RESEARCH FRONTIERS IN ENERGY, MATERIALS, PRODUCTION, AND TRANSPORTATION

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The growth of research in various areas highlights the increasing needs of human life, such as in the fields of energy, materials, production, and transportation. Research in the field of fluid flow for energy savings is now very advanced, and research on the fluid flow pattern with a micro-scale is performed to obtain a high heat transfer with a low pressure drop. The use of microorganisms, biomass, and the Organic Rankine Cycle (ORC) is employed to stimulate heat transfer and fluid flow to produce energy through a more efficient and more environmentally friendly process.

Furthermore, research on the designs and processes of air-conditioning systems is essential in view of energy consumption, which has exhibited a significant rise. Air conditioning is included in the future of transportation, namely electric cars, to achieve energy efficiency in vehicles. In addition to vehicle systems, attention should also be given to the precision of the routes and schedules of vehicles, particularly for public transport, so research on transportation modeling has also become very important. Another increasing requirement, which in the past has not been very well thought out, is the level of human comfort in driving. The challenge is to align the needs of driving comfort with energy efficiency requirements. The effort to reduce fuel consumption is also applied in marine transport modes by reducing the drag of ships.

Moreover, cost efficiency related to energy consumption is an important issue in the production process. The management of manufacturing processes, including the production arrangement layout area, will greatly affect efficiency. This special edition presents the current manufacturing research in relation to various technologies associated with materials, automation, semiconductor, and nano devices.

The first paper, written by Sukamta, Indarto, Purnomo, and T.A. Rohmat, investigated slugging as initiating water hammer phenomena through non-direct contact steam condensing in a horizontal pipe heat exchanger. The authors found that the flow pattern area of non-slugging (stratified and wavy flow), transition (wavy-slug flow), and slugging (slug and large-slug) were determined, and here, the transition flow pattern of slug and large-slug is defined as the initiation of water hammer, and the transition area range of the wavy-slug flow pattern are from $\dot{m}co = 1´10–1$ kg/s to $\dot{m}co = 6´10–1$ kg/s for $\dot{m}st = 6´10–3$ kg/s to $\dot{m}st = 7.5´10–3$ kg/s, and $\dot{m}co< 3´10-1$ kg/s for $\dot{m}st = 8´10–3$ kg/s to $\dot{m}st = 9´10–3$ kg/s. They claimed that the obtained data are very important to developing a database for the input of an early warning system design in a safe two-phase flow installation piping system during steam condensation.

The second paper, written by Yanuar, Gunawan, and D. Sapjah, observed the influence of using a spiral pipe to increase the drag reduction of a 1-mm diameter silica sand slurry flow. In this experimental observation, the authors showed that particle concentration, the Reynolds number, and the ratio of pitch and diameter significantly impact drag reduction. The authors argue that slurry transportation using a spiral pipe is more efficient compared to using a circular pipe; however, that flowing slurry in a circular pipe can create a blockage if the velocity cannot overcome sedimentation, especially at a low velocity and for a long time.

The third paper, written by Deendarlianto, Wiratni, A.E. Tontowi, Indarto, and A.G.W. Iriawan, used a micro-bubble generator (MBG) on aerobic waste water treatment under laboratory and industrial conditions. The type-tested MBGs were a porous pipe and orifice and an MBG with a spherical body and drilled holes, respectively. Furthermore, the feasibility test using a bio-ball as the porous media for microorganism attachment in aerobic waste water treatment also showed a promising result. The authors

claimed it could reduce the carbon on demand (COD) around 354 mg/l. The value of dissolved oxygen (DO) was larger than 2 mg/L. The pH level was always 6, and the temperature was not more than 35ºC, which meet the requirements of aerobic waste water treatment.

The fourth paper, written by I.N.S. Winaya, R.S. Hartati, I.P. Lokantara, I.G. Subawa, and I.M.A. Putrawan, deals with a pilot-scale bubbling fluidized bed gasifier with a diameter of 0.68 m and a height of 1.50 m using an oil burner to heat up the bed. This study used four types of biomass mixed with coal at different mass composition variations in an air gasifying agent. The gasification efficiency and the carbon conversion efficiency increased when increasing the mass ratios of waste fuels.

The fifth paper, written by H. Riyanto and S.Y. Martowibowo, optimized waste heat recovery from a cement plant using the Response Surface Methodology (RSM) for which the ORC is applied for electric power generation. The working fluid of the ORC power generation system was selected amongst candidates of organic working fluids, i.e., iso-butane, iso-pentane, benzene, and toluene, using the technique for order of preference by similarity to ideal solution (TOPSIS), a multi-criteria decision analysis (MCDA) method. The implementation of the RSM attained the optimum operating conditions of a high-pressure turbine, a low-pressure turbine, and a condenser at 11.3 bar-a saturated vapor, 4.3 bar-a and 184ºC, and 1.8 bar-a, respectively. The conclusion of their study showed that gross electric power at 5.7 MW at 12.5 percent energy conversion efficiency is generated by the pertinent ORC WHRPG.

The sixth paper, written by S. Sholahudin and H. Han, observed the important parameter of the weather for heating load estimation. The result obtained from the design of the experiment and an ANOVA test showed that the dry bulb temperature and wind speed have significant effects on the heating load; however, the dew point, global horizontal radiation, and direct normal radiation are not very influential. The heating load estimation using two significant inputs has been tested and the results show there is no significant difference in accuracy. The authors argue the design of the experiment and the ANOVA test can be applied to reduce the number of inputs for neural network training.

The seventh paper, written by Nasruddin and H. Sinambela, proposes a cooling system observation for an electric car with a cooling load of 2894.12 Watt. The authors conducted a simulation for air distribution in the cabin, an observation of the cooling system energy consumption, and took some measurements to observe the energy consumption with an installed inverter. The authors argue that the inverter can reduce energy consumption for the car's cooling system, and the use of a Brushless Direct Current (BLDC) compressor for the cooling system of the electric car can make the system run smoothly.

The eighth paper, written by Misbahuddin and R.F. Sari, presents modeling of a new approach to the Bayesian Mixture using the Gaussian Mixture Model (GMM) to formulate the conditional of probability density function and the Expectation Maximization (EM) Algorithm to estimate the new parameter of the GMM to obtain the maximum likelihood estimation (MLE). For the experiment of the model, a road model of the bus lanes at the Universitas Indonesia is used, and a structure of the Bayesian network for a road network is developed. The minimum error can be achieved using this model. The model has the potential to predict the bus arrival time effectively.

The ninth paper, written by M.A. Puspasari, E. Muslim, B.N. Moch, and A. Aristides, reported an ergonomics research study with a fatigue measurement in a car driving activity using physiological, cognitive, and subjective approaches. The purpose of this study is to determine the significance of driver fatigue using those three factors and to generate a comparison of fatigue between male and female drivers. The methodology involves 12 respondents, which included six male respondents and six female respondents aged 17–25 years measured by physiological (blood pressure and heart rate), cognitive (psychomotor vigilance test), and subjective (Karolinska Sleepiness Scale) variables. The results show that heart rate is the most sensitive variable; however, all of the variables in male and female respondents do not have a significant result. In addition, there is no big difference in fatigue between male and female car drivers. However, the approaches could not be standardized to measure fatigue for male and female car drivers.

The tenth paper, written by E. Muslim, B.N. Moch, M.A. Puspasari, and R.A. Siregar, is another typical ergonomics study with a fatigue measurement of a driving activity among male motorcycle drivers based using cognitive, physiological, and subjective approaches. The purpose of this research

was to measure the effect of cognitive, physiological, and subjective approaches toward fatigue while driving a motorcycle for two hours. The methodology used two age categories, namely a productive age category (16–35 years old) and an adult age category (35–60 years old). For the cognitive approach, the levels of concentration and stress (tension) are measured using Design Tools; meanwhile, for the physiological approach, a blood pressure meter is used and for the subjective approach, is calculated using the 9-scale Karolinska Sleepiness Scale (KSS). The results show that the influence of heart rate on the level of fatigue is found to be significant in both age categories. Meanwhile, the effect of blood pressure on the level of fatigue is found only in the adult age category. A Simple Reaction Time measurement result found a significantly effect on the level of fatigue in the adult age category.

The eleventh paper, written by S. Supriadi, Gunawan, Yanuar, and H.S. Budhi, presents experimental results for ship fuel consumption reduction. The authors propose an alternative method to fabricate micro-riblets using laminate transfer molding to modify the painting morphology for a micro-riblet replication on a ship hull. The ship model used in their work is a high-speed boat model that is two meters long. The authors can show that the ship speed increases under a similar propulsion power, and the significant effect of micro-riblets is obtained at a higher speed.

The twelfth paper, written by Sunaryo, A.A. Priadi, and T. Tjahjono, presents the concept of a ship traffic separation scheme and its simulation for implementation on the Sunda Strait. The authors use a modeling and simulation approach, which started with a problem identification of the needs for solving the problem. The authors argue the implementation of a Traffic Separation Scheme on the Sunda Strait will ensure the safety of vessels sailing both on the Indonesian. Archipelagic Sea Lane 1 and the ferry crossing lane between the Port of Marak and the Port of Bakauheni; hence, any collision between vessels can be avoided.

The thirteenth paper, written by A.S. Baskoro, E. Karyanta, and H.S. Nugroho, presents the creation of manufacturing information systems for tote box manufacturing production for gamma irradiators at 300 Kci. The authors argue the manufacturing information can be a source of accurate information so that management can more quickly determine the progress of the manufacturing process and faster make decisions, such as order the raw materials, check and inspect if a bottleneck in production occurs, etc.

The fourteenth paper, written by I.M. Hakim and V. Istiyanti, reported the improvement of layout production facilities for a secondary packaging area of a pharmaceutical company using the CORELAP method. The layout of the production area of the secondary packaging area of the pharmaceutical company is not optimal, for example, as it is a false location of material handling. This study aims to present a redesign of the layout, where the approach starts with identifying the order of the process and the relationship between processes. They are processed into ARC to obtain TCR values for each process and then they are iterated by CORELAP. The result shows the proposed layout has a material handling distance 9.017% shorter than the current layout, and the process of the same type of packaging becomes more adjacent.

The fifteenth paper, written by T. Rusianto, M.W. Wildan, K. Abraha, and Kusmono, obtained a ceramic magnet with a chemical composition of barium hexaferrite ($BaFe_{12}O_{19}$) through the synthesis of magnetite powder from iron sand taken from the Southern Coast of Yogyakarta in Indonesia. The results showed that the magnetite, which was directly calcined, compacted, and sintered, showed a $BaFe_{12}O_{19}$ phase and the presence of a Fe_2O_3 phase with a BH (max) of 0.26 MGOe, an Hc of 1.27 kOe, and an Ms of 31.421 emu/g. The sintered ceramic magnet, which was initially oxidized at a temperature of 900°C, showed a $BaFe_{12}O_{19}$ phase with a BH (max) of 0.78 MGOe, an Hc of 1.95 kOe, and an Ms of 46.970 emu/g. The authors concluded that the iron sand from the Southern Coast of Yogyakarta in Indonesia has the potential to produce ceramic permanent magnets.

The sixteenth paper, written by G.S. Prihandana, T. Sriani, and M. Mahardika, reported a review of a surface modification used to improve the blood compatibility of the PES membrane. To have a PES membrane with a higher blood compatibility, two coating materials, which are parylene and fluorinated diamond-like carbon (F-DLC) films, were applied onto the membrane surface. The experiment results show that both coating materials improved the blood compatibility of the membrane in their own way.

The seventeenth paper, written by I.N.W. Satiawan, I.B.F. Citarsa, I.K. Wiryajati, and I.K. Wiratama, examined and analyzed three Pulse Width Modulations (PWMs) to utilize voltage space

vectors. The Equal Reference Sharing (ERS), the Unequal Reference Sharing (URS), and the Decomposition PWM are applied. A combination of the switching pulses from the upper switches of inverter 1 and 2 is used. The results show the Decomposition PWM scheme is able to utilize the most effective voltage vectors compared to the ERS and URS PWM. The new switching strategy can enhance the converter's performance, particularly in terms of improving the power sharing capability between two converters.

The eighteenth paper, written by W. Wahab, M. Ridwan, and B. Kusumoputro, designed and implemented an automatic image data acquisition system using an IP-based multi-camera. The cameras are mounted on a semi-rigid steel frame and shaped in three quarters of a circle with two rigid steel arms that formed at a 90-degree angle to each other. The arms were driven by a DC motor, controlled by a microcontroller, and supervised by a computer to conduct data acquisition activities. The results show the average time between each image capture was less than one second. The images were not limited around the face of the object, but still covered a larger area than required.

The nineteenth paper, written by Y. Whulanza, T. Sitanggang, J. Istiyanto, and S. Supriadi, combines a seedless-electroplating process with maskless lithography as an alternative to Litography Galvanoforming Abformung (LIGA) with a normal, simpler, and cheaper semiconductor process at a tolerable result. The result of the various voltages on seedless electroplating occurs at an exposure of 7.5 VDC for 30 seconds, and the thickness of metal electroplated is at a range of ±1.5 μm. Moreover, a resolution of ±10 μm and a roughness of ±0.31 μm were achieved during the deposition.

The twentieth paper, written by D. Moraru, K. Tyszka, Y. Takasu, A. Samanta, T. Mizuno, R. Jablonski, and M. Tabe, investigated the coupling between neighboring dopant atoms in nano devices. The different regimes of inter-dopant coupling are controlled by the doping concentration and a selective doping process. Tunneling transport characteristics for single and coupled dopants is evaluated. From the results, tunneling transport spectroscopy can reveal the fundamental physics of isolated dopants compared to strongly coupled dopants. Direct access to the behavior of coupled dopants can be provided through the observation of surface Si nano transistors.

We hope that this edition of IJTech conveys some new insights in the way we conduct our research and we invite you to join us in this venture by sending your work for consideration.

With warmest regards from editorial board members,

Dr. Agus Pamitran   Dr. Hendri D.S. Budiono   Prof. Dr. Nandy Putra   Dr. Muhamad Asvial