

PREFACE ARTICLES AUTHORS PUBLISHING INFORMATION Therefore, the world needs more research and innovation, and we cannot remain silent on this matter. As we know, research and innovation is a long and cumulative process that includes much decision-making from idea discovery to implementation. Through the 4th Borobudur International Symposium in 2022, we try to accommodate researchers, scholars, and practitioners to disseminate their research and innovation results in order to contribute to solving global problems.

This symposium also invited the world-class keynote speakers; they are: 1) Dr. Wahyu Caesarendra, from the University of Brunei Darussalam; 2) Associate Professor Yun Arifatul fatimah, from the Center for Sustainable Intelligent Circular Economy, Indonesia; 3) Professor Nuran Acur, from the University of Glasgow, Scotland; 4) Dr. Sukanya Dej-adisai, from Prince of Songkla University; and 5) Dr. Matthias Wetzel, from Asia University.

This symposium raised the theme "The Innovation Chain: A Contribution to Society and Industry" and was attended by 324 presenters from 14 countries, including: Indonesia, Malaysia, Brunei Darussalam, Japan, Thailand, China, Taiwan, Australia, Kazakhstan, Scotland, Germany, Hungary, France, and Brazil.

Certainly, this event will not be successful without the support of co-hosts. On behalf of the committee, we thank the 17 co-hosts:

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- 2. Politeknik Negeri Samarinda, Samarinda, Indonesia
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- 16. Universitas Trisakti, Jakarta, Indonesia
- 17. Universitas Trunojovo Madura, Bangkalan, Indonesia

We hope that the articles presented in the 4th BIS-STE 2022 provide new insights for participants and for a wider audience, stimulate new research paths, and open up opportunities for research collaboration between institutions.

Scientific Committee of 4th BIS-STE 2022

Muji Setiyo Zulfikar Bagus Pambuko Chrisna Bagus Edhita Praja Agus Setiawan Fitriana Yuliastuti Lintang Muliawanti Veni Soraya Dewi



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All of the articles in this proceedings volume have been presented at the 4th BIS-STE 2022 $\,$ on December 21, 2022 in Magelang, Indonesia. These articles have been peer reviewed by the members of the Scientific Committee and approved by the Editor-in-Chief, who affirms that this document is a truthful description...

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PLC and HMI Application for Fuel Selector Switch on Bi-fuel Vehicles (Gasoline-LPG)

Muhammad Firdaus Jauhari, Rusmini Sri Maryati, Raihan, Saberani, Norhafani, Muhammad Arsyad

This design aims to develop a PLC and HMI application in the scope of automation in the automotive industry. The implementation of the fuel selector switch function was made as a simple project for a control system related to the use of fuel in a bi-fuel SI engine that operates with gasoline or LPG....

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Design of Rocket Stove with Computational Fluid Dynamics (CFD) Simulation

Yotam Stefanditya, Felicia Maya Puspita Anastasya Kusbagyo, Agus Kurniawan, Bayu Prabandono

The rocket stove is a type of improved cooked stove that adopts an L-elbow/J-elbow shape. There are many rocket stoves on the market but the design itself only adapts in terms of shape without taking into account the design principles for wood-burning cook stoves. This study aims to analyze the design...

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The Impacts of Water Injection Application on the Performance of Internal **Combustion Engines**

Wawan Purwanto, Ahmad Arif, Martias, Hendra Dani Saputra, Yolana Nursyafti, Alif

As the temperature of the air entering the combustion chamber rises, consequently the combustion temperature, resulting in complete combustion of air and fuel in the combustion chamber and a decrease in the performance of the internal combustion engine. It also influences increasing emissions while decreasing...

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The Effect of Straw Mulch on Several Factors of Soil's Water Retaining Capacity During One Season of Upland Rice in Latosol Kemang, Bogor

Yunus Arifien, Tun Susdiyanti, Faizal Maad

To maximize the availability of water for plants, data on the amount, intensity and distribution of rain is needed, the amount of water infiltration, the maximum ability of the soil to retain water, the amount of water lost from the root zone, the water requirements of plants, and the dynamics of soil...

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Stroom Electric Motorcycle Body Design

Hardy Adiluhung, I Wayan Mudra, Arini Arumsari

Urban areas become one of the highest motorcycle users with urban people who tend to be more open to new things such as technological advances and environmental concerns, so they can follow the development process of electric motorcycles well. Things that need to be considered in this design are the...

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Big Data Analysis on Urban Planning Governance: How is Big Data Used to Plan Urban Management?

Eny Boedi Orbawati, Retno Dewi Pramodia Ahsani

Big data is a collection of structured and unstructured data in large volumes and stored in one unit from the internet of things (IoT). In the government planning sector, big data is a supportive instrument to find gaps and weaknesses in governance. This study aims to analyze the use of big data in urban...

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Effects of the FRP Layer and Concrete Strength on Fiber-Reinforced Polymer-Confined Artificial Lightweight Aggregate Concrete

Butje Alfonsius Louk Fanggi, Ambros Raha Lelang Wayan, Obed. Oktafianus Nego Nenobais, Matelda Christiana Mauta, Yosefus Conterius

The characteristics of lightweight concrete are distinct from those of the many other types of concrete. On the other hand, there has been relatively little investigation into the performance of such concrete when it is wrapped in fiber-reinforced polymer. This study investigates effect of fiber reinforced...

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Toxicity of Various Organic Substances in Wastewater and Evaluated on *Brachydanio rerio*

Latifa Mirzatika Al-Rosyid, Sarwoko Mangkoedihardjo, Sawitri Komarayanti, Yuvita Dian Siswanti. Musarofa. Himawan Ganiar Prabowo

High content of pollutants can be harmful to the biota in salt water and fresh water. There is a change in the level of danger from substances that are not mixed to mixed. This study is important and necessary for the discharge of wastewater. The objective was to obtain a varied range of substances and...

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Development of Bamboo Materials for Body Speed Boat Application

Andi Lamappasessu, Dwi Rahmalina

The research of natural fibers in various engineering fields is currently developing, because of its availability, easy to process according to its designation, low-cost, good mechanical and physical properties and is friendly to the environment. The use of bamboo (bamboo strip reinforced/BSR) material...

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A Review and Bibliometric Analysis on Essential Oil Nanoencapsulation

Wahyudi Budi Sediawan, Indah Hartati, Hary Sulistyo, Muhammad Mufti Azis

The potential applications of essential oils are limited by their natures as they are oxidized easily by light, heat, and other environmental factors. Essential oil impediments and their short shelf life promote the development and application of essential oil nanoencapsulation. Nanoencapsulation techniques...

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The Use of Meemba Leafe (Azadirachta Indica) for Recovery of Mouse β -Pancreas due to the Type-2 Diabetes Mellitus

Mirah Rejeki, Hartono, Adi Prayitno, Soetrisno, Kun Harismah, Andi Suhendi

One of the serious diseases that has been a concern in medicine is Diabetes Mellitus (DM). The rate of morbidity and mortality is significantly high. The medicine that comprehensively recovers the disease is necessary. This enables β pancreas recovery. The extract of Meemba Leaf is expected to fulfill...

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Preliminary Studies of Hydro Power Plant using Laboratory-Scale Pelton Turbine: Speed-Variable Controlled and Their Effect on Electrical Power

Muhamad Taufik Ulhakim, Sukarman Sukarman, Muhamad Rifqi Putra Syah, Ghazi Tikamori, Khoirudin Khoirudin, Amir Amir, Budi Kristiawan, Ade Suhara

Indonesia is one of the richest countries, with 70% of its areas abundant in water. These advantages can be utilized for the necessities of life, for example, building the hydroelectric power plant considering that some areas in Indonesia have yet to be reached by electricity. Hence, this work was conducted...

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Design of the Real Time Image Capture Feature for Vegetable Production in Sharia Based E-Commerce

Sutadi Triputra, Ririn Suharsih, Utan Sahiro Ritonga, Alghif Aruni Nur Rukman, Eni Kusumawati

In 2021 the consumer complaint service at the Ministry of Trade in Indonesia recorded those 95.3% or 8,949 consumers made complaints in the e-commerce sector. This condition increased 10 times compared to the previous year. The results of a survey conducted by shopback found that 62.9% of consumers felt...

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High Performance Oven for Coconut Shell Charcoal Briquetting

Andreas Prasetyadi, Wibowo Kusbandono

Coconut shell charcoal briquetting usually applies thermal drying with LPG, CNG, and biomass as the common fuel for heating. Fuel price is significant for production cost in addition to raw material and environmental issue. Therefore, its price is subject to fuel price volatility. As the fossil price...

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The "INOMARI" Android Application as a Model of Distance Learning Media for Vocational School

Ahmad Fathan Rizgi Irawan, Didit Widiatmoko Soewardikeoen, Adrian Ariatin

Distance Learning due to the Covid-19 pandemic has challenged many schools, especially for vocational schools which have the main competence in the form of practice. The research took place at SMKN 1 Simpang Empat, South Kalimantan which has the main problem that only 15% of students achieve the minimum...

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A New Method of Controlling Inlet Water Flow Rate in Solar Energy Water Distillation

F. A. Rusdi Sambada, I Gusti Ketut Puja

Only some water can evaporate in the distillation process using wick-type solar energy. The more water that does not evaporate, the lower the distillation efficiency. A faucet generally uses for controls the inlet water flow rate. However, the faucet causes a significant flow rate.

The greater the inlet...

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The Study Calorific Value of Organic Briquettes for Optimizing Healthy Food Drying as an Alternative to Rainy Weather

Joko Yunianto Prihatin, Ganang Wicaksono Pratama, Heri Kustanto, Slamet Pambudi, Lujeng Widodo

Briquettes are a form of renewable energy that can replace the decline in oil and gas production as a necessity for human life. Briquettes made from coconut waste have a very positive potential in environmental sustainability compared to plastic and metal waste. Improper composition of raw materials...

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The Effect of The Capillarity on the Efficiency of Wick-Type Solar Energy Water Distillation

Riki, Bagas Dwi Nur Sasongko, F. A. Rusdi Sambada

The low efficiency of the wick-type solar energy water distillation is due to the significant flow rate of contaminated water that will be distilled at the absorber. The flow rate of water in the absorber is generally regulated using a faucet. However, setting the water flow rate using a faucet is very...

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Determination of Tsunami Evacuation Route using Dijkstra's Algorithm: Case Study of Batukaras, Indonesia

Aldo Novaznursyah Costrada, Elis Agustiana, Nina Siti Aminah, Mitra Djamal

During a tsunami, the choice of evacuation route is vital for safety. Dijkstra's algorithm is used to plan the shortest route for evacuation. The optimal shortest route is obtained from various nodes to the evacuation zone by identifying the distance, determining the speed and density of pedestrians,...

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Effect of Pumice-Based Nanosilica and Sodium Silicate Addition on Impact Strength of GFRP Composite

Willy Akhsani Taqwim, Kuncoro Diharjo, Bambang Kusharjanta, Andry Rakhman

GFRP composite has become an alternative material for various engineering applications due to its outstanding characteristics. The purpose of this study is to investigate the impact properties of GFRP composites in relation to the addition of sodium silicate (SS) and nano active filler pumice particle...

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Performance Evaluation of SPWM and SVPWM Inverter in FOC-based PMSM Drives Under Dynamic Speed and Load Disturbance

Mentari Putri Jati, Muhammad Rizani Rusli

The article discusses the significance of high-performing Permanent Magnet Synchronous Motors (PMSM) in industries such as transportation, robotics, and industrial sectors due to their small size, high efficiency, and fast responsiveness. Field Oriented Control (FOC) is used in PMSM drives to achieve...

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3D Airlift Pump Simulation With Variation of Nozzle Diameter Based on Computational Fluid Dynamics

William Ferdi Famgeorgy, Stefan Mardikus, Natanael Bima Anansa

Water is a liquid that plays an important role in our daily lives that has properties that are easy to distribure from high to low pressure places and the opposite from high to low pressure places using an airlift pump that working principle in the form of transporting water with the help of a mass flow...

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3D Airlift Pump Simulation with Variation of Pipe Diameter Based on Computational Fluid Dynamics

Natanael Bima Anansa, Stefan Mardikus, William Ferdi Famgeorgy

Airlift pump is a device for raising water that is the simplest and easiest to assemble, it can even be easily found in the community because basically an airlift pump only requires two fluids, namely water and air which have a mass flow rate to raise the water. However, the airlift pump has a drawback....

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A Numerical Study of $\mathrm{AL_2O_3}\text{-}\mathrm{TIO2}$ Hybrid Nanofluid on Radiator Performance

Najmul Hidayat, Sudarmadji

Fluid cooler on system cooler machine automotive generally use coolant with mixture ethylene 2 glycol minimum 30 percent. Moment This use Nanoparticles can mixed on fluid cooler base between fluid And nanoparticles that have characteristic physique thermal more Good from fluid cooler pure. This is simulating...

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Maintenance Improvement Through Implementation of RCM and FMECA on Cooling Unit Radar System

Hendrawan Candra Purnama, Lobes Herdiman, Susy Susmartini

The readiness of military defense radar is absolute in air surveillance to keep from potential threats that may endanger the security of nation. Good maintenance is closely related to the readiness level of the defense radar system. Maintenance through the application of Reliability Centered Maintenance...

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Sentiment Analysis of the Maps Application Uses the SVM Method and Predicts the Growth of Maps Application Users

Ilham Fariz Asya Mubarok, Tukino, Baenil Huda, Aprilia Putri Nardilasari, Risa Nur Islami, Muhammad Khaerudin

Nowadays, the directions application is often used by many people, this application is very helpful for its users in finding the best travel routes, by simply entering the address code, this application can provide routes that can be passed for various types of vehicles. In Indonesia itself there are...

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Implementation of Project-Based Learning Model at Politeknik Negeri Medan

Roslina, Ismael, Andam Lukcyhasnita, Dina Arfianti Siregar, Bayu Asmara, Hasnah Juniarni Nasution, Abbiyu Shiddiq As'ad, Dame Uli Sinaga

Each student has a different interpretation of the experiences gained in everyday life. When students are in the learning process in class, the lecturer facilitates learning activities so that new concepts are formed that are in accordance with scientific concepts. Lecturers should design effective learning...

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Important Elements in Green Human Resource Management: An Analytical Approach Using a Fuzzy Interpretive Structural Modeling

Uky Yudatama, Siti Puryandani

Green Human Resource Management is an effort that can help reduce the impact of environmental damage. An important problem that has occurred so far is that the implementation of GHRM in organizations has not been able to run properly because they do not yet know what are the important elements/keys that...

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Review of K-250 Concrete Compressive Strength Using Mix Design Manual on Development Projects Continued Talud Airport of Syukuran Aminuddin Amir Luwuk

Mukhtar Lutfie, Adryan Winardi Latuba

Compressive strength is the stress that occurs in the test object when the load is applied until the test object is destroyed. Before making the test object, the first stage is to do a slump test. If it meets the standard specifications then manufacture the test object. The specimens were dried in the...

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The Effect of Doses of Red Shoot Leaf Extract *(Syzygium myrtifolium Walp)* on Decreased Cholesterol Total Levels in Male White Wistar Rats In Vivo

Denih Agus Setia Permana, Mika Tri Kumala Swandari, Imam Agus Faizal, Dini Puspodewi, Aprilia Iin Aminia Putri

The prevalence of cholesterol in Indonesia is 66.41%. Central Java is among the five provinces with the highest levels of consumption of fatty, cholesterol, and fried foods, at 60.3%. The purpose of this study was to determine the effect of an extract of red shoot leaves (Syzyginium myrtifolium Walp)...

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Forecasting the Adapted-Meta Technology on Shariah Compliant Mortgage

Fauzan Muhammadi, Nor Fahimah Binti Mohd Razif, Rahimin Affandi, Abdul Rahim

Currently our life has stormed by fast development of meta-technology that could transform physical being into digital verse. This fact has affected many issues, one of which is mortgage activities. The problem is that we tend to follow debating issues on its several controversies and not trying to foretell...

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Carbopol-940 Improves the Physical Properties of Cocoa Peel Extract Emulgel

Nisa'ul Khoiriyah, Dwi Bagus Pambudi, Nuniek Nizmah Fajriyah, Eko Mugiyanto, Nur Izzah

Recently, the utilization of the herbal skincare industry has drawn much attention. One component utilized in formulations to provide a gel-like consistency and maintain the stability of a medical preparation is carbopol-940, a cosmetic gelling agent. It is frequently combined with an emulgator, triethanolamine....

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Preparation and Analysis of Activated Carbon Derived from Yellowfin Tuna Fishbone using a Straightforward Carbonization Technique

Zuriah Sitorus, Kurnia Sembiring, Emita Sembiring, Enda Rasilta Tarigan, Doli Bonardo

A successful preliminary study was conducted to examine the characteristics of activated carbon derived from yellowfin tuna fishbone using the carbonization method due to its ease and efficiency. Surface morphology and elemental composition analysis of activated carbon was performed using SEM-EDX, while...

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Analysis of Financial Resilience in Magelang to Develop Effective Policies Naufal Afif, Nur Hidayah

Financial resilience is an important issue today. COVID-19 pandemic that has occurred since 2020 causes household finances adversity due to financial shocks. The Indonesian Political Indicator states that most Indonesian experienced a decrease in household income in February 2021. The fact is that many...

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Design of Oxygen Generator Based on Oxymetry: Prototypes for Vergenios Baby

Nur Chabibah, Sandi Ari Susiatmi, Alfa Yuliana, Titis Wicaksono, Mokhamad Ilham Maulana Karim Priatna

Oxygen therapy saves lives in several respiratory and non-respiratory diseases in neonates and children. The most common indication for oxygen therapy in newborns was pneumonia, one of the leading causes of death in children under five years old in most developing countries. The Oxygen Concentrator (OC)...

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Characteristics of Mortar Composed of Crushed Solid Waste of Roof Tiles as Partial Replacement of Fine Aggregate

Hariyadi, Mohammed A.S. Algoul, Ayed Ahmad Zuhud, Jauhar Fajrin

Due to the growing quantity of solid waste resulting from building damage, it is suggested that roof tile waste could be used in mortar in place of sand. This study aims to determine the physical and mechanical properties of mortar produced with waste roof tile as one of the incredients. In this investigation....

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The Challenge of Slum Upgrading Plan in Urban Area: A Case Study of Dirgahayu Village, Kotabaru, Indonesia

Hanny Maria Caesarina

Dirgahayu village is acknowledged as a slum coastal neighborhood and considered visually damaged the urban area of Kotabaru. This urban village is included in the current local planning priority through stack house program. On the other hand, there are some resistances from the locals regarding this...

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Era of the Industrial Revolution 4.0: Analysis of Infographics Visual Text as a Communication Media During the Covid-19 Pandemic in Bali

Anak Agung Gde Bagus Udayana, I Nengah Sudika Negara

The era of the industrial revolution 4.0 and the outbreak of Covid 19 at the same time has affected to the loss of many lives. The need of proper media is necessary due to the socialization of the pandemic within the community. The media which mostly used by the government is website provided with infographic...

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Theoretical Framework for the Implementation of Data Analytics in Measuring Small Business Performance in Indonesia

Mohammad Riza Radyanto, Enty Nur Hayati, Firman Ardiansyah Ekoanindiyo

Small Business faced a lack of human resources to manage a business so they have no ability to use and analyze descriptive or predictive data. Weakness in analyzing data causes them to be unable to make strategic decisions in improving their business performance and unable to display competitive advantage,...

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Assessing Deep Learning Model Using AlexNet for Water Traffic Counting in Martapura River

Nahdi Saubari, Wang Kunfeng

In recent years, the traffic of water transportation in Martapura river has been increased and creating many problems for the city and its environment. Hence, the traffic needs to be managed from time to time. Deep learning model might be used for traffic counting by detecting the ships. This study aims...

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EMG Signal Measurement of Flexor Carpi Radialis Muscle in Post Stroke Patients and Normal Individuals Using Time Domain and Frequency Domain Feature Extraction

Agung Pamungkas, Lobes Herdiman, Susy Susmartini

Stroke patient increase with 50% motor deficit disability. Therapists identify muscle conditions conventionally with a subjective approach, especially in post-stroke patients by measuring the flexor carpi radialis muscles. There has been no measurement of the flexor carpi radialis muscle in the intervention...

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Application of Cocoa Pod Extract Compost with the Addition of Biochar and Pleurotus sp to Shallots on Sandy Clay Land

Iradhatullah Rahim, Sukmawati, Nur Ananda, Muh. Rustan, Rahmat Muda, Irninthya Nanda Pratami Irwan, Suherman, Muh.Iqbal Putera

The utilization of sandy clay is done by adding organic materials to minimize excessive chemical input. The purpose of this study was to determine the soil's characteristics after applying cocoa husk compost and Pleurotus sp to 2 types of biochar, namely rice husk and corn cob biochar. Furthermore, the...

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Students' Reading Interest and Metacognitive Awareness in the Reading Concept Map (Remap) Model Integrated to Cooperative Learning in Biology

Siti Zubaidah, Nur Hayati, Nur Ismirawati, Arsad Bahri, Susriyati Mahanal

The aims of this research were to determine the effect of learning model that can improve students' reading interest and metacognitive awareness. This research employed quasi-experimental design which purpose is to increase students' reading interest and metacognitive awareness through the use of Remap...

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The Quality Control of Refinery Bleaching Deodorize Palm (RBDP) Olein with Variations of Phosphoric Acid (H_3PO_4) and Bleaching Earth (BE)

Istianto Budhi Rahardja, Azhar Basyir Rantawi, Hendra Saputra, Dian Oktavia Pambudi

Crude palm oil (CPO) is the result of the production process of processing palm oil from fresh fruit bunches (FFB) of oil palm plantations. CPO is referred to as crude palm oil which is refined to become frying oil for public consumption. The process of refining CPO to become frying oil is carried out...

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The Role of Digital Skills Advantage Enhancing Gen Z Work Readiness for the Future Digital Workplace: Evidence from Indonesia

Fery Riyanto, Amron, Sih Darmi Astuti

Digitalization in the industrial era 4.0 has changed how work and workplaces have become digital. It is predicted that many jobs will disappear in the future, which requires individuals to move dynamically according to the movement of industrial patterns. Many jobs are lost, of co. Of, there will be...

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Implementation of Predictive Maintenance on Defense Radar Using FMECA Method and PHP Software to Support Maintenance Action Decision Making

Hendrawan Candra Purnama, Susy Susmartini, Lobes Herdiman

The operational readiness of the defense radar is crucial in protecting the country's sovereignty from aerial threats. Proper monitoring of radar health status needs to be continuously developed to support high operational performance. Prioritizing equipment repairs through appropriate predictive maintenance...

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The Digital Capability and Job Satisfaction Effects on the Performance Improvement of Islamic Boarding School Employees in Indonesia

Nur Ahmad Budi Yulianto, Amron, Piji Pakarti

Islamic boarding schools are one of the oldest educational institutions that cannot be ignored from the history and culture of Indonesia because it is proven that Islamic boarding schools have employees who are able to adapt to the times. In this digital transformation era, Islamic boarding school employees...

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The Influence of Filler Concentration on Mechanical and Thermal Properties of Whey Protein Isolate/Silica Biocomposite Film

Ika Zuwanna, Medyan Riza, Sri Aprilia, Yanna Syamsuddin, Rozanna Dewi

The incorporation of silica (SiO2) into whey protein isolate (WPI)-based biocomposites film has been explored. This study aimed to determine the effect of SiO2 addition on the characteristics of WPI by casting. WPI was prepared with variations in SiO2 concentration ranging from 0% to 7% (w/w). The resulting...

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Reducing Pertamax Inventory Costs at a Gas Station by Eliminating Shortage Using Probabilistic Economic Order Quantity

Sono, Andian Ari Istiningrum, Dwi Nurma Heitasari

Gas Station Z is a retail entity selling various fuel products such as gasoline (pertalite, pertamax) and diesel, the demands of which were fluctuating. Such a fluctuating demand often contributed to a condition in which customers failed to get the product at the right time. In addition, the gas station...

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A Review on Real Driving Cycle-Based State of Charge Prediction for EV Batteries

Ikhsan Romli, Bermawi Priyatna Iskandar

Research on performance of Electric Vehicle is very important, especially in driving range of a Battery Electric Vehicle (BEV) that requires precise State of Charge (SoC) predictions. The battery SoC is an important parameter that reflects the performance of the battery.

Meanwhile, the battery has varying...

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Social Media as Communication for Natural Disasters: Analysis of Social Media for Disaster Management in Bantul Regency

Ishak Abidin, Muhammad Nur Kurniawan, Reyga Pramudita, Satria Iman Prasetyo

This study aims to describe the process of communicating natural disasters through social media belonging to the Disaster Management Agency (BPBD) of Bantul Regency. The choice of research location was based on the high disaster risk index in Bantul Regency against natural disasters. Taking into account...

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Digitalization of Tourism Villages: Social Media as a Tourism Promotion Strategy in Tinalah Tourism Village, Kulon Progo Regency

Kevin Arya Pranaja, Muhammad Akbar Nugraha Sabarna, Dimas Prahmana, Satria Iman Prasetvo

This study aims to determine the communication strategy of Tinalah Tourism Village in promoting digital-based tourist destinations through social media. This research takes a case study in Dewi Tinalah Tourism Village as a digital tourism village that uses social media as a means of promoting tourism...

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Agile Governance in Public Services: A Website Study of Mal Pelayanan Publik in the Special Region of Yogyakarta

Muhammad Ariq Rafi, Fadia Azzahra, Akhmad Kurniawan, Satria Iman Prasetyo

The background of this research is the Panrb Ministerial Regulation Number 23 of 2017 concerning the Implementation of Mal Pelayanan Publik (MMP). The Provincial Government of the Special Region of Yogyakarta (DIY) signed a commitment to implement the MPP with PANRB. It is hoped that MPP can make it...

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Games Knowledge Model Development Indonesia Traditional Approach On-To-Knowledge

Tukino, Baenil Huda, Agustia Hananto, Hendry, Eko Sediyono, Saepul Aripiyanto

Traditional games are a form of play that reflects the customs of a tribe which are passed to the next generation. Traditional games have a philosophical meaning implied in each game and are also very fun. From the point of view of benefits, traditional games played by children are able to stimulate...

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Microstructure and Mechanical Properties of Friction Stir Welding Aluminum AA1100 with the Parameter of the Tool Pin Profile

Nur Kholis, Helmy Purwanto, Darmanto, Muhammad Faiz Fadhlillah

The tool pin profile on Friction Stir Welding (FSW) has great influence toward the result of welding. The tool pin profile is one of the vital factors influencing the result of welding such as the microstructure and the mechanic characteristic on the joint of Weld Nugget (WN). This study aims to analyze...

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A Graph with Central and Local Reference Set

Yuni Listiana, Liliek Susilowati, Slamin

The local metric set is a subset of vertex set in graph that introduced by Okamoto et al. It is referred to a subset where is for every two adjacent vertices in graph has different representation with the subset. Previously, Slater introduced the location set and reference set as another term of resolving...

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Distribution Process of Biodiesel as a Primary Fuel to Support the Implementation of Logistics Strategy in Central Java

Yunanik, Sono

This study focuses on the distribution process of Biodiesel in relation to the logistics strategy of the FUEL TERMINAL which regulates the supply of Biodiesel products to Consumers (SPBU) as primary fuel. The analysis method used is SWOT, IFE, EFE and Internal External Matrix (IE). The results of the...

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Digital Scales Based on Arduino Uno for Parents and Children via android and PC applications

Tri Hannanto Saputra, Fenty Pandansari, F. X. Suryadi

Stunting is a problem that we all face towards the golden generation of 2045. Stunting is a serious condition in children which is characterized by the child's height being below average or the child being very short and his body not growing and developing properly. The problem of stunting is an important...

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The Application of Sculpture Art to Environmentally-Based Works of Art by Utilizing Plantation Wood Waste Materials

Gustyan Rachmadi, Husen Hendriyana, Asep Sufyan Muhakik Atamtajani, Fajar Rahadian

In the era of globalization, science, including art, occupies the same role, namely being able to penetrate synergies with various other sciences. In this case art relates to the natural environment, agriculture and plantations as well as tourism. In the era of the Ministry of Tourism and Creative Economy....

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Experimental Study of Performance Comparison of Lithium Iron Phosphate Batteries and Supercapacitors on Electric Motorcycles

Yuan Perdana, Hermansyah

Electric vehicles generally use batteries for energy storage, but currently there are designs for electric vehicle energy storage using supercapacitors (SC) or a combination of batteries and SC. In previous research, an electric motorcycle was made by converting Suzuki Shogun SP125 chassis, 800-1000...

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Analysis of Magnetic Pattern Distribution in a Mini-Permanent Magnetic Power Plant to Produce Optimal Electricity

Agri Suwandi, Budhi Muliawan Suyitno, Eka Maulana, Lutfi Gangsar Prayogo, Dahmir Dahlan

The use of electrical energy is becoming increasingly important in Indonesia, but the energy used is still dominated by fossil fuels by 87.64 percent. As a result, research is required to develop new energy sources. One of the renewable energies, the presence of a permanent magnet power plant, converts...

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The Effects of Carbon Taxes on Firms' Carbon Emission: Simulation Model in Indonesia

Andewi Rokhmawati

This research examines the effect of taxes on carbon on firms' carbon emissions. To examine the effect, this research used a manufacturing firm-level dataset from 2012-2019. The data were secondary data collected by Indonesian Statistics. The research did not include 2020 and 2021 because Indonesian...

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Performance of Small Commercial AC System with R-32 Applied for Educational Building in Tropical Country: A Thermodynamic Simulation

I Nyoman Suamir, I Wayan Adi Subagia, I Dewa Made Susila, Ketut Bangse, Adi Winarta

A numerical evaluation on the performance of small commercial AC systems using R-32 as their refrigerant is presented. The evaluation is specifically applied for educational buildings in Bali Province, Indonesia. A digital model was developed. The model was established in Engineering Equation Solver...

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Evaluation on the Potential Production of Horizontal Molding - Crystal Clear Ice Block Applying One Direction Heat Absorption

I Nyoman Suamir, I Putu Sastra Negara, I Wayan Suirya

The paper presents investigation on a small capacity of horizontal molding-crystal ice block machine. The investigation was motivated by the increasing need for crystal clear ice blocks in Bali as a tourist destination. Therefore, it is necessary to develop a crystal block ice machine that is functional...

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Potential Use of Refrigerated Distiller in Improving Quality Consistency and Productivity of Balinese Distilled Drink

I Nyoman Suamir, Made Ery Arsana, Ida Ayu Elistyawati

In Bali, there is an alcoholic drink that is traditionally distilled by Balinese villagers. The drink is well known as Arrack Bali distilled from fermented sap of palm flower. The use of traditional distillation equipment makes villagers unable to produce the drink with consistent quality. In fact, the...

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Seasonal Energy Efficiency of Split AC Systems Applied for Different Regions Across Indonesia Archipelago: A Numerical Approach

I Wayan Temaja, I Nyoman Suamir, I Ketut Rimpung, I Nyoman Suparta

Seasonal energy efficiency of latest split type AC systems which commonly use R-410A, R-32 or R-290 refrigerants has been investigated in this paper. A numerical approach was applied on split AC system which operated at diverse environmental conditions of different regions across Indonesia archipelago....

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The Existence of Boats and Luang People - Maluku - Indonesia

Efilina Kissiya, Gábor Biczó

This paper is a narrative of the results of the initial exploration of Luang Island, which is one of the small outermost islands in Maluku, Indonesia. The purpose of this study is to describe the existence of the boats and the Luang people in their lives. This study uses a qualitative method with an...

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The Effect of Elevated Temperature on the Mechanical and Morphological Properties of Aramid and Carbon Fiber Reinforced Epoxy/MWCNT

Roosdinal Umar, Istiroyah, Herry Purnomo, Dandy Ramadhan Tri Hutomo, Yurohman, Mohamad Baiquni

Aramid and carbon Fiber-reinforced polymer (FRP) has been widely used in automotive and aerospace industries, due to high-strength and low-density. The development of FRP composite material is needed to achieve higher mechanical properties of FRP in aerospace fabrication, especially for the performance...

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Simulation of Fluid Sloshing in Core Catcher for Nuclear Accident Using Moving Particle Semi-Implicit Method

Asril Pramutadi Andi Mustari, Stefany Imanuel Sihombing, Anni Nuril Hidayati

Fluid sloshing simulations and tests were performed in a nuclear reactor scheme, especially core meltdown, using the moving particle semi-implicit (MPS) method. The MPS method is a method for analyzing the interactions between incompressible particles. In this method, the fluid is represented by particles,...

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Study of Thickness Effect on Freeze-Valve Scheme for Molten Salt Reactor Safety System

Asril Pramutadi Andi Mustari, Virgo Eben

Molten Salt Reactor (MSR) is a liquid fuel reactor type candidate for Generation IV reactors due to its excellent safety system. A freeze valve is one of the safety systems used in MSR to prevent reactor accidents due to uncontrolled fuel temperature increases. The freeze valve is designed to melt when...

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The Relationships Between Supply Chain Resilience and Firm Performance: The Mediation Role of Digital Innovation

Suwaryo Nugroho, Surachman, Rofiaty, Ainur Rofiq

This study aims to provide an explanation of the relationship between supply chain resilience and firm performance as well as the mediating role of digital innovation in West Java, Indonesia's food and beverage manufacturing. The relationship between supply chain resilience and firm performance...

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Mobile Information Academic-Based UI/UX Design System Application Using the Design Thinking Method (Case Study: University of Singaperbangsa Karawang)

Intan Purnamasari, Vira Kristianinggrum, Apriade Voutama

Unsika Academic Information System is a service owned by Singaperbangsa Karawang University which has a function for the management and administration of student academic activities. However, this service is currently only available based on a website, then it has a confusing flow when you want to use...

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Web-Based Knowledge Management System Design on Micro, Small Medium Enterprise (MSMEs) Reog Ponorogo

Ghulam Asrofi Buntoro, Indah Puji Astuti, Wahna Widhianingrum

Reog is one of the famous arts in Ponorogo. Reog Ponorogo is held not only to entertain the public, but also for ritual ceremonies. Reog craftsmen who are members of the Reog MSME business experienced many obstacles, especially during the covid-pandemic in obtaining raw materials, production, and marketing....

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Traditional Sport, Indigenous Heritage, and Tourism Branding: Jemparingan PERPATRI in Madura, Indonesia

Yuliana Rakhmawati, Zandan Chanana, Qoniah Nur Wijayani, Diah Indiyati, Evi Novianti

As a form of cultural artifacts, jemparingan brings local values and virtues that need to be preserved. This article focuses on the ways in which PERPATRI as traditional archery association, after its successful bid to introduce as traditional sport, Jemparingan is branded as a sport tourism destination...

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Review on Katuk (Sauropus androgynus (L.) Merr.) and Milk Production of Breastfeeding Mothers in Indonesia

Setyaningrum Rahmawaty, Zelyne Avita Padmasari

Katuk (Sauropus androgynus (L.) Merr.) leaf and its products, culturally have been used by lactation mothers in Indonesia to improve their milk production. A limited study examined the different processing/serving of the leaf to the milk releasing. This study aimed to explore the effectiveness of katuk...

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Mathematical Computational Thinking Ability of Junior High School Students

Adi Ihsan Imami, Muhammad Rijal Kamil, Agung Prasetyo Abadi

This research is motivated by students' mathematical computational thinking skills, which still need to improve. So, the goal of this study was to analyze and describe how students in Class VIII SMP think about math when they solve problems about probability. The research method used is descriptive qualitative....

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Analysis of Higher Order Thinking Skills and Science Process Skills in $21^{\rm st}$ Century Education

Irham Nugroho, Minzani Aufa, Novita Nurul Chasanah, Defa Ajeng Wardani

An important demand of 21st century education is to improve students' cognitive abilities. Higher-order thinking skills (HOTS) and science process skills (SPS) emphasize knowing facts, relating them to other relevant information, and using them to solve new problems. Based on the data, more than 50%...

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The Work-Life Balance of Student Association Executive Board: The Role of Self-Efficacy, Transformational Leadership, and the Environment

Dian Riani, Hadi Sumarsono, Titis Purwaningrum, Siti Chamidah, Umi Farida

Being active in an organization is often the reason why students don't graduate on time. Students who become administrators of organizations should be able to balance their roles between being students and being administrators. This study aims to examine the factors that affect work-life balance of the...

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The Impact of the COVID-19 Pandemic on Cardiovascular Disease Research: A Bibliometric Analysis

Husnul Khuluq

During the pandemic, the literature on the COVID-19 landscape has improved significantly. Cardiovascular disease is a significant risk factor for COVID-19 patients. In this paper, we will use bibliometric analysis to map the patterns in global COVID-19 on Cardiovascular research, allowing researchers...

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Public – Sector Innovation: The Implementation, Integration and Process HomPIMPA Health Information System-Based in Improving of Health Services in Sumenep Regency

Mujmal Ghanimah Usri, Muhammad Kamil

Public service must be provided by the government to community. In this case, the public services must be managed effectively and efficiently and ensure accessibility of services to realize good public values. The problems of public service delivery in Sumenep Regency, especially in the health public...

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Comparative Analysis of E-learning Methods to Improve Students English Outcome during Covid-19 Pandemic Period

Aris Rakhmadi, Yanti Haryanti

The result of the English Proficiency Test (TOEP) of UMS students in the first and second periods of 2021 shows an increase in student failures, from 33.96% to 50.82%. The increase of TOEP failures means the possibility of mistakes and deficiencies in the teaching and learning process, in point of fact...

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Investigating Spatial Correlation Between COVID-19 Incidence and Poverty in Klaten Regency, Central Java

Choirul Amin, Bela Hidayah, Dewi Novita Sari, Kuswadji Dwi Priyono, Chintania Azahra Tantri Noermartanto

A health and financial crisis has been brought on by the COVID-19 pandemic. The tight restrictions put in place to stop the COVID-19 virus have affected and limited economic activity, resulting in a drop in per capita income and an increase in the population of the poor. This research aims to analyze...

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Ergonomic Approach: Posture Analysis and Design of Activity Aids for the Elderly

Ratnanto Fitriadi, Arif Farhan Syach, Afiqoh Akmalia Fahmi, Etika Muslimah, Indah Pratiwi

The ratio of dependence of the elderly to the productive age in Indonesia continues to increase which correlates with the need for facilities. One of the facilities needed and commonly used together with the productive age is the bathroom. Most Indonesians have permanent bathtubs and toilet squats that...

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The Influence of Students' Attributes on Thematic Map Reading Ability

Ratih Puspita Dewi, Yunus Aris Wibowo, Yuniar Budi Rahmawati, Wulansari Dwi Pambudi, dan Dewi Mayangsari

A thematic map is a media in conveying specific spatial information on the surface of the earth. One form of spatial information is disaster vulnerability area. Through maps, students can improve their competence in understanding spatial disaster information. The better the ability to read the information...

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Effect of Extraction Solvent on Extraction Yield, Cytotoxic Activity and Bioactive Compound in Zingiber officinale Roscoe var rubrum

Kirana Anggraini, Dyah Ayu Woro Setyaningrum, Laela Wulansari, Hening Tyas Andayani, Laviany Putri Shihran, Isra Fauziyyah

Red ginger (Zingiber officinale Roscoe var rubrum) is a commonly used spice in Indonesia. It contains various chemical constituents, such as phenolic compounds, terpenes, polysaccharides, lipids, organic acids, and fiber. The health benefits of ginger are mainly related to its phenolic compounds, such...

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Promoting Motivation and Autonomy Through Online Teaching-Learning Process by Using ESP Printed Material

Agustin Rebecca Lakawa, Retno Indriyani, Aditya Barkah

The constructs of motivation and autonomy reveals that these two terms can be used in language learning to adjust to the current situation. The understanding of the terms will accommodate the parties involved in dealing with the complex situations in English for Specific Purpose (ESP) situation. These...

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of workers, in terms of time and demands of work tasks related to the workload that has

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NASA TLX and SOFI Mila Faila Sufa, Dyah Kurnia Sari

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been given. PT. XYZ is one of the Indonesian...

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Influence of Extraction Solvents on Capsaicin Compound and Cytotoxic Activity of *Piper retrofractum Vahl*

Analysis of Mental Workload and Fatigue of Packer Unit Operators Using

Human activities can be grouped into two main components including physical activity and

mental activity. Mental workload is a combination of a component regarding the condition

Kirana Anggraini, Dyah Ayu Woro Setyaningrum, Laela Wulansari, Hening Tyas Andayani, Laviany Putri Shihran, Isra Fauziyyah

Capsaicin (8-Methyl-N-vanillyl-trans-6-nonenamide) is an active compound found in plants from the genus Capsicum. Genus capsium posseses different species of red chilli (Capsicum annuum Linn), green chilli (Capsicum annuum var.annuum) and other varieties that are familiar in Indonesia. However, the plants...

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Evaluation of Coffee Bean Defects, Quality of Brewed Coffee, and Caffeine Content of Premium Ground Coffee

Analianasari, Taufik Nugraha Agassi, Muhammad Perdiansyah Mulia Harahap

Premium coffee has a market segmentation with high prices because it has carried out coffee bean processing following SNI standards, especially coffee quality defects. Drinking coffee is related to the effect of freshness after drinking coffee, and the refreshing product comes from the caffeine content....

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Effects of Indian Sandalwood Essential Oil (Santalum album Linn) in Inhibiting the Growth of Biofilm Streptococcus Mutans ATCC 25175

Velicia Ghina Nadhifa, Ciptadhi Tri Oka Binartha

Streptococcus mutans is a major cause of dental caries. The gold standard for antimicrobial mouthwash is chlorhexidine gluconate 0.2%. If used long term, chlorhexidine gluconate might induce an allergic response as well as tooth discoloration. The essential oil of Indian Sandalwood is a natural product...

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ARTICLES					
AUTHORS	Controlled Media				
ORGANIZERS	Samsu Adi Rahman, Fre				
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High Performance Oven for Coconut Shell Charcoal Briquetting

Andreas Prasetyadi^(⋈) and Wibowo Kusbandono

Department of Mechanical Engineering, Universitas Sanata Dharma, Yogyakarta, Indonesia pras@usd.ac.id

Abstract. Coconut shell charcoal briquetting usually applies thermal drying with LPG, CNG, and biomass as the common fuel for heating. Fuel price is significant for production cost in addition to raw material and environmental issue. Therefore, its price is subject to fuel price volatility. As the fossil price increases, the production is getting more expensive. An alternative approach for briquetting process using refrigerated drying was proposed. The research aimed to measure the oven performance applying refrigerated drying involving the machine performance and time for removing water content of the briquette. An experiment of drying 132 kg briquette was conducted in an oven of 197.5 cm x 100 cm x 112 cm dimension. The briquettes were cubes of 2.5 cm x 2.5 cm x 2.5 cm and had been aerated for 2 hours. The refrigerated drying machine has capacity of 715 W and the drying was performed in closed loop air method. It was recorded that the COP machine was 12.20 in average with drying process of 59 hours. The time processing was comparable to conventional one, but the energy price was lower.

Keywords: Coconut Shell, Briquetting, High Performance Oven

1 Introduction

Charcoal briquetting production generally consisting of molding and shaping, drying, and heating is high energy and time-consuming fuel processing. The shaping is a process to create specific form of the charcoal briquette after the raw materials have been mixed with some water addition. Following it, drying and heating up are applied to reduce the water content of the briquette and increasing its hardness, respectively [1]. Among the steps, drying and heating are the main energy consumer and subject to fuel price volatility. The processes usually need fuel such as LNG, LPG, and biomass. A good briquette has water content of 5% or less [2]. The drying and heating the briquette up are affected by environment condition and fuel price. Temperature, and humidity affect duration of the production process. Normally, it needs 6 days for briquetting with 4 days in oven for drying and heating up. The fuel price is significant in briquette production cost. Accordingly, application of the thermal heating using fuel implies on working environment as it increases the temperature and firing prone. Therefore, it is important to induce a new strategy in briquette processing especially drying to reduce production time and cost, such as vapor compression method.

Application of vapor compression method for refrigerated drying has been studied. It was utilized on grain drying, corn chips drying [3] [4], wooden planks [5], clothes [6] [7] [8, 9], and briquette [10]. In corn chips production, the method was investigated for reducing the water content of the chips before frying. Extensive studies of the method for clothes have been conducted to find optimum condition for drying during laundry [10]. All reports show the method is very potential in drying process due to psychrometric advantage over thermal method. Moreover, it was noted that the temperature increased significantly when the process was conducted in closed system [11]. Circulating the air inside of the drying chamber increases the temperature of the air and reducing the water content. The features are important in briquetting process.

Aiming to measure the oven performance of drying process and its vapor compression process, the research was conducted and presented in an article confining 5 sections. The introduction starting the article showing the research rationale. The theories of vapor compression and psychrometric are the main topics of the second part to provide the understanding of the processes. Methods of experiment explaining the measurement strategy, the parameters, and its setting is the content of the 3rd section. Results of the experiment is presented in the 4th section that is followed with conclusion as the final part.

1.1 Theoretical review

Refrigerated drying is method to remove the water content of a material using psychrometric principle of condensation to reduce the humidity of the air [12] popular as heat pump drying [13]. Low air humidity allows the water removed from the surface of the solid to the air. At the same time, it also the way to increase diffusion of the water from the inner part of the material. The principle implies need of method increasing the condensation from the air. Vapor compression is a popular and a simple way in term of practical approach for heat pumping.

1.2 Psychrometric

The psychrometric describes relation of water content, temperature, and the enthalpy of the air. The relation is depicted on a chart, called psychrometric chart as shown in Fig. 1. The parameters have 1st capital letter of each word with values are following the gold arrow direction. The horizontal axis of the chart is dry bulb temperature. The sling shows the wet bulb temperature which is the condition of condensation. The vertical axis is absolute humidity or specific humidity, while slinging lines inside of the chart are the lines of relative humidity (RH). Crossing the chart in diagonal direction are the enthalpy and the specific volume. The direction of the enthalpy and specific volume values are similar to the wet bulb direction.

Increasing temperature of air allows more water vapor can be absorbed into the air. If the content of water vapor is still, it means that the relative humidity decreases. Increasing the temperature of the air implies higher enthalpy of the air at the same time. Such principle of reducing RH is applied for thermal drying or heating the air up. The

method can be seen in Fig. 1 as the purple arrow from left to right direction (D to E) and the red arrow in the same direction (A to B).

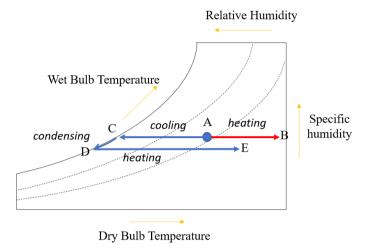


Fig. 1. The basic Psychrometric diagram.

Another way allowing drying process is to reduce the absolute humidity of the air. It happens when the water content of the air is getting lower through condensation or absorbing the water content using hydrophilic material. The process consists of reducing the temperature until its condensation point which reduces the absolute humidity of the air but it increases the RH (arrow AC), condensing through decreasing temperature (sling arrow CD), and heating (arrow DE) as seen Fig. 1.

1.3 Vapor Compression

Vapor compression is a method of transferring heat from low temperature bath to high temperature bath. To pump the heat, a kind of fluid namely refrigerant is cycled to evaporate at low temperature in evaporator and condense in the condenser with higher temperature. To do this work, the refrigerant pressure is controlled. In evaporator, the pressure of the refrigerant is set to be low using expansion equipment such as capillary tube or expansion valve. Therefore, the refrigerant can evaporate easily and absorb the heat from low temperature bath. Meanwhile, the pressure of refrigerant in condenser is set to be high using the help of compressor. The high pressure allows heat move to high temperature bath. The component of vapor compression machine is shown in Fig. 2. Compressor does input work for the cycle, the evaporator absorbs heat from low temperature bath, and the condenser releases heat to high temperature bath.

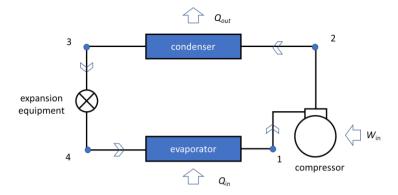


Fig. 2. The Refrigerator sections.

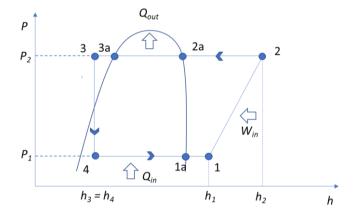


Fig. 3. Vapor compression cycle. Proper refrigerant allows superheating, de-superheating, and subcooling take place.

The cycle of vapor compression is shown in Fig. 3. It consists of boiling process, superheating, isentropic compression, desuperheating, cooling, subcooling, and condensation. The boiling process takes places in evaporator. In the process, the liquid refrigerant gets heat from the environment and heated up until its boiling temperature (4-1a). From 1a-1, the process is called superheating, where all of the refrigerant is evaporated to be vapor. The next step is isentropic compression (1-2) where the compressor pumps this gaseous refrigerant to condenser. The desuperheating (2-2a) is the process of cooling this vapor until its boiling temperature followed by cooling (2a-3a) and subcooling (3a-3). Then, this vaporized refrigerant is condensed (3-4) using expansion process. The working pressure of evaporator is P_1 , and the working pressure of the condenser is P_2 . The subcooling and superheating are applied to increase the performance of the cycle. The superheating increases enthalpy of the refrigerant (h_1) before leaving the evaporator, while subcooling, reduces the temperature of the refrigerant $(h_3 = h_4)$ in condenser before leaving it.

The specific thermal absorption of the refrigerant in evaporator is shown in Eq. 1. It is the enthalpy difference of the refrigerant rate at the evaporator outlet and evaporator inlet. The h_1 and h_4 are the enthalpy of the refrigerant at the evaporator outlet and inlet, respectively.

$$Q_{in} = (h_1 - h_4) (1)$$

The specific thermal desorption in condenser is mentioned by Eq. 2. The value is the enthalpy of the refrigerant rate at the condenser inlet (h_2) minus the enthalpy of the refrigerant rate at the condenser outlet (h_3) .

$$Q_{out} = (h_2 - h_3) \tag{2}$$

The work of the compressor is determined with the difference of the enthalpy leaving the compressor (h_2) and entering it (h_1) . This work is shown in Eq. 3.

$$W_{in} = (h_2 - h_1) (3)$$

The refrigerated drying coefficient of performance is determined with Eq. 4. The drying process depends on Qin for reducing the specific humidity and Qout at the same time for reducing the relative humidity.

$$COP = \frac{(Q_{in} + Q_{out})}{(W_{in})} \tag{4}$$

2 Method

The experiment of the research was conducted to measure the refrigerated drying process performance using the equipment setup as shown in Fig. 4. No 1,2,3, and 4, are shelves, the briquettes, refrigerated dryer, and water collector, respectively. No. 5 and 6 are the outlet and inlet of the refrigerated dryer, in respective order. The dimension of oven is 197.5 cm x 112 cm x 100 cm. The oven consists of 2 rooms, they are the A room for drying shelves and B room for drying machine. The capacity of the refrigerated dryer is 1 hp with compressor of 715 W. The wet mass of the briquette was 132 kg distributed on 8 shelves. It was targeted to be 100 kg dry briquette. The dimension of a briquette was 2.5 cm x 2.5 cm x 2.5 cm. In a kilogram, there were 72 pieces. Before the briquettes were put in the oven, they were aerated for 2 hours.

The collected data of the experiment was the psychrometric data of the refrigerated dryer inlet and outlet air. The dry bulb of the inlet was the oven temperature. The working pressures and pressure of the vapor compression cycle were collected from the data sheet. These data are used to find the temperature of the air leaving evaporator and leaving the condenser. The performance was calculated from the enthalpies obtained from the ph-diagram of the R-290 refrigerant following Eq. 1-4.

To determine completion of drying process, the condensed water was collected and measure. The collected water was assumed to be mass difference of the briquette. The measurement was conducted every three hours. When the weight of the briquette was 100 kg, the process was stopped. Some briquettes were collected for measuring its weight. In average, the weight of a briquette should be 13.8 g.

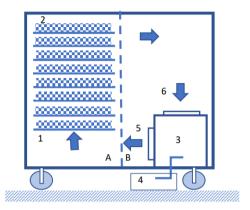


Fig. 4. The oven and the equipment setup.

3 Result And Discussion

Weight of the briquette shows refrigerated drying efficacy. Its weight is shown in Fig. 5 indicating that the weight of the briquette reduces following the exponential trend. This trend confirms the drying process of other materials. When the specific humidity of the air decreases, it needs more effort to reduce it. At the same time, the temperature of the air increases which also indicates higher enthalpy of the air. Assuming that the machine has constant COP, it implies that the machine efficacy decreases with the time due to psychrometric character of the air. The drying reduces specific humidity of the air by time. Loop of the cycle in psychrometric chart is getting small as shown in Fig. 6a, Fig. 6b, and Fig. 6c. Technically, the machine can't remove the vapor anymore, as the A – B line is overlapping with C – D line. At this condition, the refrigerated drying work as the thermal drying capacity which depends on relative humidity only. The psychrometric charts show that the relative humidity of the air in such condition is around 8%, with temperature of 55°C. These psychrometric conditions are comparable to other works [10,11].

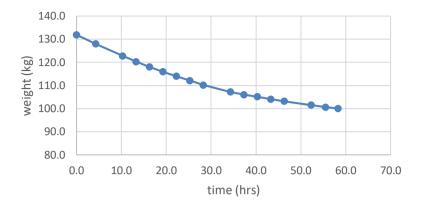


Fig. 5. The weight of the briquette over time. In 59 hours, the drying is completed.

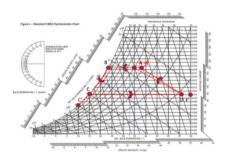


Figure 1- Burlan CHEI Perhamento Cual

Fig. 6. a. The air cycle at 5 hours drying.

Fig. 6. b. The air cycle at 25 hours drying

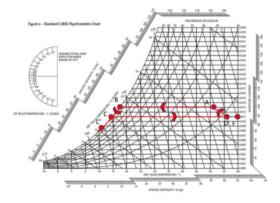


Fig. 6. c. The air cycle at 55 hours drying

The working pressures and temperature of refrigerant on the evaporator and condenser is shown in Table 1. The R-290 refrigerant worked at 6.326 bar and 21.179 bar in evaporator and condenser respectively. The temperature of the evaporator and condenser in respective order were 10°C and 60°C. These parameters indicate that the vapor compression cycle did not have any superheating nor subcooling as shown in Fig. 7. The figure shows the enthalpy of the refrigerant as shown in Table 2.

Table 1. The working pressure and temperature of the evaporator and condenser of the refrigerated drying.

Refriger- ant	Evaporator Working Pressure (P _I) (bar)	Condenser Working Pressure (P ₂) (bar)	Evaporator Working Temperature (Tevap.) (°C)	Condenser Working Temperature (T _{cond.}) (°C)
R-290	6.326	21.179	10	60

Table 2. The enthalpy of the vapor compression cycle of *refrigerated drying*.

Refrigerant -		Ent	halpy	
Kenngerant -	h_I (kJ/kg)	$h_2 (kJ/kg)$	h_3 (kJ/kg)	$h_4 (kJ/kg)$
R-290	583.92	623.08	364.68	364.68

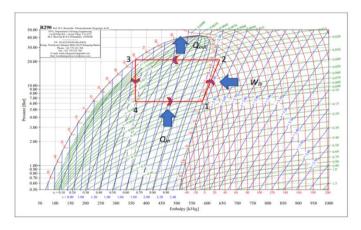


Fig. 7. The vapor compression cycle of R-290.

The performance of the vapor compression cycle of the refrigerated drying can be calculated following Eq. 1-4 using the data of Table 2. The COP of the system is 12.20, with Q_{in} and Q_{out} of 219.24 kJ/kg and 258.40 kJ/kg respectively. The work of the compressor (Win) is 39.16 kJ/kg. Every kilogram refrigerant cycle, it creates 258.40 kJ enthalpy effect drying through cooling process in condenser. This cooling effect is applied for condensing the water vapor and reducing the air temperature. Meanwhile, the heating up temperature is 219.24 kJ for every kg refrigerant cycle. This heating effect is bigger than its work. This performance was also mentioned in [10,11,12].

Comparing to the thermal drying that depends on heating up process only, the refrigerated drying has two advantages which are the explanation of list by Butz and Schwarz [11]. First advantage comes from the drying effect on cooling process which reducing water vapor content of the air. Less vapor part of the air is very significant in drying process. Secondly, this alleviation of absolute humidity process provides low enthalpy air which is easier for heating up in heating process. The direct drying has to increase the air temperature with higher water vapor content. The water vapor heat capacity is far greater than the dry air, so reducing water content first is very useful in drying process. Reducing water content allows less heat specific of the air.

4 Conclusion

The refrigerated drying oven was proposed for producing coconut shell charcoal briquette. The oven provides higher efficacy because of cooling effect and heating effect. The total COP of the system was 12.20, which is far higher than conventional approach using thermal drying. The method provides less energy cost of briquettes processing. The drying process was 58.25 hours for 100 kg charcoal briquette.

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