BOOK OF ABSTRACTS

The 1st TSME International Conference on Mechanical Engineering (TSME-ICoME)

Ubon Ratchathani, Thailand

October 20-22, 2010

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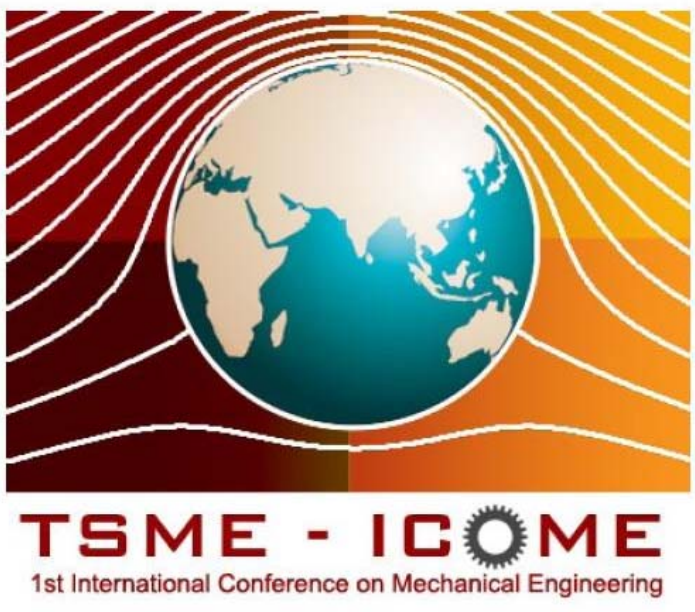

October 20th - 22nd, 2010 Sunee Grand Hotel,

Ubon Ratchathani, Thailand

Book of Abstracts

Editor

Phadungsak Rattanadecho

PREFACE

It is my great pleasure to present this formal collection of the Proceedings of the, 1st TSME International Conference on Mechanical Engineering (TSME-ICoME 2010) which is held in Ubonratchathani, Thailand during October 20-22, 2010. TSME-ICoME 2010 is the first International conference which sponsored by the Thai Society of Mechanical Engineers (TSME) with the collaborations from ASME, IMechE, and JSME (Thailand Chapters). It should be emphasized that this international conference offers a great opportunity for us to provide an international forum for the great communication and dissemination of original work that contributes to the understanding of the main and related disciplines of mechanical engineering, either empirical or theoretical. The topic areas cover the whole spectrum of mechanical engineering, which include, but are not limited to: Aerospace and Marine Engineering, Applied Mechanics, Materials and Manufacturing, Dynamic System, Robotics and Control, Energy Technology and Management, Thermal Systems and Fluid Mechanics and Biomechanics.

I am pleased to note, however, that TSME-ICoME 2010 has succeeded in attracting the most papers and the most participants despite the formidable competition! With the initial number of submitted abstracts of around 160, close to 92 full papers were reviewed and have finally been included in the Proceedings. What is especially remarkable is that we have succeeded in obtaining peer reviews of all papers included in the Proceedings.

As the Chairperson of the TSME-ICoME 2010 and on behalf of the organizing committee I wish to express my sincere thanks to the distinguished keynote speakers, the contributing authors, all the session chairs and the participants. I would also like to thank all members of the International Organizing Committee, the Local Organizing Committee and all members of Mechanical Engineering Department, Ubonratchathani University. My thanks are also due to a number of reviewers who helped tirelessly with the abstract and manuscript review processes. This form of assistance is indeed heavily responsible for the technical success of TSME-ICoME 2010. I am grateful to our sponsors, including the Prapai Technologies Co., LTD, Alpine Electronic Air Filter and Kinetics Corporation Limited Thailand. My appreciation also goes to a number of graduate students for their continuing help and hard work to organize the event.

P. Rattanadecho

Phadungsak Rattanadecho

Chairperson of the TSME-ICoME 2010

Letter from TSME President

The Thai Society of Mechanical Engineers (TSME) was officially founded in 2007, although its history goes back some twenty years ago. It has been formed loosely as a network of mechanical engineering departments from various universities and institutes in Thailand, known as ME-NETT. Annual ME-NETT conferences have been organized for 24 years, with different universities taking turns as the host. Together with thisyear's24th ME-NETT conference, the host Ubon Ratchathani University and TSME are proud to introduce the 1st TSME International Conference on Mechanical Engineering. This marks a new beginning after we have had international sessions in the ME-NETT conference for two years. We hope that this conference will be useful to the research and development in the field of mechanical engineering.

On behalf of TSME, I am grateful to the Department of Mechanical Engineering, University of Ubon Ratchathani for their dedication to make the 24th ME-NETT and 1st TSME-ICoME conferences successful. We appreciate the support from our partner organizations; The Japan Society of Mechanical Engineers (JSME), the Institute of Mechanical Engineers (IMechE) , and the American Society of Mechanical Engineers (ASME). Their respective chapters in Thailand have collaborated with us to make this TSME-ICoME possible. My gratitude also goes to all the committee especially the chairman, Prof. Dr. Phadungsak Ratanadecho, and his staff for all the hard work. Lastly Khun Fatimah Hemman, and the secretarial staff, have also been very helpful to TSME and ICoME.

Additionally, I would like to extend a warm welcome to all the authors and participants of this 1st TSME-ICoME. We hope that all of you will have a wonderful experience with this fruitful conference, and at the same time enjoy the sights of Ubon Ratchathani, Thailand.

Sincerely,

Worawut Wisutmethangoon, Ph.D.

TSME President

Associate Professor

Department of Mechanical Engineering

Prince of Songkla University

Letter from JSME President

On behalf of the Japan Society of Mechanical Engineers (JSME), I would like to congratulate the Organizing Committee in the TSME on wonderful work they have done in planning, arranging and organizing the comprehensive Conference, The First TSME International Conference on Mechanical Engineering, collaborated with ASME, IMechE and JSME.

Mechanical engineering is a core field of engineering that contributes to the creation of a sustainable society and the resolution of social issues. Rooted in science and technology and covering a wide range of fields, the JSME will play an important role in building a bright future for humanity not only in Japan, but also overseas, of course in Thailand.

Communicating with societies of foreign countries is also of growing importance. With the cooperation of our international chapters, we are going to enhance our international activities, including building partnership with mechanical engineering societies in other countries and participating in related international conferences. Of these, further strengthening the close relationship between Japan and Thailand will be pivotal for our international ties.

I hope that a fruitful success will be provided through the first TSME International Conference on Mechanical Engineering.

Yoichiro Matsumoto

President, the Japan Society of Mechanical Engineers

Letter from IMechE

Wynand Wessels ., BSc Eng (Mechanical) , C.Eng , MIMechE.
IMechE Thailand member chair.

Dr Paul Bland, Ph.D, D.I.C., M.Eng, A.C.G.I., AMIMechE.
IMechE Thailand member.

On behalf of the IMechE headquarters in London, and the IMechE Thailand members chair Mr Wynand Wessels, I would like to congratulate TSME on their first international conference and also in bringing together our respective professional engineering institutions.

The IMechE is an outward facing international organisation, meaning we place great value in building collaboration with other groups and acting across national boarders. Population growth, environmental concerns and economics are forcing the world to face up to some of the biggest challenges it has ever faced. As a consequence, the IMechE has adopted four key themes of energy, environment, transport and education.

Professional mechanical engineers acting in unison on an international platform, are vital in helping to overcome global challenges, to improve the world through engineering and to change the way we live. The collaborative activities and links between our institutions here in Thailand are just at the beginning of what will hopefully be a continuous steady strengthening process.

On a personal note, I look forward to attending the technical sessions, meeting colleagues again, and discussing how to build on our current collaboration.

Finally, thank you in advance to our hosts, Ubonratchathani University, for what I am sure will be a most enjoyable and productive conference.

Signed:

Paul Bland

Dr Paul Bland

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Keynote Lecture

The First TSME International Conference on Mechanical Engineering
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An Examination of Crown-Like Fire Initiation and Fire Spread in Shrubs

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Abstract

Fire behavior in Chaparral is akin to crown fire behavior with the difference that bulk of the fuel is present at distances of 0.1 to 1.0 m above the ground, unlike the situation in large coniferous forests, where the distances are of the order of 10 m and higher. Chaparral is a vegetation complex that is characterized by evergreen sclerophyll shrubs. It is predominant in low- to middle elevations throughout the Mediterranean-like climate areas of California, Arizona, and Mexico. When ignited, under the right set of conditions, it can lead to large, highintensity crown fires.

The process of transition of a surface fire to a crown fire was examined in detail experimentally using a single crown fuel matrix that is representative of the crown of a single shrub, or a section of a continuous shrub canopy. The crown fuel was arranged in a volume with dimensions 0.30 m × 0.30 m × 0.80 m in height, depth, and width respectively. It comprised of live chamise (Adenostoma fasciculatum) with foliage diameter of ≈ 0.50 mm and branch diameter of approximately ≈ 3.50 mm. The surface fuel comprised of aspen (Populus tremuloides) excelsior evenly distributed over a 0.80 m ×1.80 m flat bed. The effect of varying crown base height, mean wind speed, and crown bulk density was studied. Ignition of crown fuel occurs when the crown base height is located within the continuous or intermittent flame regions of the surface fire. More recently, this has been extended to multiple crown fuel elements that are separated spatially. The latter experiments are carried out in a 1.20 m width × 1.20 m height × 6.4 m length, open-roof wind tunnel to ensure that flame-generated buoyancy effects are not suppressed. Crown separation distances (CSD) in the horizontal direction investigated range from 0.1 m to 0.3 m. Fire behavior, ranging from two distinct fires to situations in which the surface and two crown matrix fires are merged, have been observed. Additional diagnostics including particle image velocimetry results are examined to better understand the detailed fluid dynamics. In all cases, a large eddy simulation methodology was utilized to model the experiments. Results from these simulations will also be described.

The First TSME International Conference on Mechanical Engineering
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Electric Energy Conversion Technique for Eco-Equipments via Embedded Technology

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Abstract

This paper presents the electric energy conversion systems on a basis of unique embedded systems by the integrated Power Electronics Technology. These play an important role for saving from "the Global warming" in the earth. This paper also gives a learning activities. This teaching materials enables to increase student motivation for their recognizing to all equipment which can be friendly with environment and human society. These are a key technology in the high performance clean energy for future.

Keywords: The Global warming, Embedded system, Electric energy conversion, Converter, Digital signal processor.

Alternative Energy and Combustion

(AEC)

The First TSME International Conference on Mechanical Engineering
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Design and Development of a Compact Screw-Press Biomass Briquetting Machine for Productivity Improvement and Cost Reduction

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Abstract

This paper presents a design and development of a compact screw-press briquetting machine which combines three functions including crushing, mixing and briquetting in a single unit. By eliminating individual machines, the great savings in space, material handling and worker, and the improved efficiency can be realized. This technology also helps to reduce cost and production time, and improve productivity, and eventually lead to be able to survive in competitive environments. This paper also presents characterizing property of the briquettes produced by the developed machine. Finally, a cost analysis for the compact briquetting machine is presented.

Keywords*:* Compact biomass briquetting machine, productivity improvement, cost analysis.

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Particulate Matter Trapping and Oxidation on a Diesel Particulate Filter

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Abstract

Through microscopic visualization experiments, a process generally called “depth filtration” is shown to be caused by surface pores. Also, the existence of a soot cake layer is an important advantage for filtration performance because it can trap most of the particulates. The concept of an ideal diesel particulate filter (DPF), in which a SiC nanoparticle membrane instead of soot cake is sintered on the DPF wall surface, is proposed to improve the filtration performance at the beginning of the trapping process and reduce the energy consumption during the regeneration process. The filtration performance of the membrane filters is shown to be better than that of the conventional DPFs. In the regeneration process, the apparent activation energy for soot oxidation on the membrane filters is smaller than that on the conventional non-catalyst DPFs. The results show that SiC nanoparticles play a significant role in oxygen mobility in soot oxidation territories.

Keywords: Diesel Engine, Emission, Diesel Particulate Filter

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Investigation on a Free-Piston Stirling Engine and Pneumatic Output

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Abstract

This paper presents numerical and experimental study of a free-piston Stirling engine (FPSE) with pneumatic output. A free-piston Stirling engine (FPSE) was designed and manufactured which works at relatively low differential temperature. The FPSE is a beta type configuration. The FPSE couples with a pneumatic cylinder. Theoretical analysis was done over a wide range of conditions to determine engine performance and characteristic with air as the working gas. In the proof-of-concept device, the displacer or the light piston was driven by pneumatic cylinder as gas spring that in turn, controls engine speed. The hot end of the displacer cylinder was heated with electric heater at 250°C maximum temperature. The other end of the displacer cylinder was cooled with a water circulation having 40°C temperature. The power piston was connected to the piston of pneumatic cylinder for lifting load. The engine was operated at the initial pressure at approximately 6 bars. The testing results showed that the work and power was obtained at 1.5 bars of pressure difference and 120 rpm engine speed of 12.5 N.m and 4 W, respectively, while the work and power, from the simulation results were 15 N.m and 5 W, respectively, at the same operating condition and engine specification. Output power from numerical simulation was slightly higher than that of experiment according to theoretical assumptions.

Keywords: free-piston, Stirling engine, pneumatic, Beta type

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Performance and Emission of a Small Engine Operated with LPG and E20 Fuels

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Abstract

The engine performance and exhaust emissions of a small engine were experimentally investigated. The engine with displacement of 197 cm^3 (12 in^3) was minor modified and operated with gasoline, liquefied petroleum gas (LPG) and ethanol fuel mixture blending 20% ethanol and 80% gasoline (E20). The engine testing was done over a wide range of engine speed. Engine power, fuel consumption and exhaust emissions of the engine using gasoline, LPG, and E20 were measured and compared. The experimental results showed that small engine operated with LPG had lowest power and torque while engine operated with gasoline and E20 had comparable power. However, using LPG on small engine had lowest fuel consumption and carbon monoxide (CO) emission compared to that of using gasoline and E20. Engine operated with E20 provided least hydrocarbon (HC) concentration than that of LPG and gasoline. Considering the results of engine power and exhaust emissions, using gasoline on small engine gave the best output engine power while using LPG and E20 had lowest CO emission and lowest HC concentration, respectively.

Keywords*:* small engine, performance, emission, LPG, E20, fuel consumption

The First TSME International Conference on Mechanical Engineering
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An Experimental Study on Aldehyde Emissions of a Hydrous Ethanol Fuelled Small SI Engine Generator Set

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Abstract

Ethanol is an attractive alternative fuel for a SI engine. It has high octane number, oxygen content and be considered as renewable energy. However, using of the ethanol as a fuel in the SI engine emits higher amount of aldehyde compound, which are the probable carcinogen, from the exhaust comparing with the conventional gasoline as the fuel. The objective of this study to reveal quantitative analysis of aldehyde emissions, i.e. formaldehyde and acetaldehyde, from a modified 6.5 kW generator equipped with the SI engine using hydrous ethanol. The load and engine speed of testing conditions are fixed at 4 kW and 3300 rpm, respectively. The studied parameter is 5-40% water contents in ethanol. Specific fuel consumptions and thermal efficiency for each condition are revealed. The aldehyde concentrations are sampled and analyzed from the engine exhaust using California Air Resource Board (CARB) Method No. 1004. The regulated emissions are also measured by gas analyzer, i.e. HC, CO and NO_x. The experimental results will discuss the emission characteristics from the hydrous ethanol fuelled SI engine. This study is useful for the future development of hydrous ethanol SI engine generator.

Keywords*:* Aldehyde, Hydrous Ethanol and SI Engine.

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A Self-Aspirating Porous Burner (SPB) with Matrix-Stabilized Flame for Small and Medium Scale Enterprises (SMEs)

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Abstract

In the present work, a porous medium technology is used to improve a relatively low thermal efficiency of a self-aspirating conventional burner (CB) with free flame, which is widely used for small and medium scale enterprises (SMEs) in Thailand. A self-aspirating porous burner (SPB) with matrix-stabilized flame is proposed to replace the CB in the future. The SPB is designed and tested to understand its combustion phenomena and emission characteristics. A design criteria of the SPB is done by conserving some important characteristics of the existing CB, i.e. using the same mixing tube with the same pressure drop across the mixing tube and using the same pressure drop across a proposed porous burner to be equal to that of the multi-ports ring burner of the CB. The proposed porous burner is formed by a packed bed of randomly arranged alumina spheres. The Peclet number (*Pe*) combination with Ergun's equation are used to evaluated the pressure drop (ΔP) across the porous burner at different alumina sphere diameters which forms the packed bed of the porous burner. The designed and tested SPB yields favorable experimental results. With geometry and dimensions obtained from the calculation, the SPB can offer a matrix-stabilized flame with an intense thermal radiation emitted downstream at relatively high turndown ratio of 2.65 with the firing rate ranging from 23-61 kW. Emissions of CO and NO_x, respectively, are found at relatively low value of not more than 95 ppm and 85 ppm (corrected at 0% O_2) within the range of the firing rate studied.

Keywords*:* Self-aspirating burner, Porous burner, Premixed flame, SMEs.

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400-hour Durability Tests of Direct-Injection Engine Using Neat Palm Biodiesel

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Abstract

The objective of this study is to systematically investigate a long-term effect of using palm biodiesel in a compression ignition engine. A four-cylinder direct injection diesel engine, commonly employed in small farm trucks, was operated continuously on an engine dynamometer for a total of 400 hours using a modified driving cycle based on the EMA (Engine Manufacturers Association, USA) screening test. The tested engine was fueled only by neat palm biodiesel throughout the study. After each 50-hour test interval, various parameters such as power, torque, fuel consumption rate, cylinder pressure and exhaust emissions of CO, CO_2, NO_x, and THC were measured at various engine speeds of full load operation in order to determine any differences in the engine performance. The results revealed that this farm truck engine can be fueled with biodiesel for 400-hour operation without any significant effect on both engine performance and emissions.

Keywords*:* Biodiesel, Durability, Performance, Emissions, Diesel engine

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Development of Density Test Kit Prototype for Biodiesel Quality Control

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Abstract

The present prototype of a density test kit was invented to circumvent the challenges of inaccessibility to laboratory-grade equipment for biodiesel quality control. The prototype is economical to manufacture and easy to use, so it is an affordable means for small-scale biodiesel producers to monitor the density of their biodiesel by themselves. The test kit comprises two transparent columns, one for holding water as a reference liquid and the other for biodiesel sample. Both columns are connected to each other via a small air pump. The pressure built up by the air pump results in the difference in height of the two liquids. Based on the hydrostatic pressure principle, the height difference can determine the density of the biodiesel sample, given the density of water as a reference. Calibrated with the ASTM-standard-compliant equipment, the test kit prototype can measure biodiesel density within the range of 0.84-0.92 g/cm^3 with an accuracy of 0.01 g/cm^3, and can operate at room temperature between 15-45 °C.

Keywords*:* Biodiesel, Density measurement, Test kit.

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Development of Biogas Compression System for Using in Household

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Abstract

This research presents the study and development of biogas compression system for using in household. The two horse power compression system was developed and the motor was used as power source generator, including gas scrubbing machine system. The result showed that system could compress biogas into 15 kg container, in the amount of 0.50 kg, operating time 6.11 minutes, 1.35 kW of energy consumption or 0.138 kW h. Furthermore, increasing biogas by reducing the temperature before compressing was done by three different methods; (1) air cooling system (2) water cooling system, and (3) ice cooling system. From the experiment, it was found that the (3) method could reduce to minimum temperature at 9.87 $^{\circ}C$ before biogas compressing and gave 0.56 kg of final biogas (12% increasing) by comparable energy consumption. From using of biogas in household as substitution to LPG, it was found that using a 15 kg -container of LPG was equal to the energy of 67 containers of biogas which could save the expense 275.05 baht per one container of LPG. If a container of LPG could be used 7 days and cost of compression system was 15,000 baht, the break even point was 1.04 year.

Keywords: Biogas, Biogas compression system, LPG.

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Effects of Injection Pressure on Combustion Behavior and Emission in Commonrail Single-Cylinder Diesel Engine Using Jatropha Methyl Ester (JME)

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Abstract

This research aimed to correlate combustion characteristic with exhaust emissions in a 4-stroke single cylinder diesel engine equipped with commonrail system. The tested fuels were neat jatropha methyl ester (JME) and ultra low sulfur diesel fuel (JIS No.2). Emission analysis was conducted in Yanmar diesel engine model NFD-***13*** having its typical injector replaced by a commonrail injector unit. Injection pressures were selected at 20 and 140 MPa with engine loads varied by indicated mean effective pressure (IMEP) from 200 to 800 kPa with an increment of 200 kPa at a low speed of 1,200 rpm. The emission results showed lower THC and CO emissions for both fuels at low injection pressure while lower diesel smoke/soot emission at high injection pressure. For best comparison, combustion characteristic was further analyzed with optical diesel engine configured to the exact same conditions (compression ratio, injection pressure and engine speed). Rate of heat release (RHR) and combustion flame were captured as a function of IMEP for both fuels. The results showed that the RHR trends of both fuels were not so different because of their similar cetane numbers. Furthermore, the combustion flame brightness being luminous could be observed for the injection pressure of 20 MPa; whereas, the blue flame was seen instead for 140 MPa. This can be the effect of diesel smoke/soot, which was abundantly detected in the case of 20 MPa.

Keywords: Jatropha Methyl Ester, Commonrail injector, Optical diesel engine, Rate of Heat Release and Combustion flame

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Impact of Water Contents Blended with Ethanol on SI Engine Performance and Emissions

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Abstract

Recently, the oil crisis and energy security has become the serious concern all over the world. Ethanol, one of the alternative fuels for SI engine seems to have the potential for replacing the conventional fuels like gasoline. However, the process of removing water contents from hydrous ethanol to make it anhydrous is very costly on operation. In order to have the economical advantage, the use of ethanol with water content can be seen as an interesting choice as a fuel in SI Engines. Therefore, this work aims to investigate the impact of water contents blended with ethanol on thermal efficiency and emissions of SI engine. The 125-cc SI engine was used for the experiments. Tests were run at constant engine speed and stoichiometric air fuel ratio. The results show an increase in the thermal efficiency for hydrous ethanol having more than 10% water content. The bsfc value is increased on increasing water content. The NO_x produced by hydrous ethanol is very low. The unburned hydrocarbons and the CO emissions are increased on water addition but even after the addition of 20% water by volume they are found lower than those in case of gasoline. So it proposes a solution for the fuel which satisfies the current environmental concerns and helps in improving the fuel economy. This experimental study presents a discussion about the reliability of hydrous ethanol in near future.

Keywords*:* Water Content, Hydrous Ethanol, Thermal Efficiency, Emissions and Spark Ignition Engine.

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The Effect of Primary Air Preheat on the Primary Aeration of a Self-Aspirating Burner

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Abstract

Air preheat is used in many applications for heat recovery. In recent years, the combustion with air at higher than atmospheric temperatures also occurs in the new type of a self-aspirating burner. Although the preheating temperature of the combustion air resulting in thermal efficiency improvement, the emission of CO was relatively high. In the present work is aimed at investigating the effects of changes in the combustion air temperature on the primary aeration and flame structure. These studies were performed for both with preheat and without preheat case of combustion air. A self-aspirating burner operates as the gas emerges from an injector orifice and entrains the primary air. The primary air temperature is controlled by air heater. The gas/air mixture enters a mixing tube, then distributed uniformly to the multiple port burner with premixed flame. The oxygen concentration in the mixture is measured by the oxygen sensor. It shows the level of primary air within this mixture. The flame structure is also captured by a digital camera. It is observed that the level of primary air entrainment is increased with increasing the heat input. At a high level of heat input, the primary air entrainment will be stable and not depending on the heat input, due to limitation of the size of mixing tube and the burner port. The preheated case gives a lower primary aeration than the without preheat case, because the preheating effect will make the fluid in the mixing tube has more viscosity. A yellow tip flame also occurs with increasing the preheated air due to decreased primary aeration. As a result, it lead to the understanding of the influences of air preheat which affect primary air entrainment. This information may be helpful in designing a high-performance burner in the future.

Keywords: Self-aspirating burner, preheating effect, primary aeration, flame structure

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Combustion Characteristics of Direct Injection Stratified Charge of Gasohol Fuels

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Abstract

In this research, combustion characteristics of gasoline/ethanol blends in direct injection stratified charge engine were carried out using a constant volume combustion chamber. To evaluate the influence of blending on the combustion behavior .The flame propagation of different blends of ethanol–gasoline blends (20%, 85% and 100% ethanol) as well as pure gasoline were investigated under various swirl intensities and equivalence ratios. Pressure data taken during the testing allowed for detailed analysis. The different blend of fuels were compared in terms of combustion characteristics , rate of pressure rise, combustion duration, flammability limit also stratification degree that demonstrate the stability of combustion in lean operation will be investigated and discussed.

Keywords: Constant volume combustion chamber, direct injection, stratified charge, Ethanol/gasoline blends, Swirl intensities

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Evaluation of Parameters for Biofuel Production in CSTR

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Abstract

Catalytic deoxygenation of refined palm oil have been investigated in a 300mL Parr's semibatch reactor with a PID controller, dodecane as solvent and nickel molybdenum as catalyst. The reactant examined was refined palm oil. The main operating parameters studied were temperature, pressure, turbine speed and gas atmosphere. Liquid samples were collected every three hours and analyzed by a gas chromatography (GC) to quantify desired products (C13-C18) in diesel range. In conclusion, it was found that the amount of desired products is plateau with temperature. On the other hand, lowering operating pressure increases the conversion by almost 20%. In addition, the faster the turbine speeds the higher is the conversion. Ultimately, between hydrogen gas and argon gas, hydrogen was more preferable due to its ability to deoxygenate triglyceride.

Keywords*:* Deoxygenation, palm oil, nickel-molybdenum

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Constructal Pattern of Solar Chimney Power Plants on Land

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Abstract

In this article we show how to use constructal design to distribute solar chimney power production on available land area most efficiently. We find that the power generated per unit of land area is proportional to the length scale of the power plant. Because of the flow resistances associated with distributing the power over a territory, the size of the territory must be finite and optimally allocated to each power plant. Several patterns of the multi-scale plants on a square area are explored. The global performance of such patterns is greater when more land area is allocated to the largest plant. It was found that this performance depends comparatively less on the total land area covered by all power plants.

Keywords*:* solar chimney; solar tower; constructal, distributed energy systems; multi-scale power plants.

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Enhancement of Thermal Conductivity with Al_2O_3 for Nanofluids

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Abstract

The enhancement of the thermal conductivity of water in the presence of Alumina (Al_2O_3) using the employed surfactant, as the dispersant, is presented in this study. The volume concentration of Alumina–water nanofluids is below 0.2 vol.%. With the addition of dispersant and surfactant, the thermal conductivity of the produced nanofluids reveals a time-dependent characteristic. The thermal conductivity, considerably steady at the starting point of measurement, increases gradually with elapsed time. The results indicate that Alumina–water nanofluids with low concentration of nanoparticles have noticeably higher thermal conductivities than the water base fluid without Alumina. For Al_2O_3 nanoparticles at a volume fraction of 0.001 (0.1 vol.%), thermal conductivity was enhanced by up to 18.4%.

Keywords: Alumina, Nanofluids, Thermal Conductivity, TPS, Sensor

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Experimental Studies of A Steam Jet Refrigeration Cycle: Effect of The Primary Nozzle Geometries to System Performance.

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Abstract

This paper describes an experimental investigation of a steam jet refrigeration. A 1 kW cooling capacity experimental refrigerator was constructed and tested. The system was tested with various operating temperatures and various primary nozzles. The boiler saturation temperature ranked from 110 to 150°C. The evaporator temperature was fixed at 7.5°C. Eight primary nozzles with difference geometries were used. Six nozzles have throat diameters ranked from 1.4 to 2.6 mm with exit Mach number of 4.0. Two remained nozzles have equal throat diameter of 1.4 mm but difference exit Mach number, 3.0 and 5.5.

Keywords**:** Refrigeration, Ejector, Steam-Jet

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Starting Characteristics of an Engine using Neat Ethanol

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Abstract

The objectives of this study are to investigate starting characteristics of ethanol at low temperature, and find out a solution for cold starting problem, which is related to the cold-start operation of engines fueled with ethanol. The testing engine is a single cylinder, four strokes SI engine with fuel injection and ignition timing system being controlled by ECU (electronic control unit). The cold starting performance tests were conducted using ethanol fuel with different percentage of ethanol, surrounding temperature, heating method, and amount of fuel injection. From the experimental results, when using ethanol fuel with conventional engine, the problem of cold starting occurred at surrounding temperature lower than 15 °C and 20 °C for E85 and E100, respectively. Increasing of injection duration can lower the possible cold start temperature of neat ethanol to 10 °C; whereas, glow plug and pre-cranking heating methods can make the engine start at 10 °C and 12.5 °C respectively. These findings could be considered as solutions to the cold start problem in engine fuelled with pure ethanol fuel in Thailand.

Aerospace and Marine Engineering

(AME)

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Survey of Micro Air Vehicles in an International Even & Utilization in Thailand

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Abstract

Micro Air Vehicle (MAV) is a very small autonomous aerial vehicle which can be carried and operated by one person. It had been originally interested for military as surveillance, pointing target, dropping sensor, and etc. The flight competition of MAV has been first organized in 1997 by USA. Numerous researches on MAVs have been done around the world. This paper talks about the MAVs which have been developed and presented in the international MAV flight competition, in particular IMAV in Germany, July 2010. Different MAV configurations and some technologies are presented. Finally, the application of MAVs / UAVs in Thailand will be discussed.

Keywords*:* MAVs, UAVs application, Low Reynolds number.

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Adaptive Wing by Using a W-Spar Concept

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Abstract

Adaptive or morphing wings can achieve its flight control through structural flexibility. This concept has been studied by many researchers throughout the world. Nevertheless, most of the wing internal structures in the literature are difficult or even impossible to construct practically. This paper studies the possibility to use a simple-to-construct W-spar for a morphing wing structure. The sizing optimization is posed to have the best wing thicknesses while design constraints include flutter, divergence, and stress. The optimization problem is solved by using hybridization of genetic algorithm and a response surface method. The results obtained are illustrated. It is shown the W-spar concept is acceptable for use as an adaptive aircraft structure.

Keywords**:** adaptive wing, aeroelasticity, lift effectiveness, W-spar, vortex ring method

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Determination of Wind Turbine Blade Flapwise Bending Dynamics

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Abstract

Damages related to flapwise bending of wind turbine blades is a very common type of failure experienced by small wind turbines in Thailand. Turbine blade structural designs and hub connections are usually capable of withstanding steady high speed wind. However, when it comes to unsteady flows, especially strong gusts, the wind turbine blade structural integrity is often vulnerable. Had the wind turbine experience a steady rise of wind speed, the local angle of attack at every blade element would have been kept relatively low due to the increasing rotor rotation speed at high wind speed. However, the gusts usually happen so quickly that the rotation speed is incompatible to the approaching wind resulting in exceedingly large local angle of attack which, in turn, causes large drag forces and bending moment in the flow direction. The resulting deflection may be catastrophic. This research work aims to study the flapwise bending dynamics of a wind turbine blade by assessing the blade flapwise equation of motion. The analysis focuses on Hopf bifurcation determination (instability analysis) with respect to changes in governing parameters, in this case, wind velocity and the blade structural stiffness. The calculation procedures and example results may be used by blade designers in material selection, connection type selection and establish the wind turbine safe operational envelope.

Keywords*:* Wind turbine blade, flapwise bending, Hopf bifurcation, stability analysis.

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Characteristics of High-Speed Liquid Jets in Water

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Abstract

This paper describes the study of high-speed liquid jets injected in water from an orifice. The main focus is the comparison of jet characteristics between the jets injected in ambient air and water. The high-speed liquid jets are generated by the impact of a projectile launched in a horizontal single-stage power gun designed and constructed at Department of Mechanical Engineering, Faculty of Engineering, Ubon Ratchathani University. The jets have been visualized using the high-speed video camera and shadowgraph method. The effect of jets injected in ambient air and water on jet penetration, jet velocity attenuation and other characteristics have been examined. The maximum average jet velocity of 1,700 m/s (Mach no. 5) in ambient air has been obtained. The difference of characteristics of the jet injected in air and water such as jet body, shock wave, jet velocity attenuation and penetration distance can be observed clearly. However, this jet tip velocity can be sustained for only a very short period (a few microseconds). It then attenuates very quickly.

Keywords**:** High-speed liquid jet, Horizontal single-state powder gun, Shock wave, Shadowgraph technique

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An Investigation of Failure Scenario of the Metallic Insert in Sandwich Structures

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Abstract

This paper addresses an experimental study of the metallic insert in composite sandwich structures, which simulates an insert application on to a fuselage of a helicopter under pull-out failure load test. Nomex® honeycomb core and carbon epoxy composite face skins were used for specimen fabrication. The molded-in type should always be used to this application because of its ability to bond the insert, core and face skins into one rigid unit with the selected resin potting medium. Observation of the response of the specimens during testing showed that first failure occurred by buckling of the honeycomb cell wall that attributed to a transverse shear failure adjacent to the potting mass. However, the strength and stiffness of the sandwich structures containing a potting/lower face skin bond decreased substantially with increasing debonded size until interfacial failure and followed by rapid rip of the honeycomb core that attributed to a tension failure at the ultimate load test.

Keywords**:** Sandwich structures, junction, Metallic insert, Insert failure behavior.

Applied Mechanics, Materials and Manufacturing (AMM)

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Microstructures and Mechanical Properties of Portland Cement Pastes at Early Age Subjected to Microwave Accelerated-Curing with a Multi-Mode Cavity

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Abstract

This paper presents the microstructures and mechanical properties of cement pastes subjected to microwave energy with a multi-mode cavity. The microstructures of hydration products of cement pastes were examined by SEM with EDX and XRD. Furthermore, compressive strengths of the pastes were also measured. The obtained results shown that the temperature increases monotonically during the microwave curing process. Significantly, the paste at lower water-to-cement ratio behaves high temperature rise. The phases which includes calcium silicate hydrate (Ca_3SiO_5), calcium hydroxide ($Ca(OH)_2$) and xenotile ($Ca_6(SiO_3)_6(H_2O)$) are identified. When cured at elevated temperatures, pastes develop strength quite rapidly. At the age of 8 hours after microwave curing at 100 ^{0}C, 0.25-w/c paste attained a strength of 25.1 MPa (239 % higher than the lime-saturated water-cured paste); at 24 hours curing the strength is 68.3 MPa, and 7 and 28 days the strengths are 74.9 and 75.2 MPa, respectively.

Keywords**:** Microwave; Multi-mode cavity; Microstructure; Mechanical; Portland cement pastes

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Effect of Filler on Heat Build-up of Rubber

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Abstract

The research is about added filler to reduce heat build-up in a solid tire. This study is using two different fillers, Carbon Black and Silica; 40:10 phr, compared with four different brands of solid tire manufactured in Thailand. It is found that proportion of filler reduces hysteresis loop and Young's modulus, whereas compressive properties are the same.

Keywords: Filler, Natural Rubber, Heat Build-up

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Fabrication and Development of High Temperature Shape Memory Alloys

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Abstract

In the present day, the operating temperature of Ti-Ni shape memory alloys in practical applications are limited at relatively low temperature of 100°C. For this reason, Ti-Ni shape memory alloys cannot be used in the industry where higher temperature range are required, for example, sensor in nuclear reactor, sensor control fuel injector and semiconductor inspector, etc. This research aims to fabricate shape memory alloys which can be used in high temperature range in order to extend the applications. Zirconium (Zr) was selected to be the third element to add in Ti-Ni alloy for increasing transformation temperature. The effect of Zr – content on mechanical properties and transformation behavior of Ti-Ni-Zr alloys were investigated. Ti-Ni-Zr alloys with Zr – content of 20 – 30 at. % ($Ti_{51.5-X}$ $Ni_{48.5}Zr_x$ with X = 20-30 at. %) were prepared by induction furnace under Ar atmosphere. Transformation temperatures were detected by differential scanning calorimeter (DSC). Oxidation tests under 800°C were carried out in order to evaluated the oxidation resistance. In order to investigate the effect from cold work hardening, the alloys were cold-rolled to thin plate with reduction ratio of 5 %. Mechanical properties were evaluated by universal tensile testing. From the results, it is seen that transformation temperatures of $Ti_{51.5-X}$ $Ni_{48.5}Zr_x$ increases from 397 - 452°C with increasing Zr – content from 20 to 25 at. %. Oxidation resistance of each specimen was clearly enhanced with increasing Zr – content. Micro – hardness and yield strength increases from 434 to 521 Hv and 300 to 383 MPa with increasing Zr – content from 20 to 30 at.%, respectively. On the other hand, percentage of elongation decreases from 8.35 to 2.16 % with increasing Zr – content from 20 to 30 at.%.

Keywords: High Temperature Shape Memory Alloys (HTSMA), Shape memory effect, Superelastic, Transformation temperature, Oxidation resistance

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Development of High Quality Aluminum Parts using Semi-Solid Die Casting

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Abstract

Generally, die casting is a process of casting metal by forcing molten metal into the mold under high pressure and high velocity. This result in a possible to mass production of a thin-walled parts compare with sand casting, gravity casting and low pressure casting. Unfortunately, high speed injection can be caused a casting defect and fail to meet requirement of reliable parts such as a suspension parts in automobile industry. To serve increased demand for high quality castings, the semi-solid die casting has been developed to overcome those problems. Basically, the casting quality depends on the flow characteristics and the solidification phenomena in the cavity. For the semi-solid die casting, those characteristics or phenomena differ significantly from the others because of its less liquid phase. In this paper, a quick and easy semi-solid slurry manufacturing process developed by Tohoku University will be introduced. By utilizing this method, a production of high strength parts and pressure tightness parts for motorcycle and others application can be performed with many advantages such as less gas porosity, less shrinkage porosity, and better metal structure can be obtained. Furthermore, the efficiency in production cost and productivity are the advantage of commercialization in die casting process.

Keywords: High Strength Parts, Pressure Tightness Parts, Semi-Solid Die Casting, Cup-Method

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Near-Field Acoustic Characteristics of Supersonic Jets from Chevron Nozzles

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Abstract

The near-field acoustic characteristics of suppersonic jets from chevron nozzles have been investigated by the optical wave microphone. This laser-based microphone not only unobstructs the flow, but it is also able to measure the simultaneous sound propagation both vertical and horizontal directions. As a result, the real time fluctuation of the jet has been observed that the screech tone from 2-notched nozzle is only propagated on the unnotched side with sound speed, and the strongest source of the noise is movable when the notch number is changed.

Keywords: Screech tone, Near-field acoustic, Chevron nozzle, Optical wave microphone.

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Cost Effectiveness Study of a Novel Hot-Dip Galvanizing Process

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Abstract

A novel hot-dip galvanizing process for steel has been developed to improve the longevity of the finished product and reduce zinc layer thickness. Its cost effectiveness, however, has not been validated. This paper studies the cost differences between the novel and the traditional processes by constructing a process-based cost model and using it to investigate important process cost drivers. Sensitivity analyses on the drivers provide product and process characteristics which will guarantee the cost effectiveness of the technique.

Keywords*:* Galvanizing, Cost effectiveness, Cost modeling

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New Design Concepts for Low Friction Plain Journal Bearings

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Abstract

An unlubricated journal bearing or bushing is simply a cylinder with a hole in the center. It normally supports a translating or rotating shaft. Examples include door hinges, caterpillar tracks and pistons. They are simple and inexpensive but can be prone to friction and wear. This can lead to them seizing or binding especially in dirty environments. This paper will present 2 new inexpensive designs for journal bearings which reduce the problem of wear and seizing inherent in existing journal bearings.

Keywords*:* Journal Bearings, Low Friction, Low Wear

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Fracture Toughness of Closed-Cell Polymeric Foam under Mixed-Mode I/II Loading

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Abstract

Closed-cell polymeric foams are widely used as core materials in sandwich structures. During services, the structures might experience complex loading situations. Moreover, pores in the closed-cell foam could be the locations for initial defects or cracks in the structure. Thus, failure of polymeric foam is usually dominated by crack coalescence and propagation under mixed-mode loading. In this study, the mixed-mode (mode I/II) fracture behaviors of closed-cell PVC foam were investigated under various mode-mixity angles (β= 0° to 90°), i.e. the β is 0° for pure mode I loading, and becomes 90° for pure mode II loading. Single-edge notched bending specimens with 10-mm thickness were used in the present work. The tests were carried out at loading rate of 10^{-1} mm/min. It was found that K_{IQ} decreased with increasing mode-mixity angle. While, K_{IIQ} increased with increasing mode-mixity angle from 0° to 45°, and became insensitive to the change of the mode-mixity angle above 45°. Moreover, the fracture toughness of the PVC foam under dominated mode I loadings (β< 45°) was higher than that under dominated mode II loadings (β> 45°) due to the contraction in thickness direction and crack tip blunting at the dominated mode I loadings. These fracture mechanisms corresponds to the observation of fracture surfaces.

Keywords*:* closed-cell polymeric foam, single-edge notched bending, fracture, mixed-mode I/II loading

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Analysis of Wear Behaviors in Hard Disk Drive Manufacturing Processes for Selection Appropriate Coating Films

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Abstract

One of the main problems in Hard Disk Drive (HDD) manufacturing is the contamination during fabrication. This problem is caused by wear particles of fixtures and other moving parts. Among those, stainless steel particles are found to be the main causes of scratches occurring on the part surface and hence should be eliminated. Surface coating is one solution that can reduce tool wear. This research is aimed to improve the surface properties of tooling used in Hard Disk Drive manufacturing process by Physical Vapor Deposition (PVD) coating technique. The abilities of the film to reduce wear are studied. The commercially coated thin film properties are evaluated by various tests. Ball-on-Disk tests were carried out in order to obtain the specific wear rate of each surface. The SUS304 balls were prepared by coating with TiCN, AlCrN, TiAlN (Nanolayer), TiAlN films. The disks were made of SUS304. Hardness of each coating films is measured by nano indentation test. The surface resistivities of the coating films are measured by surface resistivity test. The result reveals that all of coating surfaces can reduce the specific wear rate within the allowable contact pressure of 600 MPa comparing to non-coated surface. Especially TiAlN (Nanolayer) and AlCrN films show outstanding ability to reduce specific wear rate. Further, it is seen that the similar level of surface resistivity was obtained independent of type of coating film.

Keywords*:* Hard disk drive, Contamination, Surface coating, Wear Particle, Stainless steel

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A Determination of the Optimized Conditions for Rubber Injection Moulding

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Abstract

Rubber injection moulding is one of the processing methods widely used to manufacture rubber products which generally have complex geometries such as motor boots, engine hoses, steering wheels, automotive glass runs, and automobile tension rod bushes. However, most processing parameters chosen for injection process are often obtained using trial-and-error as well as operator's experience resulting in unsatisfied product quality. Consequently, in order to gain further understanding of the determination of those injection variables, an investigation of the optimized injection conditions of the EPDM bellow used in washing machines was studied in this research. Both numerical flow analysis and empirical work were carried out and then results were analyzed with the 2_4 full factorial method. The results show that the significant factors on rubber injection process are founded as injection pressure, injection temperature, mould temperature, injection time. It can be founded that the optimum levels of factors at the injection time of 17 seconds and the mould temperature of 180 °C. These conditions can be further used for reduction of air traps existed. The optimization of these parameters can lead to less air trap which improves rubber product quality.

Keywords*:* Optimized condition, Rubber, Injection moulding, EPDM, Full factorial method.

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Effect of Ni-Content on Mechanical and Transformation Behavior of NiTi Shape Memory Alloys for Orthodontics Applications

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Abstract

This study aims to investigate the effect of Ni-content on mechanical properties and transformation behavior of NiTi shape memory alloys for utilizing as orthodontic wires. NiTi binary alloys with Ni-content ranging from 50 to 51 at% were prepared. The specimens were cold-rolled with percentage reduction of 10, 20 and 30%, respectively. Then they were heat treated at 400°C and 600°C for 3,600s, respectively. The results show that transformation temperatures strongly depend on Ni-content, i.e., transformation temperatures rapidly decrease with the increase of Ni-content. Moreover transformation temperature decreases with the increase of cold-rolling reduction ratio. However, the higher is the reduction ratio, the superelastic properties become more evidently. Further heat treatment temperature 400°C provides specimens with better properties compared to those of 600°C. The results obtained can be use to determine optimum alloy composition of NiTi alloy to be used as orthodontic wires.

Keywords*:* orthodontic wires, Ni-content, Reduction ratio

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Improvement of Glass Disk Durability and Sensitivity in Flying Height Measurement

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Abstract

In hard disks, flying height or the spacing between the read/write head and the magnetic disk has been greatly decreased to less than 10 nm in order to achieve high-density magnetic storage. Generally, the fly height is measured in a flying height tester using the principle of light interferometry observed through a transparent glass disk. This specially manufactured glass disk is extremely flat and smooth which costs $300-500 each. Due to the intermittent contact between the head and glass disk, this characterization process easily causes the disk wear and scratches. In this paper, we employed a hard coating material of diamond-like-carbon (DLC) layer as a protective layer over the commercial glass disk to increase its wear resistance resulting in disk lifetime improvement. In the fabrication process, silicon adhesion layer and DLC protective layer are deposited on the commercial glass disk by ion beam deposition. According to a wear test performed in a triboindentor, the wear depths measured from the fabricated disks coated with 15-nm thick DLC were 5-7 nm whereas that of a bare glass disk was 62 nm. Furthermore, we investigated the sensitivity of the flying height measurement using the fabricated disks. The analysis results suggested that the sensitivity of flying height measurement using the fabricated disks improved by 341% as compared to that of the measurement using a commercial glass disk. This approach gives a great promise to the disk lifetime extension as well as the significant improvement of the sensitivity in flying height measurement.

Keywords*:* glass disk, flying height, hard coating materials, diamond-like-carbon, sensitivity

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Study of Screw Tightening Sequence on the Looseness of the Top Cover in the Hard Disk Drive Assembly

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Abstract

In hard disk drive (HDD) assembly process, the top cover is attached to the base assembly via screws. Screw tightening sequence could result in looseness of previously fastened screws and thus rework of the process. The current work focuses on the study of behavior and effects of screw tightening sequences to the screw looseness by using nonlinear finite element method. The three-dimensional 3.5- inch HDD assembly including top cover, base, rubber seal and screws are modeled and analyzed. It can be concluded that the later sequences of screw tightening affect the looseness of the previously fastened screws to some extent. Higher lose of tightening torque is observed at the screws located near the currently tightened screw. Alteration of the screw fastening sequence as well as the applied torques can reduce the looseness and therefore prevent the top cover slip.

Keywords*:* Screw looseness, Hard disk drive, Tightening sequence, Finite element analysis

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Topological Design of a Hard Disk Drive Suspension Using Multi-Objective Population Based Incremental Learning

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Abstract

The work in this paper presents topological design of a hard disk drive (HDD) suspension. A multiobjective design problem is set to explore Pareto optimum topologies that maximise the first sway mode natural frequency and simultaneously minimizing bending stiffness of the suspension. Design constraints include the first bending and torsion modes natural frequencies. Population based incremental learning (PBIL), as an optimiser for multi-objective optimization, is used to explore a Pareto optimal front of the design problem. Some selected suspension topologies thereafter are modified so as to meet all HDD suspension requirements. It is illustrated that the proposed design approach is a powerful numerical tool for design/optimization of HDD suspension systems.

Keywords: population based incremental learning (PBIL); topology optimization; Pareto optimal front; bending stiffness, hard disk drive suspension

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Passive Vibration Control of an Automotive Component Using Evolutionary Optimization

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Abstract

In this paper, the use of multiobjective evolutionary optimisers for passive vibration suppression of an automotive component is demonstrated. The component is used to connect a car engine to some point of a car body between the front seats. Under such circumstance, the structure is subject to several mechanical phenomena e.g. stress failure, fatigue, vibration resonance, and vibration transmissibility. The optimisation problem is posed to find structural shape and size such that maximising structural natural frequency and simultaneously minimising structural mass while constraints include stress failure and displacement. The multiobjective optimiser employed is the multiobjective version of Population-Based Incremental Learning (PBIL) with and without using a surrogate model. The optimum results obtained are illustrated and discussed. It is found that the propose design scheme is effective and efficient for automotive component design.

Keywords: multiobjective evolutionary algorithm; shape optimisation; Pareto optimal front; automotive component; Vibration suppression

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A Parametric Study of Drop Test for Hard Disk Drives Packaging Using Finite Element Analysis

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Abstract

Design a package for logistic hard disk drives concerning considerable parameters. Mostly the loadings are confined to fulfill with ASTM D4169 and company restriction, however, the cushion performance can be varied. In this work, simulations employing finite element analysis are performed to investigate the performance of cushion having various cushion spacers from 3 millimeters to 9 millimeters. Six positions of impact (6 sides of corrugated box) were examined and compared with the actual drop test. The results indicated that changes in cushion spacer have significant influence on the longitudinal of corrugated box. For the most hazard drop side, impact acceleration is reduced dramatically when the spacer is increased to a certain distance.

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Manufacturing of a Prototype Blade for Small Wind Turbines

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Abstract

Most of the wind turbines installed in Thailand are designed and manufactured abroad, usually with optimum operation at wind speeds higher than the wind in Thailand. Attempts have been made to develop wind turbine blades locally to make them aerodynamically more suitable for actual wind conditions. It is then necessary to produce supporting structure capable of withstanding the operating loads of these blades. This paper presents the manufacturing of a prototype blade for small wind turbines. The objective is to implement simple manufacturing processes suitable for fabricating small blades yet capable of extending to the construction of larger blades. The prototype blade was made in-house from a glass/polyester composite using hand lay-up process with an emphasis on materials and equipment that are readily available from local suppliers. An existing 1.2-meter blade was used to create the mould. The new blade made from this mould weighs 2.15 kg, only 0.1 kg or 5% heavier than the original =commercial> blade. Flapwise bending tests were performed on both blades in cantilever beam configuration. The new blade boasts 7% higher stiffness than the original one when load versus tip deflection results are compared. No significant twisting deformation was observed during the tests. The materials and processes used in this work can thus produce blades comparable in weight and stiffness to some that have reached commercial stage of development.

Keywords: Wind turbine, blade, manufacturing, composite material

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Simulation of Impact Regimes

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Abstract

Impact regimes defined by projectile mass and velocity can produce very different characteristic target structural responses, and complex behaviour when the regime boundaries are crossed. This has previously been proven by experimental work. The objective of this work was to qualitatively model the experimentally observed impact behaviour, and to identify any deviation in trends between experiments and the simulation in terms of the type of response, but not in terms of material damage. An explicit FE commercial package was used to simulate the impact of a free flying projectile onto a flat aluminium plate, varying projectile mass and velocity, target span and thickness. Behaviour was characterized by prediction of projectile-target contact time, projectile rebound velocity and target maximum deflection at its mid-span. Two extreme conditions of low velocity/high mass and high velocity/low mass were simulated, and the transition between these two regimes was explored by incrementally varying mass and velocity. For low velocity/high mass, the simulation matched the main trends from the experimental work, with a classic quasi-static large scale global deflection type behaviour of sub first mode rebound. For high velocity/low mass, the agreement was less strong due to a lack of damage mechanics, but still confirming the response was localized to the contact zone. For the transitions between regimes, the simulation also matched the experimental work showing projectile-target intermittent contact when sweeping across the mass boundary, and a delay in global response when sweeping across the velocity boundary. Unlike the experimental work, the simulation allows the easy viewing of stress waves developing over time, which can be used to confirm and explain some of these observations.

Keywords: Impact, regimes, boundaries, transition, simulation

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Effect of Cold Work on Pseudoelastic Property of Ti-Nb Alloys for Utilizing as Artificial Bone

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Abstracts

Nowadays, there are many materials which are used in medical applications such as stainless steel 316L, Ti-6Al-4V and other Ti alloys. However, these materials are staying high modulus of elasticity when compare with human bone**.** From this reason, this research aims to explore the pseudoelasticity from Martensitic transformation in Ti-Nb alloys in order to obtain a low modulus of elasticity-liked properties. In this study, effect of cold-work on pseudoelasticity of Ti- Nb alloys was investigated by varying reduction ratio of thickness during cold-rolling process. Ti- Nb alloys with Nb-content from 22 to 26 at% were prepared by arc-melting method. Cold rolling processes were carried out at reduction ratio of 90 and 95% for each specimen, respectively in order to apply the internal stress for introducing metastable phase. After cold-rolling, specimens were heat-treated at 873K followed by aging at 573 and 673K, respectively for 3.6 ks in order to obtain precipitation strengthening due to formation of ω phase. Tensile tests were carried out in order to evaluate mechanical properties of each specimen. In order to investigate the pseudoelasticity, load-unloading tests under various strains were performed at room temperature. It is found that the pseudoelasticity can be confirmed in the alloy with Nb-content ranging from 23 to 26.7 at%, while modulus of elastic due to detwining of martensite variant increase with increasing reduction ratio. Excellent recovery pseudoelastic strain ratio is confirmed in a Ti- 25.6at%Nb alloy. Moreover the very low modulus of elastic can be obtained during the range of reorientation of martensite variants which is suitable for utilizing as an artificial bone.

Keyword: Pseudoelasticity, Titanium alloy, Artificial Bone and Martensitic transformation

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Computer Simulation of Mechanical Response of Suspension Processed by Bending and Heat Treatment

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Abstract

In suspension manufacturing, one of the most important factors is the suspension preload or so called “gramload”. Such factor controls the flying height during the operation of the hard drive. The suspensions made of SUS304 stainless steel are formed in a metal die and further adjusted by mechanical bending until the gramload is in a certain range. Finally, fine gramload adjustment is carried out by laser treatment. Although such processing has been commercially applied to suspension production for many years, there is no clear explanation on the principle responsible for the change of the gramload due to bending and laser heat treatment. Therefore, the objective of this work was to study the effect of bending and further heat treatment on the mechanical behavior of thin SUS304 stainless steel sheet using the finite element method. The results of this work can be used explain the mechanical response of the suspension after bending and after heat treatment.

Keywords*:* Thin Stainless Steel, finite element method, gramload.

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Transient Thermal Elastohydrodynamic of Rough Surfaces under Line Contact with Non-Newtonian Solid-Liquid Lubricants

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Abstract

The thermal compressible elastohydrodynamic lubrication of rough surfaces under line contact with non-Newtonian solid-liquid lubricants was investigated in transient operating conditions. Properties of non-Newtonian solid-liquid fluids have been obtained experimentally using solid particles namely, Molybdenum disulfide. The newly derived time-dependent modified Reynolds equation and the adiabatic energy equation have been formulated using a non-Newtonian power law viscosity model. The simultaneous systems consisting of the modified Reynolds equation, elasticity equation and energy equation with initial conditions were solved numerically using the multi-grid multi-level method with full approximation technique. The dynamic characteristics of the two infinitely long cylindrical rough surfaces in line contact under thermoelastohydrodynamic lubrication were presented with varying dimensionless time and with varying particle concentration for the pressure profile, temperature profile and oil film thickness profile. The results of rough surfaces thermoelastohydrohynamic lubrication with non-Newtonian solid-liquid lubricants are compared with the case of smooth surfaces.

Keywords *:* Thermal elastohydrodynamic lubrication, Non-Newtonian solid liquid lubricants, Power law model, Modified Reynolds equation, Adiabatic energy equation.

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Improving the Quality of Groove in Electro Chemical Machining (ECM) Process by Taguchi Method

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Abstract

This research presents a study of relationship between Electro Chemical Machining (ECM) parameters and groove depth and groove Ratio. Design of Experiment (DOE) by gomplete randomized and Taguchi method has been applied to investigate the optimal combinations of process parameters to the targets: 10 micron of groove depth and 1 of groove ratio. Signal-to-noise(S/N) ratio was determined to know the level of importance of the parameters. The results were confirmed experimentally at 95% confidence interval. Based on ANOVA, 10 amperes of current with 10 pulses, duty factor is 40% and gap factor is 50 micron was found to be significant for best groove depth and groove ratio.

Keywords*:* ECM, Design of Experiment, Taguchi, Groove depth, Groove ratio.

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Creep-Fatigue Crack Growth Behavior of Sn-37Pb and Sn-3.0Ag-0.5Cu Solders at Room and Elevated Temperatures

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Abstract

Fatigue crack growth tests of Sn-37Pb and Sn-3.0Ag-0.5Cu solders were conducted under frequencies from 10 to 0.1 Hz and a stress ratio of 0.1 at room temperature and 70°C. J-integral range (ΔJ) and modified J-integral (C^*) were used to discuss about cycle-dependent and time-dependent crack growth behavior. The experimental results showed that crack growth behavior of both the solders were predominantly time-dependent at lower frequency and higher temperature, while it was predominantly cycle-dependent at higher frequency and lower temperature. Furthermore, from the fracture surface observations of both the solders, it was found that as the frequency decreased and/or the temperature increased, the fracture surface appearance changed from transgranular to intergranular manner for both the solders.

Keywords: Lead-contained solder, Lead-free solder, Fatigue crack growth, Creep crack growth, Frequency, Temperature

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Failure Analysis of a Helical Gear

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Abstract

This paper reports the result of an investigation of a premature failure of a helical gear in a reducer gearbox used in a continuous hot rolling steel re-bars mill in Thailand. Standard investigative procedures were employed in the analysis. It was found that the gear failed by fatigue fracture. Beach marks on the fracture surfaces were clearly visible. Detail examination of the surface of the gear revealed that extensive surface damage had occurred in the form of pitting. Sub-surface damages in the form of spalling were also observed. Such observations indicated that the gear was under excessive contact stress during operation. Stress analysis did, in fact, confirm such hypothesis. These surface and sub-surface damages lead to fatigue crack initiation followed by crack growth and eventual fracture. Excessive contact stress resulted from the replacement of the original 300 kW motor by a new, more powerful 600 kW motor in order to roll thicker billets. It is concluded that the helical gear failed by fatigue fracture initiated by surface and sub-surface damages resulting from excessive contact stress. The lesson learned from this case is that one must be careful when replacing key components of machines or other engineering systems. The effects of such replacement must be thoroughly analysed.

Keywords*:* Helical gear, Helical gear failure, Failure analysis, Fatigue failure

Biomechanics

(BME)

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Simulation of an Occlusal Interference of an Implant Crown

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Abstract

A periodontal ligament is a tissue that forms between a tooth and a supporting bone. It absorbs and distributes the occlusal force to the supporting bone. In addition, it contains mechanoreceptors which sense the mechanical load. In dental implantation, bone forms around the implant without the periodontal ligament. Therefore, the sensitivity to the mechanical load decreases. Occlusal interference of an implant crown is an interference of a mandible movement by an initial contact between an implant crown and its antagonist teeth. There is potential of overloading of an implant if the occlusal interference occurs. In this study, an occlusal interference of an implant crown was simulated to quantify the magnitude of the resulting occlusal force. A finite element model of a mandible with an implant anchored in the first molar position was created. A rigid plate was used to collectively represent the maxillary first molar, which is the antagonist tooth, the periodontal ligament and the maxilla. Finite element contact analysis was performed to simulate the occlusal interference. The occlusal interference height was calculated from the combined displacements of the implant crown from the finite element analysis and the maxillary first molar from the existing experimental results. From the obtained results, the occlusal interference height of 100 micrometers can result in an increase of the magnitude of occlusal force of 84.82 N.

Keywords*:* Occlusal interference, Finite element method, Dental implant

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Biomechanical Study of the Thai Humerus with Humeral Shaft Fracture at Ninety Degrees Abduction

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Abstract

The rotator cuff and deltoid muscles are the active muscle group when the humeri lift to abduction status. They are the main effect of the stress distribution on the implants and strain distribution on the humeral bone when the humeral shaft fractures occur. To stabilize the humeral shaft fracture, the standard humeral nail was used to fix the fracture gap with the antegrade insertion technique. This study aims to find the effect on the implants and four fracture gaps along the humeral shaft at ninety degree abduction by finite element analysis with six muscular forces from the mechanical testing device which was validated the data. The result were shown that the fourth gap condition occur the highest strain on the fracture gap and the highest stress on the implant. The retrograde insertion technique must be proving for compare the appropriate technique for stabilize the humeral shaft fracture.

Keywords*:* Thai humerus, Humeral shaft fracture, Biomechanical study.

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The Effects of Dielectric Shield on Specific Absorption Rate and Heat Transfer in the Human Body Exposed to Microwave Energy

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Abstract

This paper proposes a numerical study to simulate the effects of dielectric shield on the specific absorption rate (SAR) and the temperature increase in the human body exposed to microwave energy. Three shield dielectric properties at microwave frequencies of 300, 915, 1,300, and 2,450 MHz are selected for the shielding investigation. Based on the obtained results, the installed shield strongly affects on the SAR and the temperature increase in human model. The SAR and the temperature increase in human model can be reduced simultaneously by setting the appropriate parameter of the shield (the dielectric properties). The optimum parameter of the dielectric shield greatly depends on the operating frequencies. Additionally, this paper presents an interesting viewpoint on the microwave shielding properties of various dielectric shields. Finally, these fundamental data for the implementations of the radiation protection shielding materials, with focusing on the human organism, are provided as well.

Keywords*:* microwave energy, numerical methods, SAR, heat transfer analysis, dielectric shield.

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Influence of Food Viscosity on Velocity of Bolus Transport in the Pharyngeal Phase

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Abstract

There are many ways to heal the dysphagia or difficult swallowing symptom. Self swallowing of right food is an alternative to heal as well as to cure the dysphagia effectively besides regular surgery. However viscosity of foods can be an obstacle for patients in swallowing. Understanding influence of food viscosity to velocity of bolus transport can help nutritionists in preparing appropriate and healthy food for patients. Studying this work, effect of the viscosity of shear thinning food on velocity of bolus transport was investigated. Two values of food viscosity, i.e. 95cP and 1368cP, were used. Volunteer were classified into 2 groups, 18-25 years old and more than 40 years old. Each group consisted of 3 male and 3 female volunteers. Each volunteer was subjected to 3 tests for food swallowing for each viscosity. Videofluorographic recording was performed to measure bolus velocity. The velocities of bolus transport in the younger group were found to be $9.75^{+1.55}_{-2.12}$ cm/s in low viscosity food and $11.08^{+0.41}_{-0.51}$ cm/s in high viscosity food and 7.80 ± 1.0 cm/s in low viscosity food and 7.97 ± 1.6 cm/s in high viscosity food, for female and male volunteers, respectively. Those for the older group were $9.98^{+2.92}_{-2.69}$ cm/s in low viscosity food and $9.80^{+0.99}_{-1.14}$ cm/s in high viscosity food and 9.73 ± 0.6 cm/s in low viscosity food and $9.44^{+0.48}_{-0.57}$ cm/s in high viscosity food, for female and male volunteers, respectively. Consequently, the velocity of bolus transport in female is higher than that in male for both food viscosities. Therefore the food of male patients should be prepared rarely viscosity more than female and the food of elder patients should be prepared rarely viscosity more than younger patients.

Keyword: Food viscosity, Swallowing, Pharyngeal phase, Dysphagia

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Characterization on Properties of Modification Gelatin Films with Carboxymethylcellulose

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Abstract

Effects of carboxymethylcellulose (CMC), a derivative of cellulose, blended with biopolymer gelatin films has been studied. The films were fabricated by blending CMC with gelatin solution in various ratio and casted on glass cover slips. Thermal and chemical crosslinking techniques were used to induce conjugation of free amide and carboxyl groups in protein structures of the films. Physical and mechanical properties of different gelatin/CMC films were characterized by Atomic Force Microscope (AFM) which scans on film surfaces and evaluates their elasticity. The physical structures of the films from AFM analysis indicated that increasing of CMC ratio effected in more aggregated of the protein structures of all the films. The analysis mechanical properties demonstrated that increasing of CMC ratio in gelatin/CMC films resulted gradually increasing in modulus of elasticity compared to pure gelatin films. The physical and chemical crosslinking EDC/NHS in 50 mM MES buffer in 40% ethanol improved in mechanical strength of all the gelatin/CMC films by increasing in modulus of elasticity with an average at 62.71 ± 1.69 kPa and 63.24 ± 0.92 kPa, respectively compared to pure gelatin film. These results suggested that using CMC as an additive and crosslinking techniques including thermal treatment and EDC/NHS as a crosslinking agent strengthened in protein structures which enhanced in mechanical properties of gelatin. The additive of CMC had tendency to display some interesting properties for applying in biomedical
applications.

Keywords*:* gelatin, carboxymethylcellulose, film, Atomic Force Microscope, Modulus of Elasticity

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Biomechanics Study of Knee Ligament

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Abstract

This research studies biomechanics of ligament on knee. The purpose is to calculate stress and strain distribution on knee ligament while walking. First, study anatomy of knee. Ligament is tested to obtain mechanical properties, which are used for knee behavior simulation. Next, cad model and finite element model are constructed. The stress and strain on knee's ligament while walking are calculated by finite element method. The research output is ligament behavior while walking. The maximum stress and strain occur on a top of ligament while extend leg are 33.82 MPa and 0.16 mm/mm, respectively, for 1 hamstring bundle. The maximum stress is 41.87 MPa and maximum strain is 0.18 mm/mm for 2 hamstring bundles. The advantage is to understand the biomechanics of the knee ligaments while walking. And this research result can help patients who have tear problem of an Anterior Cruciate Ligaments (ACL) and be developed for further research about force and behaviors of the other ligament and muscle in body.

Keywords*:* Hamstring, ACL, finite element method.

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Mechanical Performance Evaluation of Dynamic Hip Screw (DHS) for Trochanteric Fracture

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Abstract

This research presents evaluation of the mechanical performance of Dynamic Hip Screw in each stage of bone healing process as well as after the implant is removed. All analyses were performed based on the three-dimensional finite element model derived from computed tomography images. The assessment of the mechanical performance were used three parameters, Von Mises Stress to evaluate the strength of bone and implant, Elastic Strain to evaluate fracture stability and Strain Energy Density (SED) to evaluate the risk of secondary fracture. The results show several critical aspects of dynamic hip screw for trochanteric fracture stabilization. In the initial stage of bone healing process, partial weight bearing should be applied to avoid the implant failure as well as low fracture stability. In the late stage of bone healing, implant removal is strongly recommended in order to prevent the stress cyclic failure.

Keywords*:* Trochanteric fracture, Dynamic Hip Screw (DHS), Finite element analysis

Computation and Simulation Technique (CST)

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Sloshing Surface Monitoring Using Image Processing

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Abstract

Liquid sloshing in tanks during suddenly braking or severe maneuvering of tanker trucks can cause many problems including cracks in liquid tanks and their supporting frames, uncontrollable steering systems, etc. The Computational Fluid Dynamics (CFD) can perform to study these problems and to develop the superior tank. However, these simulations must be validated to ensure their accuracies with laboratory experiments. During sloshing of water, variations of pressure developed on the wall and the surface wave and also the motions of water are the fundamental data recorded in the experiments. This paper proposes the image processing methods to digitize the motion of the surface wave of water in the movable tank. Particularly, all image processing algorithms were applied to create the “SloshDetector” software. This software utilized video files recorded by a webcam to create the series of digitized images of the sloshing surface for validating with the data obtained from CFD models.

Keywords: *Free Surface, Sloshing, Edge Detection, CFD, Image Processing.*

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Design Optimization of Plate-Fin Heat Sinks Using Hybridization of MPSO and RSM

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Abstract

The work in this paper is aimed at demonstrating multiobjective optimization of plate-fin heat sinks and the superiority of combining a response surface method and multiobjective evolutionary optimizer over solely using the evolutionary optimizer. The design problem is assigned to minimize a heat sink junction temperature and fan pumping power. Design variables determine heat sink geometry. Design constraints are given in such a way that the maximum and minimum fin heights are properly limited. The function evaluation is carried out by using the finite volume analysis software. Two multiobjective evolutionary optimization strategies, multiobjective particle swarm optimizers with and without the use of a response surface technique, are implemented to explore the Pareto optimal front. The optimum results obtained from both design approaches are compared and discussed. It is illustrated that the multiobjective evolutionary technique is a powerful tool for the multiobjective design of the electronic air-cooled heat sinks. With the same design conditions and number of function evaluation, the multiobjective particle swarm optimizer with the use of the response surface technique totally outperforms the other.

Keywords: Multiobjective particle swarm optimizer, Response surface method, Plate-fin heat sink, Geometrical design, Finite volume method.

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Dynamic Characteristics of Impact Driven Jet in a Step Nozzle

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Abstract

High speed liquid jet can be applied and benefit in many fields such as combustion, cutting technology, and medical engineering. Liquid jet can be accelerated into high speed condition by using the methods called “Impact Driven Method” by which the liquid retained in the nozzle is impacted and then driven by a high-speed projectile. Understanding dynamic characteristics of jet generation process is essential for applying it into those technologies. So far, there are few studies in such researched areas, especially the flow inside nozzle cavity, because it is vary difficult to access in the experiment. Therefore, this study investigates the dynamic characteristics of impact driven process in a step nozzle using the Computational Fluid Dynamic (CFD) simulation. Fluid flows with transient simulation can be specified as two phase flow which consists of air and compressible diesel containing in the test chamber and step nozzle, in the initial stage, respectively. Effects of projectile velocity and mass of projectile on the characteristics of jet generation process and jet velocity are presented. Also the flow behavior due to various initial conditions is discussed in this study. It is found that the simulation shows good agreement with previously experimental results. In addition, information from this study provides the better understand on the flow phenomena of high speed liquid jet and its generation process. Moreover, the success of this study can be extended to many applications in the related fields.

Keywords*:* Computational Fluid Dynamic (CFD), Impact Driven Method, Compressible fluid.

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Airflow Simulation of Particle Suction in Hard Disk Drives Manufacturing Process

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Abstract

In Hard Disk Drive (HDD) particle is the major problem during the operation of HDD. Thus, in the HDD manufacturing process, particle is one of the important controlled parameters. In some processes the particle is removed from the HDD using suction tools. The designs of these tools affect the efficiency of particle removing process. Therefore, the prediction of the airflow induced by the suction tools becomes convenient and useful for the researchers to develop and improve each component of the tools and also the production. This project is to analyze the particle productivity and aim to improve it. In order to do so, the airflow simulation is needed to be done. The airflow is modeled and simulated using ANSYS CFX software. The results will lead the researchers and engineers to understand about the effect of each component and design of the suction tools to airflow and particle conductivity.

Keywords: Hard Disk Drive, Particle and Suction tools

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Numerical Analysis of Laminar Heat Transfer Augmentation in a Square Channel Fitted with V-Baffles

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Abstract

This article presents a numerical analysis of laminar periodic flow and heat transfer in a constant temperature-surfaced square duct fitted with V-baffle (or winglets) vortex generators. The computations are based on a finite volume method, and the SIMPLE algorithm has been implemented. The laminar fluid flow and heat transfer characteristics are presented for Reynolds numbers based on the hydraulic diameter of the channel ranging from 100 to 2000. To generate a pair of streamwise counter-rotating vortex (P-vortex) flows through the tested channel, the V-baffle with the attack angle of 30° are mounted in tandem and inline arrangement on both upper and lower walls of the tested channel with the V-baffle tip pointing downstream (V-Downstream). Effects of different baffle heights, BR in range from 0.1-0.4 at a single pitch ratio of 1.5 on heat transfer and pressure loss in the square channel are studied. It is apparent that the P-vortex flows exist and help to induce impinging flows on a side wall and the upper and lower wall leading to drastic increase in heat transfer rate over the test channel. In addition, the increase in the baffle height results in the rise of Nusselt number and friction factor values. The computational results reveal that the optimum thermal enhancement factor of the V-baffle is about 4.25 at BR=0.2 and Re=2000.

Keywords*:* Periodic flow, Square channel, Laminar flow, Heat transfer, Winglet.

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A Mesoscale Modeling Technique for Studying the Dynamic Oscillation of Min Proteins: Pattern Formation Analysis with the Lattice Boltzmann Method

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Abstract

We present an application of the Lattice Boltzmann Method (LBM) to study the dynamics of min proteins oscillations in Escherichia coli. The oscillations involve on MinC, MinD and MinE proteins, which are required for proper placement of the division septum in the middle of a bacterial cell. Here, the LBM is applied to a set of the deterministic reaction diffusion equations which describes the dynamics of the Min proteins. This determines the midcell division plane at the cellular level. We specifically use the LBM to study the dynamic pole-to-pole oscillations of the min proteins in two dimensions. We observe that Min proteins pattern formation depends on the cell's shape. The LBM numerical results are in good agreement with previous findings, where other methods were applied, and agree qualitatively well with experimental results. Our results indicate that the LBM can be an alternative computational tool for simulating the dynamics of these Min protein systems and possibly for the study of complex biological systems which are described by reaction- diffusion equations. Moreover, these findings suggest that LBM could be also useful for the investigation of possible evolutionary connection between the cell's shape and cell division of E. coli. The results show that the oscillatory pattern of Min protein is the most consistent with experimental results when the dimension of the cell is 1x2. This suggests that as the cell's shape is close to being a square, the oscillatory pattern no longer places the cell division of E. coli. at the proper location. These findings may have a significant implication on why, by natural selection, E. coli is maintained in a rod shape or bacillus form.

Keywords: Lattice Boltzmann Method, protein oscillation, Min proteins, pattern formation, Mesoscale

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Lattice Boltzmann method for simulating Min protein dynamics incorporating the role of nucleoids

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Abstract

The dynamics of Min proteins plays a center role in accurate cell division. Although the nucleoids may presumably play an important role in prokaryotic cell division, there is a lack of models to account for its participation. In this work, we apply the lattice Boltzmann method to investigate protein oscillation based on a mesoscopic model that takes into account the nucleoid's role. We found that our numerical results are in reasonably good agreement with the previous experimental results on comparing with the other computational models without the presence of nucleoids, the highlight of our finding is that the local densities of MinD and MinE on the cytoplasmic membrane increases, especially along the cell width, when the size of the obstacle increases, leading to a more distinct cap-like structure at the poles. This feature indicated the realistic pattern and reflected the combination of Min protein dynamics and nucleoid's role.

Keywords: lattice Boltzmann method; cell division; Min proteins; protein oscillation; nucleoid; *E. coli*

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Design of a Steam Ejector by Co - Operating the ESDU Design Method and CFD Simulation

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Abstract

This paper presents the procedure of designing the steam ejector for refrigeration system for air conditioning application. This study focuses on the influence of ejector geometries on its performances under the specified operating condition. The Engineering Sciences Data Unit (ESDU) and the Computational Fluid Dynamic (CFD) are used as the tools for this design. Firstly, the Constant Pressure Mixing (CPM) type ejector is selected and its basic geometries are determined by the Engineering Sciences Data Unit (ESDU). Those are convergent wall angles of 2°, 4°, 6°, 8°, and 10°, divergent wall angles of 3°, 4°, and 5°, and ejector throat lengths of 69, 103, and 137 mm. Then, the flow characteristics of the ejectors flow and performance are simulated by the CFD. The water (R-718b) is used as working fluid (or refrigerant) in this cycle. The simulating conditions are specified, according to the application, as, generator pressure of 5.5 bar, evaporator pressure of 12.3 mbar, and condenser pressure of 75 to 100 mbar. It was found that, the optimum dimensions of the steam ejector for this study are convergent wall angle of 2°, divergent wall angle of 3°, and ejector throat length of 137 mm.

Keywords*:* ejector, CFD, ejector refrigeration, air conditioning

Dynamic System, Robotics and Control (DRC)

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An Unmanned Helicopter System

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Abstract

This paper introduces the test bed of the unmanned aerial vehicle for automatic flight controls. The small unmanned system consists of a radio-control helicopter as a basic aircraft, including an Arduino-compatible controller and a pressure sensor. It measures 0.64 m long with 0.35 m wide of main rotor diameter and weighs approximately 2 kilograms. The unmanned helicopter aims for implementing automatic flight controls. Experimental results are presented for both the test bed mounted on a flying stand and a real flight condition.

Keywords*:* UAV, Helicopter, Test bed

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Implementation of Resolved Motion Rate Controller with 5-Axis Robot Manipulator Arm

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Abstract

In this research work, an industrial-process prototype, particularly pick-and-place of machined parts, is developed by using an OWI-535 5-axis robot manipulator arm and controlling with Faulhaber motion control systems. To make an end-effector of the OWI-535 robot arm following desired positions with specified joint velocities, the inverse kinematics technique, known as the *resolved motion rate controller*, can help generating motion trajectories automatically. This inverse kinematics technique can be implemented with the Jacobian pseudo-inverse or Jacobian singularity-robust inverse. This technique does not require to inversely solve algebraic or geometric kinematic equations. Computation of the robot inverse kinematics is simulated in Matlab and then a motion control of the OWI-535 robot arm is performed by the “Faulhaber Motion Manager”. The pick-and-place motion of the OWI-535 robot arm agrees with its kinematics simulation very well.

Keywords*:* inverse kinematics, robot manipulator arm, Jacobian pseudo inverse, Jacobian singularityrobust inverse

Energy Technology and Management

(ETM)

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Simulations of ITB *H*-Mode Tokamak Plasmas with Predictive Toroidal Velocity Model

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Abstract

A model for predicting toroidal velocity in *H*-mode tokamak plasma after neutral beam heating is turned on is implemented in an integrated predictive modelling code BALDUR in order to self-consistently simulate the time-evolution of plasma current, temperature, and density profiles in tokamaks. In this model, the toroidal velocity is developed according to a theory of electromagnetism in which the toroidal velocity can be obtained from a current density flow in toroidal direction. The core transport model used in these simulations is a combination of a neoclassical transport model called NCLASS, and an anomalous transport model, semi-empirical Mixed Bohm/gyro-Bohm (Mixed B/gB) that includes ITB effects. The boundary condition of the plasma is assumed to be at the top of the pedestal. The pedestal temperature is calculated using a theory-based pedestal model which is based on a combination of magnetic and flow shear stabilization pedestal width scaling and an infinite-n ballooning pressure gradient model. Time evolution of plasma temperature and density profiles of 10 JET optimized shear discharges is compared among direct experimental measurements, simulated results using toroidal velocity model and simulation results using experimental toroidal velocity data. Qualitatively, ITB formations are identified and investigated. Quantitatively, statistical analysis including root mean square errors (RMSE) and offsets are used for comparison. It is found that the averaged RMSE and offset among these discharges are respectively 28.13% and -0.19 for ion temperature, 31.78% and -0.24 for electron temperature, and 15.00% and -0.07 for electron density.

Keywords*:* Plasmas, Tokamak, Internal Transport Barrier, Toroidal Velocity, BALDUR.

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Simulation of ITER Plasma During Pellet Injection

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Abstract

In this work, MMM95 and NCLASS core transport models in BALDUR integrated predictive modeling code, together with NGS pellet ablation and pellet grad-B drift models, are used to simulate the time evolution of plasma current, ion and electron temperatures, and density profiles for ITER standard type I ELMy H-mode discharges during the pellet injection either from high field side or from low field side of tokamak. It is found that the injection of pellets from the high field side result in a rapid increase of plasma density than that from low field side. In addition, the pellets from high field side can penetrate much deeper into plasma than those from low field side. Moreover, the pellets from high field side yield an improved fusion performance while the pellets from low field side result in degradation of plasma performance.

Keywords*:* Plasma, Fusion, Tokamak, ITER, Pellet, Fueling.

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Development of Dynamic Boundary Density Model in *H*-Mode Scenarios

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Abstract

Self-consistent simulations of deuterium and carbon density in H-mode scenarios are carried out using BALDUR 1.5D integrated predictive modelling code. The anomalous transport models Mixed Bohm/gyro-Bohm (Mixed B/gB) together with a dynamic boundary density model is used in these simulations. In this model, deuterium and carbon density at the boundary are assumed to be a large fraction of their line average density. It was found using the experimental data obtained from the latest public version of the International Pedestal Database (version 3.2) that the constants of proportion for deuterium and carbon density are 0.77 and 0.74, respectively. The developed density model is implemented in BALDUR code and used to provide density boundary condition in order to simulate the time evolution of temperature and density from JET tokamak. Statistical techniques, such as root mean square errors and offset values, are used to quantify the agreement between simulated profiles and experimental measurements.

Keywords*:* Plasma, dynamic boundary density model, *H*-mode

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Preliminary Results of Core-Edge Simulations of *H*-Mode Tokamak Plasmas Using BALDUR and TASK Codes

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Abstract

A theory-based model for predicting the pedestal formation of temperature and density in H-mode plasma is used together with a core transport model in the 1.5D BALDUR and TASK integrated predictive modeling codes to self-consistently simulate H-mode plasmas. In the core plasma, an anomalous transport is computed using a semi-empirical Mixed Bohm/gyro-Bohm (Mixed B/gB), while a neoclassical transport is computed using the NCLASS model. For the pedestal, the electron and ion thermal, particle and impurity transports are suppressed individually due to the influence of ϖ_{ExB} flow shear. Because of the reduction of transport, the pedestal can be formed. The core-edge model is used to simulate the time evolution of plasma current, temperature, and density profiles for DIII-D tokamaks. A statistical analysis (percent of root mean square error, RMSE) is used to quantify the agreement with the experimental DIII-D data. The simulation results show a good agreement, with RMSE of less than 20%.

Keywords: Plasma, Nuclear fusion, Tokamak, Plasma, Transport barriers

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Construction of Energy Demand Model in Thai Transportation Sector: A Case Study for Ethanol as Diesel Substitute

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Abstract

Energy demand model is a powerful tool to predict the trend of energy demand in the future as a result of a certain incidence of interest. Both top-down and bottom-up approaches are available but for the current focus in transportation sector, bottom-up approach is chosen. Commercially available program called Long range Energy Alternatives Planning system (LEAP) was used with necessary data, such as a number of vehicles (NV) for various vehicle types, vehicle kilometer of travel (VKT) and fuel economy (FE). Due to limited data availability and complication from various types of vehicles and fuels, certain assumptions were made in order to obtain all necessary data for calculation of total energy demand in transportation sector. Vehicle ownership models were established for all vehicle types based on vehicle classification by Department of Land Transport in Bangkok and provincial regions. VKT data for some vehicle types were taken from most recent survey in 2008 with the rest being extrapolated from survey in 1997 under certain assumptions. For FE data, further complication arose from the fuel sharing options within certain vehicle types, such as gasoline/E10/E20 for spark-ignition (SI) engine, bi-fuel with gasoline and compressed natural gas/liquefied petroleum gas (CNG/LPG), and diesel dual fuel (DDF) with CNG/LPG. All these data and assumptions were used to construct energy demand model in Thai transportation sector with validation against total energy consumption. The results showed acceptable prediction. The model was then used as a tool to investigate a case study on ethanol utilization as diesel substitute.

Keywords*:* Energy Demand Model, Long range Energy Alternatives Planning system (LEAP), Transportation Sector, Ethanol, Diesel Engine

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Transesterification of Lard to Biodiesel Using Two-Step Microwave

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Abstract

A decreasing in a fossil fuel source and concerning in environmental problems have boosted a large consumption of alternative fuels. Biodiesel produced via a transesterification of vegetable oils and animal fats is a typical biofuel due to low toxic emission. In this present work, the transesterification of lard was performed in a batch system under two step-microwave using a homogeneous catalyst. This work aims to investigate the optimum reaction parameters such as methanol to fat ratio, reaction time and power and also test for some properties of product such as acid value, and viscosity. As a result, the best product was 98.1% of fatty acid methyl ester, 0.13 mgKOH/g and 40 0.41 cSt under methanol to fat ratio of 28%wt., 200 W for 3 min. Compared with conventional heating system, the microwave system consumed 13.8 times less than the conventional heating system.

Keywords*:* Biodiesel, Lard, Microwave

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Mathematical Modeling of an Evaporative Air-conditioning System and Cooling Loads in a Poultry House for Sliding Mode Control Analysis

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Abstract

This paper presents mathematical modeling of cooling loads for a poultry houses. The model was derived from characteristics of the evaporative air-conditioning system in a poultry house (size 125 m. x 14 m. x4 m.). An approach for constructing cooling load model for the system is considered base on four parameters which are desired air temperature, heat load of poultry houses, relative-humidity (external poultry house), and relative-humidity (internal poultry house). The mathematical model is very important in an evaporative cooling system design and useful for construction planning of a new poultry house. Furthermore, in order to design some controller to control air condition in the house, the heat load model and its relation with the evaporative cooling system are unavoidable. Although, such control law has not yet derived in this work. The solutions of heat load model expressed that the results from simulation of the mathematical models and real system are quite similar. So, it can ensure that the model can then be applied for the evaporative cooling systems design and also controller design. This will increase convenience for a new poultry house development process and reduce faulty design of the cooling system.

Keywords**:** Cooling load modeling, Poultry houses, Evaporative cooling.

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Development of Speed-Time Data Logger for Analysis of Motorcyclist Driving Behavior

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Abstract

This paper presents development of a speed-time data logger for a motorcycle. The speed-time data will be used to create a driving cycle in order to evaluate the amount of exhaust emission from motorcycles. The device will record time series of data by using it's internal flash memory for every second. Each record contains speed data, GPS position, and engine revolution. To ensure that the measurements of speed is close to actual drive of the motorcycles the speed and position data that was detected from GPS module will then be used to compare with that from a developed magnetic induction device. The induction device measures the vehicle speed by using magnetic sensor installed at a fixed brake drum in the rear wheel. The sensor measures the time period of the induced magnetic signal then calculates the speed of the moving motorcycles. And the speed-time data will be added to the memory simultaneously. Date collection will be done by driving a motorcycle with the data logger on the selected road route. After that, the driving will be formed. Traffic conditions and driving behavior of motorcycles can then be analyzed eventually.

Keywords*:* Speed-time data logger, Motorcycle, Magnetic Sensors.

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Designing of 100 KW Micro Wind Farm for Low Wind Speed Zone

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Abstract

Wind machine has become more important to the renewable energy section. However, the wind speed is the major factor to the wind machine power plant. The kinetic energy from the wind converts to electrical energy by the wind machine. The efficient of a good wind machine is about 35 percent. Additionally, the feasible plant factor of wind machine or wind farm could not be lower than 0.2. The higher efficiency of wind machine will shorter pay back period of the power plant investment. However, if the high wind machine designed using in the low wind speed zones, the plat factor is lower than 0.1. Therefore there is not feasible for the investment. Because the most megawatt wind machine is designed for high wind speed area. Thailand and some areas around the world is not suitable for high wind machine design, therefore this paper is presented new concept design and implementation of low wind speed machine integration into micro wind farm by using 20 units of 5 kw low speed wind turbine to 100 kw grid connect system. This 5 kW wind machine is designed for cut in wind speed of 2 m/s and generates electricity of 5000 watts at wind speed of 9 m/s. The designing of micro wind farm configuration and results is presented in this study. At the consequence, after 5 months of plant installation results showing that the small wind machine wind farm shown the significant plant factor that could be higher than a single unit of 100 kW high wind speed wind machine. This wind power plant is located in King's farm project in the rural area of Thayang, Pecthaburi Province to Southern Thailand. The investigation and study was carrying on for further development in mini wind farm for low wind speed zones.

Keywords*:* Wind machine, Micro wind farm, Low speed wind turbine

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Electric Energy Conversion Technique for Eco-Equipments via Embedded Technology

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Abstract

This paper presents the electric energy conversion systems on a basis of unique embedded systems by the integrated Power Electronics Technology. These play an important role for saving from "the Global warming" in the earth. This paper also gives a learning activities. This teaching materials enables to increase student motivation for their recognizing to all equipment which can be friendly with environment and human society. These are a key technology in the high performance clean energy for future.

Keywords: The Global warming, Embedded system, Electric energy conversion, Converter, Digital signal processor.

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Optimal Placement of Wind Farm on the Power System Topology

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Abstract

Wind farm can be used in domestic, community and smaller wind energy projects and these can be either stand-alone or grid-connected systems. Stand-alone systems are used to generate electricity for charging batteries to run small electrical applications, often in remote locations where it is expensive or not physically possible to connect to a mains power supply. With grid-connected turbines, the output from the wind turbine is directly connected to the existing main electricity supply. This type of system can be used both for individual wind turbines and for wind farms exporting electricity to the electricity network. A grid-connected wind turbine can be a good proposition if consumption of electricity is high. In this paper, we formulated a wind farm in form of doubly fed induction generator penetrating into an existing power system. An optimal placement of wind farm on the power system topology is proposed aiming to minimize fuel and emission costs of overall system. The multiobjective particle swarm optimization (MPSO) is used to minimize simultaneously fuel cost and emission of existing thermal units by changing location and varying sizes of new wind farm candidate. We employ IEEE 30-bus system to verify the proposed technique. The results show that the proposed method found the optimal position of wind farm with minimum cost of fuel and environmental pollution.

Keywords: Wind Farm, Power System, Multiobjective Particle Swarm Optimization (MPSO)

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Transmission System Expansion Planning by Ant Colony Optimization: A Case of China Southwest System

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Abstract

This paper proposes an application of ant colony optimization (ACO) to solve transmission system expansion planning (TSEP) problem based on DC power flow model. The main objective is to minimize the investment cost of transmission lines that should be added to an existing network in order to supply the forecasted load as economically as possible subject to many system constraints i.e. the power balance, the generation requirements, line connections and thermal limits. The TSEP problem was tested using the 18-bus of China Southwest system. The results obtained by ACO are compared to Genetic Algorithm (GA) in term of solution quality and computational efficiency. The experimental results show that the ACO method outperforms GA methods in terms of high quality solution, stable convergence characteristic and good computation efficiency.

Keywords: Ant Colony Optimization, Genetic Algorithm and Transmission System Expansion Planning Problem

Thermal System and Fluid Mechanics

(TSF)

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Mathematical Model in the Form of Vorticity-Stream Function for Combustion in Porous Media

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Abstract

This paper proposes a mathematical model used to numerically simulate behaviours of the two dimensional laminar premixed combustion in porous media. The governing equations proposed include vorticity-stream function equations. This set of the governing equations is non-dimensionalized and numerically solved based on finite difference algorithm. The rectangular computational domain filled with saturated porous media is subjected to premixed reactant mixture coming into the domain from the lateral wall. The top and bottom walls are insulated. The computation is conducted for half of the domain based on a symmetrical boundary with appropriate flow and thermal conditions. The proposed mathematical model is successfully validated against the published work. The computed results agree reasonably well with the previous work. The model is able to correctly describe physical behaviors of a premixed
combustion in which preheat, reaction and post combustion zone are included.

Keywords*:* Porous combustion, Mathematical model, vorticity-stream function

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Driving Cycle Generation for Emissions and Fuel Consumption Assessment of the Motorcycles in Khon Kaen City

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Abstract

In this paper, the generating of driving cycle for emissions and fuel consumption assessment of the motorcycles in Khon Kaen city is presented. The driving cycle was obtained from on-road traffic data collections, using the speed-time data logger to collect data during weekday and weekend under actual traffic along the selected road routes in Khon Kaen urban area for one month. To represent real driving pattern of the motorcycles in Khon Kaen city, the driving cycle was generated from several micro-trips which was selected in order to matching with defined target parameters of the generated driving cycle from the real speed-time data. The driving cycle was categorized into three traffic conditions on weekday, weekend and combined weekday-weekend periods by the statistical method. The results show that Khon Kaen driving cycle has a cycle length of 1145 s with total percentage error in the target parameters of 12.01%

Keywords: Driving cycle; Motorcycle; Driving pattern

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Effect of Effective Velocity Ratio on the Near-Field Mixing Structures of a Jet in Crossflow

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Abstract

The effect of jet-to-crossflow effective velocity ratio (r) on the near-field mixing structures of a jet in crossflow is investigated. Three jets with r of 2, 4, and 7 are examined under the condition of equal jet volume flowrate and equivalent stoichiometric ratio. The experiment is conducted using the combination of smoke fluid condensation, Mie scattering, and laser-sheet visualization techniques. Series of planar lasersheet visualization images, particularly the plane perpendicular to the jet exit, are taken. The instantaneous and mean images are then analyzed in order to survey the effect of r on the near-field mixing structures. It is found that as r increases, the mean mixing structure of the jet changes characteristics from the lateral-maximum, leewardly-connected, two distinct lateral lobes at the extreme low- r , r = 2, to windward-maximum, windwardly-connected structure at the extreme high- r , r = 7. For the intermediate r , r = 4, it is found that such evolution occurs spatially. That is, the jet at r = 4 evolves from the characteristics of the extreme high- r jet to those of the extreme low- r jet in the transverse direction. These results suggest that the near-field mixing structures of a jet in crossflow, in the region where the unmixed core is still present, can be described by the competing effect between the developments of 1) the lateral skewed mixing layers and the corresponding vortical roll ups and 2) the windward jet shear layer. Specifically, when consider the evolution with respect to increasing r , JICF evolves from the lateral skewed mixing layers dominated in the low- r jet to the windward jet shear layer 'dominated' in the high- r jet. On the other hand, such reverse evolution, i.e., in the direction of decreasing r, occurs spatially for the intermediate- r jet as the jet evolves in the transverse direction.

Keywords**:** jet in crossflow, effective velocity ratio, mixing, entrainment, near-field structures

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Heat Transfer and Friction Behavior in a Channel Fitted with Triangular and Rectangular V-Shaped Ribs

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Abstract

An experimental investigation has been conducted to study the turbulent flow friction and heat transfer behavior in a rectangular channel fitted with triangular and rectangular V-shaped ribs mounted periodically on the lower plate of the channel while the upper plate was heated at a constant heat flux condition. The channel has an aspect ratio (channel width to height ratio, AR = W/H) of 10 and height (H) of 30 mm. The thin rib characteristics are the rib to channel height ratio (e/H) of 0.2, 0.3 and 0.4; rib pitch to channel height ratio (PR) of 4 and the attack angle (α) of 30° relative to the flow direction. Measurements were carried out by varying the airflow rate for Reynolds number in the range of 5000- 24,000. The whole test section was insulated with thermal insulation in order to reduce heat loss to surrounding. The experimental results show that the use of the rib leads to considerable heat transfer rate and friction factor in comparison with the smooth channel. In addition, the rectangular V-shaped rib performs higher heat transfer rate and friction factor than the triangular one at a similar e/H ratio. The rectangular V-shaped rib with e/H = 0.4 yields the highest heat transfer rate but one with e/H = 0.2 provides the best thermal performance.

Keywords*:* periodic; triangular; V-shaped rib; turbulent heat transfer; friction factor.

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Thermal Behavior in a Square Channel with 45° Cross Baffle Insert

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Abstract

The paper presents a study of heat transfer and pressure loss in a heat exchanger channel inserted with inclined baffles on two opposite walls in cross arrangement. The channel has a square section with uniform wall heat flux conditions. The fluid flow and heat transfer characteristics are presented for Reynolds numbers based on the hydraulic diameter of the channel ranging from 4000 to 40,000. The inclined baffles with an axial pitch equal to the channel height and with the attack angle of 45° are mounted in tandem and in cross arrangement on the upper and lower walls of the test channel. Effects of five baffle-to-channel height ratios (e/H = 0.1, 0.15, 0.2, 0.25 and 0.3) on heat transfer rate in terms of Nusselt number and pressure loss in the form of friction factor are experimentally investigated. The experimental result shows that the insertion of the cross-inclined baffles with e/H = 0.3 provides highest heat transfer and friction factor values while the e/H = 0.25 yields the best thermal performance.

Keywords*:* Square channel; Cross baffle; Thermal behavior; Friction factor; Turbulator

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Thermal Behavior in a Solar Air Heater Channel with Ribs and Rectangular Winglets

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Abstract

Effects of combined ribs and winglet-type vortex generators (WVG) on forced convection heat transfer and friction loss behaviors for turbulent airflow through a constant heat flux channel of solar air heater are experimentally investigated. Measurements are carried out in the channel of aspect ratio, AR = 10 and height, H = 30 mm. The cross-section of the rib placed only on the upper channel wall to create a reverse-flow is an isosceles triangle shape with a single rib height ratio, e/H = 0.2 and rib pitch ratio, Pr/H = 1.33. For WVG, ten pairs of rectangular winglets having a height, b/H = 0.4; transverse pitch ratio, Pt/H = 1; two different WVG arrangements by pointing upstream (PU) and pointing downstream (PD) of the flow and various attack angles (α) of 60°, 45° and 30° are mounted on the test duct entrance to generate longitudinal vortex flows through the tested channel. The flow rate is in terms of Reynolds numbers based on the inlet hydraulic diameter of the channel ranging from 5000 to 23,000. The experimental results show a significant effect of using the combined ribs and WVG on the heat transfer rate and friction loss over the smooth wall channel. The larger the attack angle leads to higher heat transfer and friction loss than the lower one and the PD-WVG provides higher heat transfer rate and friction loss than the PU one for similar operating conditions. In comparison, the largest attack angle of the PD-WVG yields the highest increase in Nusselt number and friction factor while the lowest attack angle of the PU-WVG gives the best thermal performance.

Keywords*:* enhanced heat transfer; rib; turbulent channel flow; vortex generator; winglet.

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A Thermal Performance Study of a Glass Window Installed with a Curved Venetian Blind

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Abstract

This article is about a study of thermal performance of glass window installed with a curved venetian blind in term of heat gain in the part of shortwave radiation to the space. The curved Venetian blind, whose optical properties are considered as nonspecular element, is modeled as an effective layer. The mathematical model of the combined glass window and venetian blind is developed by combining the mathematical model of glass window and the mathematical model of a curve venetian blind using matrix layer calculation method. The experiment is performed in a test room to measure the heat gain due to solar radiation passing through the glass window installed with a curved venetian blind. The results from the developed model are compared with the experimental results. The agreement between the predicted results and the experimental results is good. It is found that installing a curved venetian blind to the clear glass window causes a significant reduction in heat gain compared to the plain glass window. It is also found that the heat gain through glass window installed with a venetian blind in the part of shortwave radiation is mainly affected by the slat properties, slat angle and solar profile angle.

Keywords*:* Venetian blind, Glass window, Heat gain, Shortwave radiation, Thermal performance.

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Development of Suitable Air Condition Control System for Closed-System Henhouse

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Abstract

This work was to study and development of suitable air condition control system for closed-system henhouse. The size of henhouse, 14x120x4 m^3, was selected to study the air condition in henhouse. The unit of multi inlet with cooling pad was installed at the middle of the henhouse wall in order to decrease the different temperature of air between the front and rear of henhouse. This unit is called “Bus Windows System (BWS)”. From testing, it was found that the different of temperature between the front and rear of henhouse was decreased from 5-6 degree Celsius to 2-3 degree Celsius. This is due to cool and fresh air from BWS was entered and mixed to the hot air in the henhouse. The result also showed that the velocity profile was uniform more than the previous one. The ventilation rate was increased and this can reduce the accumulation of ammonia in the henhouse from 7-10 ppm. to 0-2 ppm. Furthermore, from the view of production, the productivity was significant increased and it was higher than that of the standard production. However, the relative humidity after using BWS was increased about 10%.

Keywords: Bus Windows System, Evaporative Cooling System, Henhouse, Ventilation

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The γ-k_L Model for Prediction of Transitional Flow Over a Flat Plate with Zero Pressure Gradient

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Abstract

Recently, two popular transition models have been proposed for RANS-based simulations: one is the correlation-based γ-Re_θ model [1-4] and the other is the physics-based k_L model [5-7]. The former is based on the intermittency concept to control the turbulent production/destruction terms in the existing turbulence model. The intermittency factor γ requires some mechanisms to predict the onset and length of transition which stem from empirical correlations. The latter is based on a second kind of kinetic energy, the laminar kinetic energy k_L, to deal with the transition process. The onset of transition is clearly defined through some parameters, similar to the vorticity Reynolds number, and the length of transition is modeled by transferring energy from laminar kinetic energy to turbulent kinetic energy. The transition process is hence modeled physically. In addition, different base turbulence models are used in these two transition models. The γ-Re_θ model uses the SST-k-ω turbulence model [8] without any modification while the k_L model uses a modified form of the standard k-ω model that contains many damping functions responsible for transitional effects. It is found that the intermittency concept is good for developing a new RANS-based transition model without modifying the turbulence model. The laminar kinetic energy concept, however, sounds more physical. Therefore, the present paper is aimed to propose a new transition model by using the intermittency concept via a physics-based approach. The present work uses the SST-k-ω [8] as a base turbulence model. The additional equations are the transport equations for the intermittency and laminar kinetic energy. The proposed model is evaluated by comparing its results with those of two transition models cited above and also the experimental data [9].

Keywords*:* SST k-ω; Transition; Intermittency; Laminar Kinetic Energy; RANS

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Coherent Structures of Transitional Boundary Layers in a Linear Compressor Cascade

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Abstract

The objective of this study is to objectively identify coherent structures of transitional boundary layers in a linear compressor cascade. The database for the analysis is from Direct Numerical Simulation (DNS) of flow through the linear compressor cascade with incoming free-stream turbulence performed by Zaki *et al* [*ASME Turbo Expo, 2006, GT2006-90885*]. On the pressure side, the boundary layer undergoes a bypass transition. On the contrary, on the suction side, the boundary layer is stabilized and remains laminar in a favourable pressure gradient zone. Farther downstream, the laminar boundary layer experiences a strong adverse pressure gradient causing it to separate. The separation induces transition to turbulence, which, in turn, is followed by turbulent reattachment of the detached boundary layer. In order to objectively identify coherent structures in the boundary layers on pressure and suction side of the compressor blade, the Proper Orthogonal Decomposition (POD) is used in the analysis. POD extracts the most-energetic coherent structures from the boundary layers and their energy contents. Coherent structures from POD in the boundary layers of pressure and suction sides are resemble to structures detected by other visualisation methods: elongated streamwise streak or perturbation jets whose averages are known as Klebanoff modes, and travelling-wave structures which may be associated with transition and turbulence production mechanisms. Future work includes the study of the localised POD of two sub-domains namely the boundary layer of pressure and suction side sub-domains in order to obtain more compact description of the transition processes in the compressor cascade.

Keywords*:* coherent structures, bypass transition, separation-induced transition, Proper Orthogonal, Decomposition (POD), compressor cascade

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The Experimental Investigation of Heat Transport and Water Infiltration in Granular Packed Bed Due to Supplied Hot Water From the Top (Influence of Supplied Hot Water Flux and Particle Sizes)

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Abstract

This paper proposes to study the effect of the particle sizes and supplied water flux to the temperature distribution, water saturation and infiltration front. The experimental was studied for one – dimensional assuming the local thermal equilibrium among water and particles at any specific space. The particle sizes used were 0.15 mm and 0.40 mm in diameter and supplied hot water flux 0.1 kg/m^{2}s and 0.2 kg/m^{2}s. From the experimental results, it was found that the granular packed bed with larger particle size results in faster infiltration rate and forms a wider infiltration layer, especially in the direction of gravity and permeability. And the temperature distribution in granular packed bed rises due to water infiltration. The increase of the supplied water flux of water corresponds to higher water saturation and forms a wider in filtration layer. However, an extension of the heated layer is not as much as that of the infiltration layer because the temperature of water infiltration gradually drops due to upstream heat transport.

Keywords: Porous media, Water infiltration, Numerical modeling

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Experimental Analysis of the Freezing Process in Unsaturated Porous Media Cooled from Above (Influence of Freezing Temperature and Initial Water Saturation)

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Abstract

In this paper, the freezing process in unsaturated porous media considering heat and mass transport across moving boundary has been investigated experimentally. The influences of the initial water saturation and constant temperature heat source on heat transfer and water transport across moving boundary during freezing process in unsaturated porous media are clarified in details. It is found that the rate of the absorption of water into the frozen layer depends on the freezing temperature and the water saturation at the freezing front. As a result, ice content in the frozen layer is related to the rate of water absorption and the freezing temperature. The results presented here provide a fundamental understanding of freezing process in porous media.

Keywords: freezing, unsaturated porous media, freezing front

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Influence of Electrode Wire Structure on Corona Wind in a 2-D Rectangular Duct Flow (Numerical Analysis)

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Abstract

This study aims to numerically investigate the influences of number and arrangement of electrode wires on occurrence of Corona wind in a two-dimensional rectangular duct. The gap between electrode and ground wires is varied in the normal and flow directions. High electrical voltage and air flow velocity are performed at 15 kV and 0.35 m/s (Re~2200), respectively. The results show that electric fields are highly dense in the region between electrode and ground wire. In addition, electric field intensity increases significantly when the gap becomes smaller. Moreover, these results affect characteristics of Corona wind. When the gap becomes closer, diameter of Corona wind becomes smaller but swirling is more violent. With more electrode number, electric field intensity is higher and this leads circulating flow to be more complicated.

Keywords: Electric fields, Electrode Wire Structure, Corona wind

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Effect of Temperature and Pressure on Characteristics of High Speed Diesel Jets

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Abstract

This study investigates on effects of temperature and pressure in the test chamber on dynamic characteristics of high speed diesel fuel jets. The horizontal single stage powder gun was used to generate the high speed diesel jet by the method called “projectile impact driven method”. In the experiment, the projectile velocities of around 700 m/s and a conical nozzle with 30° cone angle and orifice diameter of 0.7 mm are used, and high speed video camera and optical system with shadowgraph technique were also used to capture the dynamics characteristics of the jets. The high speed diesel fuel jets are injected into the test chamber in which temperature and pressure were varied to the conditions that are standard condition (30°C, 1 bar), high temperature condition (150°C, 1 bar), and high pressure condition (30°C, 8.2 bar).

From experimental results, it is found that at the standard condition the maximum average jet velocity is around 1,400 m/s, and this is much higher than which at the high temperature and high pressure condition (1,200 m/s and 1,000 m/s respectively). However, at the later stage the jet emerged into high temperature air has the highest velocity value because of high rate of evaporation and atomization around a thin jet core which can be observed from the visualized images.

Keywords: high speed diesel fuel jet, shadowgraph technique, projectile impact driven method

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Optimizing TPV System for Maximize Surface to Surface Radiation and Minimize Cells Temperature

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Abstract

A thermo photo voltaic (TPV) cell generates electricity from the combustion of fuel and through radiation. The fuel burns inside an emitting device that radiates intensely. TPV cells capture the radiation and convert it to electricity. TPV systems, unlike typical electronic systems, must maximize radiation heat transfer to improve efficiency. To improve system efficiency and reduce system costs, engineers should work with smaller area TPV cells and then use mirrors to focus the radiation on them. However, there is a limit about the amount of beams that can be focused on TPV cells. If radiation intensity becomes too high, the cells can overheat. Thus, there is a need to optimize system geometry and operating conditions to achieve maximum performance at minimum material costs. The present article investigates the influence of operating conditions on the system efficiency and the temperature of components in a typical TPV system. The results show that the device experiences a significant temperature distribution. It also, shows that the optimal operating temperature is between 1700 K and 1900 K, where the electric output power is maximized.

Keywords*:* Thermophotovoltaic, Photovoltaic modeling, Radiation modeling

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Influence of Nozzle's Exit Mach Number on the Steam Ejector's Performance by Using Computational Fluid Dynamics

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Abstract

In this study, the computational fluid dynamics (CFD simulation) was used to describe the effect of the primary nozzle's exit Mach number to the steam ejector performance. Three primary nozzles with difference area ratio were used. They produce the exit Mach number of 3, 4 and 5.5. The boiler saturation temperature and the evaporator saturation temperature were fixed at 150°C and 7.5°C, respectively. The physical model and grid structure of steam ejector used was created by commercial software package, Gambit2.3 whilst the mathematical model was applied by commercial software package, FLUENT6.3. Simulation results were validated with the experimental values.

Keywords*:* Ejector, Steam jet refrigeration, computational fluid dynamics

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