM sample was observed. To sum up, the combined effort of GQDs and Nano-aluminum enabled MPCMs to be more applicable in energy storage applications.

Keywords: Microencapsulated phase change material Grapheme quantum dots Nano-aluminum.

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FUNCTIONALIZED MULTI-WALLED CARBON NANOTUBES BASED NEWTONIAN NANO FLUIDS FOR MEDIUM TEMPERATURE HEAT TRANSFER APPLICATIONS

Paper ID -1335

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Abstract

Functionalized multi-walled carbon nanotubes (f-MWCNTs) were synthesized and dispersed in the organic heat transfer fluids (OHTFs) to improve the thermo-physical properties of the medium temperature stable Nano thermic fluids (MNTFs). The prepared MNTFs showed an enhancement in thermal conductivity especially at high temperatures compared to the base OHTFs with addition of low quantities of f-MWCNTs. Based on the rheological studies, the Newtonian behaviour of the synthesized MNTFs have been demonstrated over a wide range of shear rates at various temperatures. The present study thus confirms the potential of developed MNTFs with desired rheological properties, high thermal and mechanical stability, high flash point, high specific heat capacity and high thermal conductivity for medium temperature heat transfer applications. The developed MNTFs found to exhibit high and stable dispersion even after centrifugation with a speed of 5,000rpm for 30 min.

Keywords: Functionalized MWCNTs, Nano fluids, Medium temperature heat, etc.

HEAT ENHANCEMENT OF HEAT EXCHANGER USING ALUMINIUM OXIDE (AL_2O_3), COPPER OXIDE (CUO) NANO FLUIDS WITH DIFFERENT CONCENTRATIONS

Paper ID -1336

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Abstract

Active and passive heat transfer techniques are commonly employed for heat transfer augmentation in fluids. Conventional heat transfer fluids like water, oil, and glycols have poor heat transport capabilities and they hardly meet the present day requirements of high heat dissipation rates in compact heat exchangers. Design of Compact heat exchanger and miniaturizing of high energy devices are possible only with the fluids having better heat transfer performance. The Nano fluids are considered to be new generation fluids characterized by better heat transfer capabilities over traditional heat transfer fluids. The Nano fluid is an emerging area of research and has lot of potential in heat transfer applications. Particles of size less than 100nm exhibit properties different from those of conventional solids. Nano materials have unique mechanical, electrical, optical, magnetic and thermal properties. Thermo physical properties of Al_2O_3 and CuO with water as base fluid have been experimentally determined at different volume concentrations. Present study is aimed at estimating the heat transfer enhancement for different Reynolds number in turbulent range at volume concentration of 0.1%, 0.25% and 0.4%.

Keywords*:* Heat transfer enhancement, $Al_2O_{3,}$CuO, Water, Heat transfer coefficient, Thermal conductivity.

HEAT TRANSFER ANALYSIS OF A NON-NEWTONIAN FLUID FLOWING THROUGH A CIRCULAR TUBE WITH TWISTED TAPE INSERTS

Paper ID -1337

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Abstract

In this paper, the moment and heat transfers of a non-Newtonian fluid flowing in steady laminar regime through a circular tube with a twisted tape at constant wall temperature is studied using CFD. The effect of different twist ratios of the tape on the convective heat transfer and the pressure drop are investigated over the Reynolds number range of 0.2-600. It was found that a twisted tape induces a swirling flow, which increases the velocity gradient at the tube wall and consequently generates an enhancement in heat transfer. Data reduction is applied to CFD data; and it is found a good agreement between the calculated Reynolds and Fanning friction numbers and the theoretical relationship (f = 16/Re). A novel formulation for evaluating the thermo-hydraulic performance was developed. The results indicate that the thermo-hydraulic performance increases when the twist ratio decreases and the Reynolds number increases.

Keywords*:* non-Newtonian flow, circular tube with a twisted tape, heat transfer coefficient.

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EXPERIMENTAL INVESTIGATION ON FORCED CONVECTIVE HEAT TRANSFER COEFFICIENT OF A NANO FLUID

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Abstract

Nano fluids are used in broad range of engineering applications due to their improved thermo-physical properties such as thermal conductivity, thermal diffusivity, viscosity and convective heat transfer coefficient. In this paper Al2O3Nano fluid has been prepared by using sonicator and the size of nanoparticle is 28 nm diameters. The property changes of Nano fluids depend on the volumetric fraction of nanoparticles, shape and size of the nanomaterial. This paper presents an experimental investigation on forced convective heat transfer coefficient of a Nano fluid flowing in a single pass and multi tubes counter flow shell and tube heat exchanger under turbulent flow condition. In this we are taking different volume concentrations (0.1%, 0.2%, 0.3% and0.4%). The results observed the heat transfer performance and characteristics of an Al203/water Nano fluid estimated. Heat transfer coefficient for forced convection is higher than the water at the same flow velocity and inlet temperatures of both hot and cold fluid conditions. The other properties of the Nano fluid such as its thermal conductivity, specific heat, density, and viscosity, tube diameter also calculated.

Keywords: Heat exchange,Al2O3 Nano fluid, Forced convection.

NUMERICAL STUDY OF NANOFLUID FLOW IN FLAT TUBES FITTED WITH MULTIPLE TWISTED TAPES

Paper ID -1339

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Abstract

In this paper, while numerically simulating the Al2O3–water Nano fluid flow in flat tubes fitted with twisted tapes, the effects of three different Heat Transfer Enhancement (HTE) methods are also separately evaluated and compared. These three HTE mechanisms include the use of Nano fluid instead of the base fluid, use of flat tubes instead of circular tubes and the use of twisted tapes inside the tubes. The obtained results indicate that although all the three mentioned mechanisms improve the heat transfer within the tubes, the HTE due to the use of twisted tapes is greater than that caused by the other two mechanisms. After discovering that the simultaneous use of the three mentioned mechanisms can considerably increase the amount of heat transfer, three different arrangements of the twisted tapes in the Nano fluid-containing flat tubes are also evaluated and compared. These three arrangements include the use of one twisted tape, use of two twisted tapes in the same direction and the use of two twisted tapes in different directions. The obtained results indicate that the use of two twisted tapes in different directions leads to the highest amounts of heat transfer and pressure drop in flat tubes.

Keywords: Multiple twisted tapes, Nano fluid Flat tubes, Two phase model, Mixture model.

PREPARATION, CHARACTERIZATION AND HEAT TRANSFER ANALYSIS OF NANOFLUIDS USED FOR ENGINE COOLING

Paper ID -1340

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Abstract

The car radiators or any vehicle engine thermal management system is evolving since its beginning, to achieve a sustainable, energy efficient stage. In this peculiar journey, the Nano fluids playing a vital role of coolants to enhance the exchange rate of heat transfer to make the radiator cooling system effective. The current article is summarized and talk over radiator cooling of engine in vehicles using Nano fluids. The nanoparticles present in the Nano fluids have higher thermal properties which contributes to higher heat transport. The article opens with the introduction of the Nano fluids, coolants and a summarized evolving history of a car radiator. The next sections include the overview of synthesis and characterization of Nano fluids based on engine coolant followed by the heat transfer analysis. Effects on the thermo physical property (Thermal conductivity and Viscosity) of fundamental parameters which can be avoidable while selecting parameters are discreetly discussed. The fundamental of convective heat transfer and the mechanism behind the change in convective heat transfer is discussed with non-dimensional numbers. A number of suggestion and guidelines are reported for the better performance and results with Nano fluids. The article provides an essential assessment of the Nano fluids in the radiator cooling and the paper also provide a detail guideline for the development of amicable future of Nano fluids in the heat transfer application.

Keywords: Nano fluids Car radiator Engine cooling, Coolant etc.

NUMERICAL INVESTIGATIONS FOR THE OPTIMIZATION OF SERRATED FINNED-TUBE HEAT EXCHANGERS

Paper ID -1341

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Abstract

Helical serrated finned-tubes are well established in many thermal systems. This paper presents the results of numerical calculations carried out for the performance improvement of these devices. The work is divided into three main investigations conducted for Reynolds numbers upto 2600. The first investigation shows the effect of the fin serration, where a comparison between performances of finned tubes with and without fin serration is presented. Another main investigation is conducted on the effect of fin twisting of the outermost part of the fin on the performance of the serrated finned-tubes. Here, twisting angles considered are between 0 to 25 degrees. The third investigation deals with the effect of the number of fin segments per period.

Keywords*:* Heat exchangers, Heat transfer enhancement, serrated finned-tubes.

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EXPERIMENTAL STUDIES ON FINNED SOLAR STIL USING PARAFFIN WAX AS THERMAL ENERGY STORAGE MEDIUM

Paper ID -1342

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Abstract

An experimental study was conducted to improve the productivity of single basin single slope solar still with thermal energy storage. Two types of solar still were designed and fabricated, in order to study the performance of each still. The first one is a conventional type and the second one is a modified solar still which has squared fins and thermal energy storage material. The performance of two different solar still were tested under two cases. In the first case conventional solar still is compared with modified solar still which has square fins placed in the basin of solar still. In the second case conventional solar still is compared with modified solar still in which square fins packed with thermal energy storage material The result show that the modified still has improved the productivity by 41%,61%, than the conventional solar still under same climate conditions for the first and second case respectively.

Keywords: Thermal energy storage, solar still, Fins, Phase change material.

AN EXPERIMENTAL INVESTIGATION OF A V-CORRUGATED ABSORBER SINGLE-BASINSOLAR STILL USING PCM

Paper ID -1343

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Abstract

In this paper, a new design of a v-corrugated absorber solar still with built-in phase change material (PCM) is presented. This design allows for the expansion of melting wax through a net of tubes extended inside the storage tank. The system is tested with and without the PCM using different water masses. Adding wick over the corrugated plate using PCM is also investigated. Paraffin wax is chosen as a PCM due to its medium storage, safety, reliability, uniform melting and moderate cost. The experimental investigation shows that the solar still with using the PCM beneath the corrugated plate with less basin water mass achieves the best thermal performance among other studied configurations. Using the PCM causes a little decrease in the daylight productivity with a considerable increase in the still overnight productivity. The daily productivity of the still with the PCM when mw=25 kgis 12% and 11.7% better than those for the v-corrugated still without the PCM and with the PCM using wick, respectively. Cost analysis is also performed where the cost per liter (CPL) for the still without PCM, with PCM and with PCM using wick are estimated as 0.07182, 0.08369 and 0.09558 $/l, respectively.

Keywords: Solar still, V-corrugated solar still, Phase change material (PCM),Wick, Daily productivity.

PERFORMANCE ASSESSMENT AND PRODUCTIVITY OF A SIMPLE-TYPE SOLAR STILLINTEGRATED WITH NANOCOMPOSITE ENERGY STORAGE SYSTEM

Paper ID -1344

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Abstract

Paraffin wax (PW) is one of promising solar energy storage materials in solar distillers because of its relatively large latent heat with a stable phase change process. However, paraffin's low thermal conductivity is a negative aspect for its efficient practice. In this study, adding nanomaterial to enhance paraffin's low thermal conductivity and its performance parameters is examined. Three cases have been investigated and compared to each others, case 1 without PW, case 2 with PW, and case 3 with copper-PW nanocomposites (NCPW). The results showed apparent advantage of nanocomposites on thermal conductivity of PW and that enhanced the heat energy storage and water productivity. The productivity increased by about125% and 119% for cases 3 and 2, respectively, compared to case 1. The system working time extended during night by 5 h and 6 h at applying PW and NCPW, respectively. It was also shown that adding Nano materials to PW can not only increase its thermal conductivity but also the system efficiency and thermal storage capacity.

Keywords: Paraffin wax, Copper nanocomposites, Experiments, Desalination, Productivity.

THEORETICAL WITH EXPERIMENTAL VALIDATION OF MODIFIED SOLAR STILL USING NANOFLUIDS AND EXTERNAL CONDENSER

Paper ID -1345

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Abstract

The effects of using Nano fluids and integrating the solar still with external condenser have been studied numerically. The performance of the modified desalination system is evaluated and compared with that of the conventional one under the same meteorological conditions. Theoretical analysis of heat and mass transfer mechanisms for the solar stills has been developed. Numerical calculations had been performed on the solar stills in Kafrelsheikh city, Egypt (31.07 °N latitude and 30.57 °E longitude) for different nano- material concentrations and providing low pressure to study the effects of these parameters on the daily productivity of the system. The analyses are conducted in the weight concentrations range from 0.02 to 0.3% for aluminum oxide (Al2O3) and cuprous oxide (Cu 2 O) nanoparticles. Thermo-physical properties of the Nano fluid are considered by assuming Nano fluid is a single-phase fluid. The simulation results are in a good agreement with the published experimental data. The daily efficiency of the modified still is 84.16% and 73.85% when using Cu 2 O and Al 2 O 3 nanoparticles, respectively, with operating the fan. And the daily efficiency when providing low pressure only is 46.23%. In addition, the conventional stills' daily efficiency was 34%.

Keywords: Distillation Solar still Nano fluids Nano materials Numerical, Statistical paired test.

EVALUATION OF COPPER NANOPARTICLES – PARAFFIN WAX COMPOSITIONS FOR SOLAR THERMAL ENERGY STORAGE

Paper ID -1346

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Abstract

Phase change materials have been used extensively as thermal energy storage mediums. The low thermal conductivity of the phase change materials remains a setback and reduces the performance of gaining and releasing of the thermal energy. In this study, 20 nm copper nanoparticles were dispersed into paraffin wax to synthesis Cu–PCM nanocomposites. Five samples have been prepared to investigate the thermal properties of the produced Cu–PCM nanocomposites (Copper–Paraffin wax nanocomposites). The results of the experimental characterization showed that the thermal conductivity of the Cu–PCM nanocomposites was increased by 14.0%, 23.9%,42.5% and 46.3% when 0.5%, 1.0%, 1.5%, and 2.0% weight of nano Cu was dispersed in the PCM, respectively. The shift in the melting and solidification temperature showed that nano Cu has acted as nucleation agent to reduce the super cooling effect during the phase change process. On the analysis of the thermal degradation, Nano Cu has improved the thermal stability of Cu–PCM nanocomposites without changes in chemical structure. The qualitative analysis showed that 20 nm nano Cu has hexagon shape with particles distribution size range from 15 nm to 125 nm. Site test, using integrated solar-TES system, showed efficiency enhancement by 1.7% when 1.0% Nano Cu has been added to the paraffin wax. These encouraging results showed that nano Cu additive could be used to enhance the thermal properties of paraffin wax for solar thermal energy storage.

Keywords: Copper Nano; Integrated solar collector; Nano additives; Nano composite; Solar thermal systems; TES.

THEORETICAL AND EXPERIMENTALPERFORMANCE EVALUATION OFSINGLE-SLOPE SINGLE-BASIN SOLARSTILL WITH MULTIPLE V-SHAPEDFLOATING WICKS

Paper ID -1347

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Abstract

A solar still is used to convert saline water into potable water by means of the distillation process. In order to improve the productivity of conventional solar still, various modifications are implemented by researchers. In the present study, multiple V-shaped floating wicks are used to enhance heat absorption and thereby increase productivity. The experiments are performed during the summer and winter seasons in Rewa, India (Latitude: 24.5373_ N; Longitude: 81.3042_E). These multiple floating wicks are made from black jute cloth wrapped in V shaped pieces of thermo col. Because of their V-shaped profile, the evaporative surface area of modified solar still is 26% larger than that of conventional solar still. The maximum daily productivity in one of the clear days is found to be approximately 6.20 kg/m2 in summer and 3.23 kg/m2 in winter with daily efficiencies of 56.62% and 47.75%, respectively. A theoretical thermal model is formulated by using the energy balance equations of the modified solar still. Reasonable agreement was seen between the theoretical and experimental results of modified solar still. An economic analysis is also performed for the modified solar still and conventional solar still; in a 10-year life cycle, the annual cost of distilled water is estimated at Rs. 1.81/kg for the former and Rs. 2.24/kg for the latter.

Keywords: Mechanical engineering, Energy.

PERFORMANCE OF A PYRAMID SOLAR STILL WITH V-CORRUGATED ABSORBERS PLATE: EXPERIMENTAL STUDY

Paper ID -1348

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Abstract

An experimental work was designed and fabricated to improve the distillate water productivity of the pyramid solar still. A pyramid solar still with v-corrugated absorber plate and conventional pyramid solar still was designed and fabricated at the same ambient conditions of Tanta city, Egypt. The performance of pyramid solar still with v-corrugated absorber plate are compared to conventional pyramid solar still, to describe the enhancement in distillate water productivity of the pyramid solar still with v-corrugated absorber plate. The experimental results showed that the distillate water productivity for pyramid solar still with v-corrugated absorbers plate is higher than that of conventional pyramid solar still. The distillate water productivity reached approximately 6.5 l/m2 day for pyramid solar still with v-corrugated absorber plate while its value was 4.4 l/m2 day for conventional pyramid solar still. The percentage improvement in the distillate water productivity for pyramid solar still with v-corrugated absorber plate was about 47.7 % compared to the conventional pyramid solar still in average. Moreover, the average daily efficiency for the pyramid solar still with v-corrugated absorbers plate and the conventional pyramid solar still are 48.4% and 32.76%, respectively. The estimated cost of one liter of distillate water productivity reaches approximately 0.2105 LE and 0.227 LE for pyramid solar still with v-corrugated absorbers plate and conventional pyramid solar still, respectively. This result is obtained during the period from June to August 2016 under the Egyptian conditions.

Keywords: Pyramid solar still, V-corrugated absorbers plate, Productivity improvement, Cost analysis.

INFLUENCE OF NANO Al_2O_3 TO IMPROVE THE YIELD OF DOUBLE SLOPE SOLAR STILL

Paper ID -1349

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Abstract

Purpose: The supply of pure fresh water is becoming a rising issue is many areas of the world. Clean water being a basic requirement is still unavailable to a large number of people. The fast development and growth in population and agriculture has helped to increase the need of clean water. The solar distillation is one of the most cost efficient ways to accomplish this.
Methodology: When water evaporates from the basin of the still, it leaves the various impurities behind resulting in clean palatable water. Solar stills have a comparatively low yield but can be used to provide safe water options to rural areas of the world. To increase the yield of the solar still nano Al2O3 fluid is used, which is prepared using a dispersant of Sodium Dodecyl Benzene Sulphonate (SDBS). The still is a double slope basin type solar still with black paint coating on the inside and external reflecting mirrors, to enhance the yield.
Main Findings: This project compares the efficiency and output of double slope solar still with and without the Nano fluid. The single basin double slope solar still was fabricated using low cost durable materials and the 0.01 vol. % Al2O3 water based Nano fluid was prepared. The results showed a positive outcome of a 15% increase in the rate of distillate collected with the use of Nano fluids. The payback period was calculated to be less than 2 weeks without Nano fluid and one week with the use of Nano fluid.
Implications: The present study is useful for obtaining pure drinking water at remote locations in Sultanate of Oman where solar energy is abundance.
Novelty of Study: Nano fluids are used to enhance the distillation rate when compared to the conventional solar stills.

Keywords: Double slope, Solar still, Nanofluids, Distillate, Solar energy, SDBS, Al_2O.

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ACTIVATED CARBON DISPERSION AS ABSORBER FOR SOLAR WATER EVAPORATION: APARAMETRIC ANALYSIS

Paper ID -1350

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Abstract

Generation and heating. As water is not a good absorber of light, seeding it with light-absorbing particles can enhance evaporation efficiency. Activated carbon (AC) is one such material with desirable absorption properties for this application. However, particle sizes in granular and powder activated carbon can vary significantly. In this work, AC particles of different sizes are analyzed and their effect on evaporation rate is studied. It is found that particle sizes less than or comparable to solar wavelength spectrum produce higher evaporation efficiencies under independent scattering conditions (f_v <0.6%). It is also found that the solar absorption coefficient reaches between 0.98 and 0.9 for a volume fraction as low as 0.01%. The evaporation efficiency is 57.3% and 38.2%higher than for pure water evaporation for size of 80 nm and 8 µm, respectively, for a volume fraction of 0.01%.A parametric analysis is performed to identify the respective effect on evaporation rate.

Keywords: Activated carbon, Evaporation, Weighted solar absorption coefficient.

ANALYSIS OF SOLAR STILL WITH NANOPARTICLE INCORPORATED PHASECHANGE MATERIAL FOR SOLAR DESALINATION APPLICATION

Paper ID -1351

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Abstract

In the present scenario, heat storage system started to play its role in every field including solar thermal applications. This paper mainly deals with the application of heat storage medium in solar desalination still applications. This research concerns with the theoretical analysis of latent heat energy storage with the incorporation of nano particles. In this research, paraffin wax is selected as the phase change material with0.3 weight% of nano particles such as TiO2, CuO and Grapheme Oxide. It is found that Grapheme Oxide with paraffin gives the higher results comparing with the other nano particles. The thermal conductivity increased to 0.8 W/mK for Grapheme Oxide nano composite and the predicted results shows that the productivity is quite high for paraffin wax with Grapheme Oxide. Mathematical modeling was carried out and the results indicate that the solar still with phase change material incorporated with nano particles gives higher results than the conventional solar stills and Grapheme oxide with paraffin is found to be the best nano particle for solar desalination still application. So it is best to incorporate Grapheme oxide nano particle with paraffin for the experimental setup to achieve higher productivity than conventional one.

Keywords: Solar still, Nano particles, latent heat energy storage, paraffin, productivity.

APPLICATION OF CARBON NANO-MATERIALS IN DESALINATION PROCESSES

Paper ID -1352

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Abstract

Scarcity of freshwater resources increases the importance of seawater and brackish water desalination processes. However, still, large amount of specific energy requirement, leading to high operational costs, presents a big challenge in adopting desalination technologies. This challenge can be addressed by considering the newly emerging nanomaterials especially those made from carbon. This paper presents a comprehensive literature survey and review that brings those carbon nano-materials (CNMs) into focus which directly participate in desalination processes. The structural and functional properties of CNMs, their fabrication into membranes, their formation into bucky papers, and their composite electrodes are some of their usages in desalination processes which are exploited. The survey and analysis of the available literature shows that CNMs can enhance capacity and efficiency of next generation desalination systems, particularly reverse osmosis, membrane distillation, capacitance deionization, and forward osmosis.

Keywords: Desalination; Carbon nano-materials (CNMs); Membrane nanocomposites; Bucky papers.

COMBINED EXPERIMENTAL AND NUMERICAL EVALUATION OF A PROTOTYPENANO-PCM ENHANCED WALLBOARD

Paper ID -1353

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Abstract

In the United States, forty-eight (48) percent of the residential end-use energy consumption is spent on space heating and air conditioning. Reducing envelope-generated heating and cooling loads through application of phase change materials (PCMs) in building envelopes can enhance the energy efficiency of buildings and reduce energy consumption. Experimental testing and numerical modeling of PCM enhanced envelope components are two important aspects of the evaluation of their energy benefits. An innovative phase change material (nano-PCM) was developed with PCM supported by expanded graphite (interconnected) Nano sheets, which are highly conductive and allow enhanced thermal storage and energy distribution. The nano-PCM is shape-stable for convenient incorporation into lightweight building components. A wall with cellulose cavity insulation and a prototype PCM-enhanced interior wallboard was built and tested in a natural exposure test (NET) facility in a hot-humid climate location. The test wall contained the PCM wallboard and a regular gypsum wallboard, for a side-by-side annual comparison study. Further, numerical modeling of the wall containing the nano-PCM wallboard was performed to determine its actual impact on wall-generated heating and cooling loads. The model was first validated using experimental data, and then used for annual simulations using typical meteorological year (TMY3) weather data. This article presents the measured performance and numerical analysis evaluating the energy-saving potential of the nano-PCM-enhanced wallboard.

Keywords: Phase change materials, Nano-PCM,PCM wallboard, PCM modeling, Finite element analysis.

COPPER NANODOT-EMBEDDED GRAPHENE URCHINS OF NEARLY FULL-SPECTRUM SOLARABSORPTION AND EXTRAORDINARY SOLAR DESALINATION

Paper ID -1354

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Abstract

Black materials are the key to convert solar light to thermal energy, but it is not easy to economically achieve full solar-spectrum light absorption and maximally harvest solar energy. Herein, we develop a "popcorn" approach based on a space-confined pyrolysis of copper carbodiimide to synthesis Cu Nano dot-embedded N-doped grapheme urchins. In situ formed Cu Nano dots are rigidly fixed and spatially scaffold in the grapheme matrix, achieving nearly full-spectrum solar light absorption (99%) over a wide spectral range (300~1800 nm). Such a highly efficient solar harvest is endowed by an intensively hybridized localized surface Plasmon resonance and stabilized by grapheme matrix. When applied in solar desalination, the N-doped graphene urchins provide structural interconnectivity and freeway for water transports and enable the as-formed plasmonic absorber to naturally self-float on water. By localizing the absorbed energy at the interfaces, efficient (~82%) and stable desalination is ultimately achieved under a simulated solar light. Practically, a solar desalination system of the plasmonic absorber can produce fresh water with a rate of~5L m□2 day□1 under solar irradiation.

Keywords: Plasmonic, Cu Nano dots, graphene, Copper Carbodiimide, solar desalination.

DISPERSION BEHAVIOR AND THERMAL CONDUCTIVITY CHARACTERISTICSOF AL_2O_3–H_2O NANOFLUIDS

Paper ID -1355

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Abstract

Nano fluid is a kind of new engineering material consisting of solid nanoparticles with sizes typically of 1–100 nm suspended in base fluids. In this study, Al2O3–H2O Nano fluids were synthesized, their dispersion behaviors and thermal conductivity in water were investigated under different pH values and different sodium dodecyl benzene sulfonate (SDBS) concentration. The sedimentation kinetics was determined by examining the absorbency of particle in solution. The zeta potential and particle size of the particles were measured andthe Derjaguin–Landau–Verwey–Overbeek (DLVO) theory was used to calculate attractive and repulsive potentials. The thermal conductivity was measured by a hot disk thermal constants analyser. The results showed that the stability and thermal conductivity enhancements of Al2O3–H2O Nano fluids are highly dependent on pH values and different SDBS dispersant concentration of nano-suspensions, with an optimal pH value and SDBS concentration for the best dispersion behavior and the highest thermal conductivity. The absolute value of zeta potential and the absorbency of nano-Al2O3 suspensions with SDBS dispersant are higher at pH 8.0. The calculated DLVO inter particle interaction potentials verified the experimental results of the pH effect on the stability behavior. The Al2O3–H2O Nano fluids with an ounce of Al2O3 have noticeably higher thermal conductivity than the base fluid without nanoparticles, for Al2O3 nanoparticles ata weight fraction of 0.0015 (0.15 wt%), thermal conductivity was enhanced by up to 10.1%.

Keywords: Nano fluid; Alumina nanoparticle; Dispersion and stability; Zeta potential; Absorbency; Thermal conductivity.

EFFECT OF AL_2O_3 NANOPARTICLES ON THE PERFORMANCE OF PASSIVEDOUBLE SLOPE SOLAR STILL

Paper ID -1356

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Abstract

This paper present the enhancement in yield (productivity) of passive double slope solar still (DSSS) using Al_2O_3 nanoparticles in the base fluid (water) for two different masses 35 kg and 80 kg. The analytical expression of fluid temperature has been derived for passive DSSS. On the basis of developed model, the analysis has been carried out for the base fluid (without nanoparticles) and for Nano fluid with three different concentrations (0.04%, 0.08% and 0.12%). Effect of different concentrations of Al2O3 nanoparticle on fluid temperature, thermal conductivity, internal heat transfer coefficients (HTC) and yield of the fluid has also been analyzed. For 0.12% concentration ofAl_2O_3 nanoparticles, the enhancement of yield for 35 kg and 80 kg base fluid has been found to be 12.2% and 8.4% respectively as compared to that of base fluid.

Keywords: Passive solar still; Nano fluid; Thermo-physical properties.

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EFFECT OF NANOFLUIDS ON THE PERFORMANCE OF PASSIVE DOUBLE SLOPE SOLAR STILL: A COMPARATIVE STUDY USING CHARACTERISTIC CURVE

Paper ID -1357

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Abstract

Nano fluids are proficient heat transfer carriers for harvesting thermal energy in solar thermal applications. In recent times, Nano fluids have been utilized in solar thermal research theoretically as well as experimentally. In this paper, an analytical expression of the characteristic equation of passive double slope solar still (DSSS) for three different Nano fluids has been obtained. The analysis has been carried out for optimized concentration (0.25%)of metallic nanoparticles. Higher thermal energy efficiency was obtained for Nano fluids (Al2O3 50.34%; TiO246.10%; and CuO 43.81%) in comparison to base fluid (37.78%). The thermal exergy was also higher for Nano fluids (Al_2O_3 14.10%; TiO2 12.38%; and CuO 9.75%) as compared to base fluid (4.92%). Productivity (yield) has also been evaluated for different weather conditions of the month of March using the proposed model.

Keywords: Passive solar still**,** Nano fluid**,** Thermo-physical properties **,**Energy and exergy.

ENERGY AND EXERGY ANALYSIS OF SOLAR STILLS WITH MICRO/NANO PARTICLES: ACOMPARATIVE STUDY

Paper ID -1358

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Abstract

In this paper, a theoretical comparative study between modified solar stills (MSSs) and classical solar still (CSS) was carried out, based on the productivity and the thermal properties. The MSSs contain brackish water mixed with either graphite or copper oxide (CuO) micro/nano particles. Cost estimations of solar still desalination by using micro/nano particles were estimated. Exergy destruction in various components of the solar still (SS) were calculated, analyzed and discussed. The exergy loss during the day time comprises the exergy destruction in the main components of the SS like basin plate, brine water, glazier plate and insulation material. The hourly convective, evaporative and radioactive heat transfer coefficients (HTCs) with and without micro/nano particles were determined. The exergy destruction in various components of the SS have been analyzed and a solution was suggested. Results revealed that the exergy of evaporation, energy efficiency and exergy efficiency of MSSs were higher than that of the classical one. The daytime energy efficiencies of MSSs with graphite and CuO were41.18% and 38.61%, respectively, but for the CSS was only 29.17%. The diurnal productivity of the MSSs was increased by 41.18% and 32.35% for graphite and CuO, respectively, compared with CSS. Moreover, the diurnalexergy efficiencies of MSSs were 4.32% and 3.78% for graphite and CuO respectively, while exergy efficiency for CSS was 2.63%. Furthermore, the costs of water production were found to be approximately 0.20, 0.21 and 0.24RMB/L (1 RMB=0.15 US $) when using MSS with CuO, MSS with graphite and CSS, respectively.

Keywords: Solar desalination**,** Energy**,** Exergy destruction**,** Micro/nano particles.

ENHANCED DESIGN OF AUTOMATED SOLAR STILL BASED ON LIGHT-HARVESTING NANOPARTICLES

Paper ID -1359

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Abstract

In the current scenario majority of the cities and towns in India are without proper planning for water need versus water availability. The per capita water availability has drastically reduced over the past. Among a range of solutions, water distillation process is optimal to produce potable water without affecting its palatability. In arid remote areas solar distillation offers a promising alternative for saline water resources as it can partially support fresh water need with free energy, simple technology and a clean environment. The aim of this project is to design a solar still for water distillation that can purify water from nearly any source. The system is compact, quick and easy-to-handle and depends only on renewable solar energy for its operation. The low daily productivity of the solar still is the main drawback in the existing system. This project provides an optimized system for monitoring and distillation of saline water using solar still with improved productivity and thermal efficiency thereby significantly reducing the production cost. This process combines the emerging technology of nano-photonics with solar energy which makes it completely off-grid. This stand-alone system is monitored and controlled using a microcontroller. Water is converted into steam, directly and immediately, even before the boiling point. It uses the highly localized & strong photo-thermal response of the nano particles dispersed in the water. In this way the design features of the existing solar still is improved in many ways to make it relatively cheap, portable and automated. Thus an optimized solar still is designed with enhanced productivity providing an eco-friendly solution.

Keywords: Water distillation, Solar still, Nano-photonics, microcontroller, automated, eco-friendly.

ENHANCEMENT OF PYRAMID SOLAR STILL PRODUCTIVITY USING ABSORBER PLATES MADE OF CARBON FIBER/CNT-MODIFIED EPOXYCOMPOSITES

Paper ID -1360

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Abstract

This work aims to augment the distilled water productivity of a modified pyramid solar still using absorber plates made of carbon fiber/nanomaterials-modified epoxy composites. The effect of using basin absorber plates made of carbon fiber/epoxy incorporating carbon nanotubes or graphene nanoplatelets on the fresh water productivity was investigated experimentally under Jordanian climatic conditions. In this study, four similar solar stills with basin absorber plates of 0.5 m^2 and a pyramid glass cover have been designed and constructed by local materials. Three absorber plates were manufactured from carbon fiber/epoxy composites incorporating 2.5 wt%, 5 wt% carbon nanotubes and 2.5 wt% graphene nanoplatelets in the epoxy matrix. Experimental results showed that adding 5 wt% and 2.5 wt% carbon nanotubes to the epoxy matrix in the carbon fiber/epoxy composites caused109% and 65% increase in the amount of distilled water, respectively, when compared with the ordinary type absorber plate (black painted galvanized steel). On the other hand, the performance evaluation indicated that the amount of distilled water was increased by 30% when incorporating graphene nanoplatelets in the epoxy matrix.

Keywords: Carbon fiber, Solar still, Epoxy, Carbon nanotubes, Graphene nanoplatelets, Composite, Absorber plate.

EXPERIMENTAL INVESTIGATION OF SIC NANOFLUIDS FOR SOLAR DISTILLATION SYSTEM: STABILITY, OPTICAL PROPERTIES AND THERMAL CONDUCTIVITY WITH SALINE WATERBASEDFLUID

Paper ID -1361

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Abstract

Modified solar distillation system with different Nano fluids was an emerging application area, which added various nanoparticles in saline water to enhance the ability of solar energy absorption and storage. However, there are lacked of exploration with the performance of Nano fluids with saline water. Therefore, the stability, optical properties and thermal conductivity of SiC/saline water based Nano fluids were systematically investigated in this study. The experimental results showed that SiC Nano fluids have good effects for enhancing the thermal conductivity with respect to base fluids (>6% increase at 0.4 vol% SiC Nano fluids) and have good capacity of solar absorption (<1% luminousness at 0.4 vol% SiC Nano fluids).With increase of salt concentration, some negative effects will affect Nano fluids both in stability and thermal conductivity. Therefore, an appropriate salt concentration range and nanoparticles load should be measured in practical application. Moreover, 0.4 vol% SiC Nano fluid was prepared with natural sea water and had sufficient stable period. The thermal conductivity of seawater based Nano fluid was enhanced about 5.2% with respect to base fluid. Good stability, low luminousness and effective thermal property of SiC Nano fluids confirmed the feasibility of Nano fluids application in solar distillation system.

Keywords: Nano fluids, Solar distillation system, SiC nanoparticle.

EXPERIMENTAL INVESTIGATION ON MODIFIED SOLAR STILL USING NANOPARTICLES AND WATER SPRINKLER ATTACHMENT

Paper ID -1362

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Abstract

The experimental investigation has been done in the month of April 2015 for climate condition of Jabalpur, Madhya Pradesh, India (latitude 23° 18′ N; longitude 79° 95′ E) during full day, 0600 a.m. to 0600 p.m. The performance of the solar still with modification of water flow over the glass cover (sprinkler attachment) and nanoparticles (cuprous oxide) in basin water has been observed, recorded, and compared with conventional still. It has been found that the collection of pure water in modified solar sill was 4,000 ml/(m2-day) as compared to 2,900 ml/(m2-day) in conventional solar still. The efficiency of 34 and 22% has been obtained for modified solar still and conventional still, respectively. With design amendments, increase in overall effectiveness was found to be 54.54%. The computed cost of pure water produced in modified still is expected to (INR) Rs. 0.98/l, in view of 12-year life of the solar still.

Keywords: solar still, water distillation, sprinkler attachment, nanoparticles (cuprous oxide), cost analysis.

EXPERIMENTAL INVESTIGATION ON THE EFFECT OF MGO AND TIO_2NANOPARTICLES IN STEPPED SOLAR STILL

Paper ID -1363

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Abstract

This work aims at augmenting the amount of potable water using MgO andTiO_2 in stepped solar still. Experiments were carried out for the climatic conditions of Chennai, India, with two different concentrations of Nano fluids inside a stepped basin under three different cases. Results show that there is an improvement in yield of fresh water from stepped solar still by 33.18% and41.05% using 0.1% and 0.2% volume concentration of TiO2 Nano fluid, respectively, Whereas the freshwater yield from stepped still with MgO Nano fluids improved by 51.7% and 61.89%. Furthermore, the economic analysis revealed that the cost of potable water from the modified solar still reduced from0.029 to 0.016 $/kg. Similarly, the useful annual energy, yearly cost per kilogram, and annual cost per kilowatt hour are significantly profitable with the use of MgO Nano fluid in the stepped basin and found as 512.46 kWh,0.025 $/kg, and 0.026 $/kWh, respectively. It is also found that the cost of potable water from the modified still significantly increases as the amount of freshwater produced is decreased with increased fabrication cost of the solar still.

Keywords: Augmentation, concentration, economic analysis, nanoparticles, stepped solar still.