



The Interaction Effect of CaCO₃ Composition, Injection Temperature, and Injection Pressure on the Tensile Strength and Hardness of Recycled HDPE

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Abstract. The mechanical properties of recycled High-Density Polyethylene (rHDPE) are inferior compared to non-recycled HDPE. To overcome this problem, Calcium Carbonate (CaCO₃) is added to improve the material's mechanical properties. The temperature and injection pressure changes can affect the material's mechanical properties. This research uses a factorial design methodology with two replications to investigate the interaction effect of the CaCO₃ composition, injection temperature, and injection pressure on recycled HDPE's tensile strength and hardness. The results showed that the interaction between the CaCO₃ composition and temperature, the CaCO₃ composition and pressure, and temperature and injection pressure increase the value of tensile strength. The interaction among the three independent variables at a high level has the most influence on tensile strength. The hardness value is influenced by the interaction between the CaCO₃ composition and temperature, the CaCO₃ composition and pressure, and temperature and injection pressure at all levels. The presence of CaCO₃ has the most significant effect on the specimen's hardness. However, the interaction with temperature and pressure reduces the effect of CaCO₃ in increasing the hardness value.

Keywords: Interaction Effect, CaCO₃ Composition, Injection Parameters, Mechanical Properties, Recycled HDPE.

1 Introduction

High-Density Polyethylene (HDPE) is a thermoplastic polymer made from petroleum. It is the largest constituent of plastic waste and is required to be recycled. The mechanical properties of recycled HDPE (rHDPE) are not the same as those of non-recycled HDPE. According to Tesfaw et al., the tensile strength of rHDPE is inferior to that of non-recycled HDPE [1]. The use of rHDPE as a mixture of non-recycled HDPE leads to an increase in manufacturing efficiency and reduces the extraction of non-recycled material. Manas et al. stated that the higher the percentage of rHDPE mixed with non-recycled HDPE, the lower the hardness value of the mixture [2]. To overcome the decrease in tensile stress of a mixture of non-recycled HDPE and rHDPE, calcium carbonate (CaCO₃) can be added to the mixture. CaCO₃ is one of the calcium salts that can

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be found in natural stone and limestone. The CaCO_3 has been added to fill thermoplastics for different applications in automotive, packaging, and construction [3, 4]. Previous research has been conducted to investigate the influence of CaCO_3 composition on HDPE. The tensile strength and ductility of the compound decrease as the percentage of CaCO_3 increases in the range of 5 to 20 percent [5]. And according to Kherici et al., the stiffness of the HDPE decreases with the addition of CaCO_3 from 10 to 35 percent [6]. In contrast, the research by Awan et al. showed that the addition of CaCO_3 in the range of 5 to 10 percent shows a significant improvement in mechanical results and results in an increase in tensile strength, toughness, impact strength, and hardness [7]. Alshammari et al. also reported that the tensile, flexural, and Izod impact strengths are improved as a function of CaCO_3 and fumed silica fillers loading in the HDPE matrix [8]. This research investigates the influence of CaCO_3 in the range of 5 to 25 percent. In addition, the increase in the percentage of nanoscale CaCO_3 from 5 to 20 percent increases the impact strength but does not decrease the yield strength of HDPE [9]. Some researchers investigated the influence of the injection molding process parameters on the mechanical properties of the HDPE. Parameters of the injection molding process that can be varied are temperature, injection pressure, injection time, holding, and cooling time. The effect of the injection temperature and pressure on the mechanical properties of the HDPE is significant. Meanwhile, the injection time, the holding time, and the cooling time affect the production time. Zhu et al. stated that higher temperature and injection pressure increases tensile strength value [10]. Karagöz and Tuna found that a higher melting temperature decreases the strength of tensile and bending [11].

Other research has been conducted to investigate the influence of CaCO_3 on recycled HDPE. Atikler et al. found that the tensile strengths of CaCO_3 -filled compounds show a decreasing trend as the filler loading increases in the range of 10 to 40 percent [12]. The research by Ngothai et al. shows that the tensile strength of the mixture of non-recycled HDPE and rHDPE is slightly affected by the particle size of CaCO_3 , where the smaller the size, the greater the tensile strength [13]. In addition, the tensile strength of the composites tends to increase with the increase of CaCO_3 in the range of 10 to 40 percent.

According to the literature, the mechanical properties of HDPE and rHDPE are influenced by the composition of CaCO_3 and various process parameters of injection molding. The results of previous studies indicate that there are different conclusions about the effect of CaCO_3 on the mechanical properties of HDPE and rHDPE. In addition, it is important to understand the influence of the CaCO_3 composition and injection molding process parameters interaction to improve the mechanical properties of the rHDPE, as the interaction among them may bring different effects compared to the influence of each of them. This research aims to investigate the interaction effect of CaCO_3 composition, injection temperature, and injection pressure on the tensile strength and hardness of recycled HDPE.

2 Materials and Methods

The rHDPE used in this research is made of pure HDPE HD5218EA plastic pellets that had been processed by using an injection molding machine, as shown in Figure 1. The pure HDPE plastic pellet has a melt flow index of 18 g/10 min and a 950 kg/m² nominal density. The pure HDPE material is heated until it is softened, injected into a mold in the shape of the desired final object, and then cooled until it solidifies again. The injection temperature used to produce the rHDPE is 160 °C and the injection pressure is 150 bar. The final object of the injection molding process is a tensile test specimen according to ASTM D638, as shown in Figure 2 [14]. After that, the tensile test specimen made of HDPE is cut into small pieces by using a crusher machine to produce the recycled HDPE material. The crusher has a 7.5 mm mesh to ensure that the rHDPE size becomes smaller than 7.5 mm.



Fig. 1. Injection molding machine.

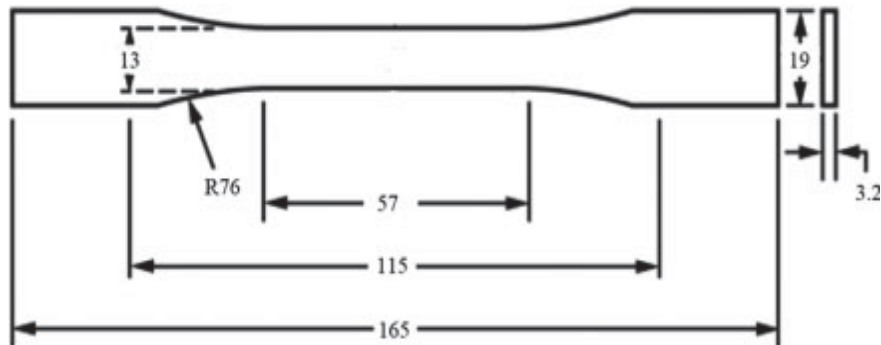


Fig. 2. Tensile test specimen.

The type of CaCO_3 used in this research is Precipitated Calcium Carbonate. Before the experiment began, CaCO_3 was crushed into powder form. The weight of CaCO_3 and rHDPE is measured by using a digital scale according to the investigated composition of CaCO_3 and rHDPE. Then, the CaCO_3 is mixed with the small piece of rHDPE using a mixer until they are mixed evenly. The investigated values of the CaCO_3 composition are 10%, 20%, and 30%. This value is determined based on the preliminary experiment result. The preliminary experiment showed that the composition of CaCO_3 up to 30 % increases the tensile strength and hardness of the rHDPE. However, the CaCO_3 composition above 30 % reduces the tensile strength and increases the hardness of the rHDPE.

The injection temperature values investigated in this research are 140 °C, 150 °C, and 160 °C. This lowest value is determined based on the melting temperature of HDPE, which is 130 °C. The highest temperature used is 160 °C to ensure that the injection molding process uses the lowest energy for heating. The injection pressure parameter values used in the research are 115 bar, 130 bar, and 145 bar. Based on the preliminary experiments, the use of a pressure of 100 bar resulted in poor specimens because the melted rHDPE had not fully filled the cavity and instead blocked the runner. The use of an injection pressure value of 160 bar for injection temperatures ranging from 150 °C to 170 °C produces flashing because the clamping force cannot hold the pressurized melted rHDPE inside the cavity.

This research uses factorial design methodology with two replications to find the effect of the interaction of CaCO_3 composition, injection temperature, and injection pressure on the tensile strength and hardness of rHDPE. The response variables of this research are tensile strength and hardness. The independent variables are CaCO_3 composition, injection temperature, and injection pressure. The values of each independent variable are divided into three levels. The values for each level are shown in Table 1. The research conducts $3^3 \times 2$ equal to 54 experiments to print 54 tensile test specimens according to ASTM D638, as shown in Figure 2.

Table 1. Value of each independent variable.

Parameters	Levels		
	Low	Middle	High
CaCO_3 percentage (%)	10	20	30
Injection temperature (°C)	140	150	160
Injection pressure (bar)	115	130	145

The tensile strength value of each specimen is measured using a Universal Testing Machine GT 7001-L30 universal testing machine manufactured by GOTECH Testing Machines Inc. The hardness value of each specimen is measured using the Shore D durometer according to the ASTM D2240 standard for the hardness test [14]. The durometer has a range between 0 and 100 HD with 0.5 HD resolution.

3 Results and Discussion

The average tensile strength value of the specimens that are injected using various values of CaCO₃ composition, injection temperature, and injection pressure are shown in Table 2. The data is analyzed using Analysis of Variance (ANOVA) to determine the effect at each independent variable value. Then, the result of the experiment is followed up by an experiment geometry analysis to determine the quantitative effect of the interaction of the parameters. The experiment geometry is carried out to calculate the magnitude of the effect on the response variable influenced by the value change of the interaction between or among the independent variables.

Table 2. Average tensile strength value.

Temperature	Pressure	10% CaCO ₃	20% CaCO ₃	30% CaCO ₃
140 °C	115 Bar	11.44	11.02	11.23
140 °C	130 Bar	10.82	11.29	10.96
140 °C	145 Bar	10.90	11.21	10.79
150 °C	115 Bar	11.66	11.94	10.60
150 °C	130 Bar	11.65	11.26	12.49
150 °C	145 Bar	11.50	12.14	13.29
160 °C	115 Bar	11.77	11.07	11.81
160 °C	130 Bar	11.89	11.31	12.82
160 °C	145 Bar	10.95	11.83	14.47

Based on the results of the ANOVA analysis in terms of the tensile strength response, the interaction of the CaCO₃ composition - temperature, CaCO₃ composition - injection pressure, and the interaction of the CaCO₃ composition – temperature – injection pressure has a significant influence on the tensile strength of the specimen. However, the interaction of temperature with injection pressure has a less significant effect.

The results of the experiment geometry calculation for tensile strength are shown in Figure 3. The interaction value shows that the increase or the decrease in tensile strength value is caused by the interaction of two or three independent variables for each level. The figure indicates a result similar to that of the result of ANOVA analysis. The interaction between the CaCO₃ composition and temperature, the interaction between the CaCO₃ composition and pressure, and the interaction between temperature and injection pressure increase the tensile strength value. In each interaction, the CaCO₃ composition only increases the tensile strength value at medium to high levels. The highest increase in tensile strength is influenced by the interaction between the three independent variables at a high level. The interaction between the three independent variables at a high level increases the value of tensile strength by 1.55.

The increase in the percentage of CaCO₃ increases the value of tensile strength because the presence of CaCO₃ increases the degree of crystallinity degree and the entropy of crystallization of rHDPE [16]. As a result, it increases the strength of the molecular bonds of the rHDPE. The presence of CaCO₃ also increases the density and increases

the interaction between materials [17]. Consequently, the tensile strength increases. However, the interaction between CaCO₃ and other process parameters at a low level decreases the tensile strength value. At a low level of temperature, the crystalline ratio decreases and the molecular bonds of the rHDPE with CaCO₃ are weakened [11]. At a low injection pressure level, the molecular structure between CaCO₃ and rHDPE is less dense than that at high-level pressure [18].

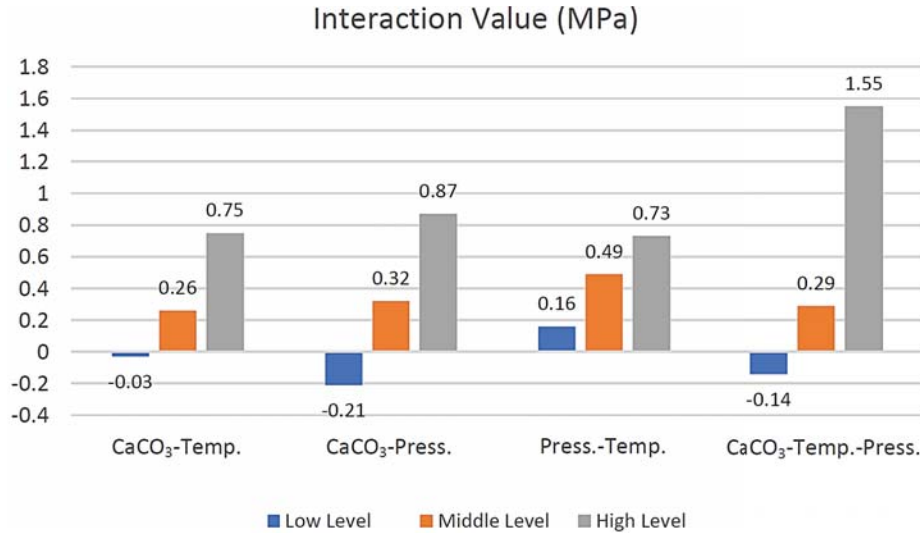


Fig. 3. Interaction value of the tensile strength.

Table 3 shows the average hardness value of the specimens that are injected using various values of the composition of CaCO₃, the injection temperature, and the injection pressure. The result of ANOVA shows that only the interaction of the CaCO₃ composition with temperature significantly influences the hardness of the specimen. The interaction of the CaCO₃ composition with temperature increases the hardness of the specimen by 2.16. Meanwhile, the other interactions have a less significant effect.

Table 3. Average hardness value.

Temperature	Pressure	10% CaCO ₃	20% CaCO ₃	30% CaCO ₃
140 °C	115 Bar	45.75	49.75	50.92
140 °C	130 Bar	46.42	48.50	49.08
140 °C	145 Bar	46.50	49.42	50.33
150 °C	115 Bar	47.17	49.33	51.00
150 °C	130 Bar	47.25	49.83	50.97
150 °C	145 Bar	46.67	49.17	50.92
160 °C	115 Bar	46.33	48.23	48.92
160 °C	130 Bar	46.08	47.51	51.25

160 °C 145 Bar 46.92 49.83 52.50

Figure 4 shows the results of the experiment geometry calculation for the specimen's hardness. The interaction value indicates the influence of the interaction of two or three independent variables for each level on the hardness value. The figure shows that the interaction between the CaCO₃ composition and temperature, the interaction between the CaCO₃ composition and pressure, and the interaction between temperature and injection pressure at all levels increase the hardness value. The increase of the hardness is influenced by the interaction among the three independent variables only at medium and high levels.

The presence of CaCO₃ has the most significant effect on the specimen's hardness. CaCO₃ has a higher density compared to HDPE material. Therefore, CaCO₃ as a filler increases the density of the rHDPE specimen and the interaction between the materials. As a result, the increase of CaCO₃ percentage increases the hardness value. However, the interaction with temperature and pressure reduces the effect of CaCO₃, as the crystalline ratio, the molecular bonding between CaCO₃ and rHDPE, and the molecular structure of CaCO₃ and rHDPE mixture may significantly reduce the effect of CaCO₃ in increasing the hardness value. The interaction with temperature influences the hardness value, as the temperature influences the crystalline ratio and the molecular bonds of the rHDPE. In addition, the interaction with injection pressure influences the hardness value because the pressure affects the molecular structure of the CaCO₃ and rHDPE mixture.

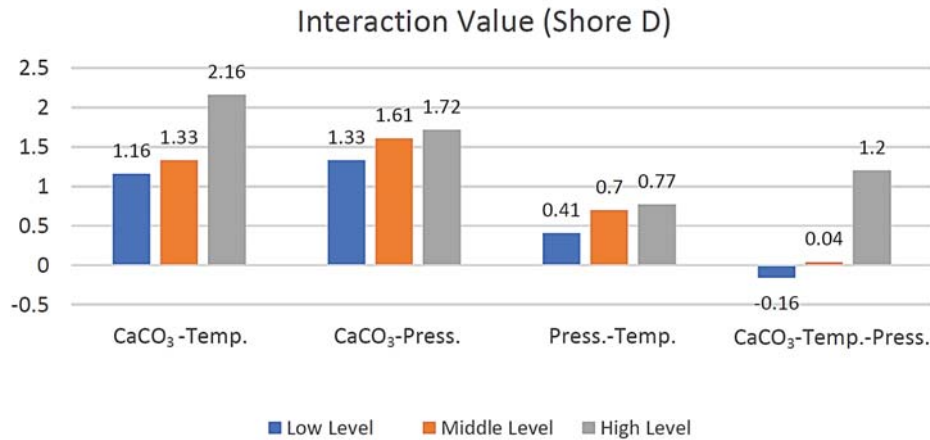


Fig. 4. Interaction value of the hardness.

4 Conclusions

This research investigates the interaction effect of the CaCO₃ composition, injection temperature, and injection pressure on recycled HDPE's tensile strength and hardness. The result shows that the interaction between the CaCO₃ composition and temperature,

CaCO₃ composition and pressure, and temperature and injection pressure increase the value of tensile strength. The percentage of CaCO₃ influences the value of tensile strength because the presence of CaCO₃ influences the degree of crystallinity degree, the entropy of crystallization of rHDPE, the density, and the interaction between materials. The increase in the percentage of CaCO₃ increases the value of tensile strength. The temperature affects the crystalline ratio and the molecular bonds of the rHDPE with CaCO₃. The increase in crystalline ratio and the molecular bonds increases the tensile strength. The injection pressure influences the molecular structure between CaCO₃ and rHDPE. The denser the molecular structure between CaCO₃ and rHDPE increases the tensile strength. Therefore, the interaction among the three independent variables at a high level has the greatest influence on tensile strength. The interaction between the three independent variables at a high level increases the value of tensile strength by 1.55. In addition, the hardness value is influenced by the interaction between the CaCO₃ composition and temperature, CaCO₃ composition and pressure, and temperature and injection pressure at all levels. The interaction of the CaCO₃ composition with temperature increases the hardness of the specimen by 2.16. The presence of CaCO₃ has the most significant effect on the specimen's hardness. CaCO₃ increases the density of the rHDPE specimen and the interaction between the materials. As a result, the presence of CaCO₃ increases the hardness of the specimen. The temperature affects the crystalline ratio of the rHDPE with CaCO₃. The decrease in crystalline ratio decreases the hardness. The injection pressure influences the molecular size of CaCO₃ and rHDPE. The coarser the molecule of the specimen, the less the hardness value of the specimen. Therefore, the interaction with temperature and pressure reduces the effect of CaCO₃, as the crystalline ratio and the molecular bonding between CaCO₃ and rHDPE reduce the effect of CaCO₃ in increasing the hardness value.

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Yenny Sari, Amelia Santoso, Nadia Angelina Putri Pangestu

The high number of defective products can cause the company to receive many complaints. This research aimed to apply the quality improvement approach i.e., the DMAIC methodology (Define-Measure-Analysis-Improve-Control), to reduce product defect. The object of discussion was the black-color cloth hangers...

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Behavior of Vehicle Platoon with Limited Output Information Based on Constant Time Heading

Agung Prayitno, Veronica Indrawati, Pyae Pyae Phyoe

This paper presents synchronization of vehicle platoon with limited-output information based on constant time heading spacing policy. Two control schemes, namely neighborhood controller neighborhood observer and neighborhood controller local observer designed based on constant time heading will be applied...

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The Interaction Effect of CaCO_3 Composition, Injection Temperature, and Injection Pressure on the Tensile Strength

and Hardness of Recycled HDPE

Hendra Prasetyo, Yon Haryono, The Jaya Suteja

The mechanical properties of recycled High-Density Polyethylene (HDPE) are inferior compared to non-recycled HDPE. To overcome this problem, Calcium Carbonate (CaCO₃) is added to improve the material's mechanical properties. The temperature and injection pressure changes can affect the material's mechanical...

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Comparing the Effects of Efficiency and Distortion in Audio Power Amplifiers with and without Tracking Power Supply Circuit Design

Yohanes Gunawan Yusuf, Veronica Indrawati

This research aims to compare the effects of efficiency and distortion in Audio Power Amplifiers with and without Tracking Power Supply (TPS) circuit design. The TPS circuit design is known for enhancing power efficiency while keeping low distortion in the amplifiers. This paper examined the performance...

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Risk Analysis to Mitigate Dominant Risk of Electrical Infrastructure Construction

Salim Afif, Moses Laksono Singgih

Over the past 5 years, the achievement of the Risk Maturity Model (RMM) level value at PT PLN (Persero) UID Bali has not yet reached the target with

a gap of 0.47 from the target of 4.19 at the end of 2024. The company's lack of optimization in using the budget period 2018-2023 may be an indicator that...

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Reducing Procurement Waiting Time through Lean Six Sigma

Bagoes Iman Prakoso, Moses Laksono Singgih

A Mass Transportation Manufacturer (MTM) is a pseudonym for the company's name as the subject in this study, faces significant challenges in its procurement process, particularly in acquiring components from foreign suppliers, which often results in prolonged delays. This delay in procurement has a direct...

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A Model for Evaluating the Impact of Priority Rules on Flow Time and Wait Time In A Job Shop Scheduling System: A Single Machine Case

Muhammad Usman Nisar, Andi Cakravastia Arisaputra Raja, Anas Ma'ruf, Abdul Hakim Halim

In the dynamic realm of job shop scheduling (JSS), where decisions regarding the order of job processing have a significant impact on the initial state and performance of the system, addressing the effects of priority changes becomes crucial. To address this challenge, the first part of the study proposes...

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Modeling and Optimization of Location Selection of Fuel Terminal Considering Vessels and Pipeline Operations

F. Qudsi, R. T. Cahyono, N. F. Sa'idah

This study discusses mathematical modeling using the mixed-integer linear programming (MILP) technique for selecting the optimal fuel terminal location which considers not only aspects of ship and pipeline transportation, but also marine technical aspects. In addition, coverage days are also included...

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Lean Six Sigma and TRIZ to Reduce Non-Value-Added Activities of the Transformer Production Process

Adritho Zaifar, Moses Laksono Singgih

Electronic Transformer Producer (ETP, a nickname) is electronic transformer manufacturing and distribution in Indonesia. The company has encountered challenges in meeting the escalating demands for both quantity and quality from its clientele. Concurrently, the company strives to curtail superfluous...

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Driving Growth in Village Industries: Exploring Effective

Financing Facilities for Micro and Small Enterprises

Gunawan

The challenge of financing for micro and small manufacturing enterprises is a global issue but needs local solutions, as the industry characteristics and financing facilities are different among countries and even within countries. In the post-pandemic period, recovering micro and small industries in...

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Remarshaling in A Bin-to-Person-based Smart Automated Warehouse

Ivan Kristianto Singgih, Mai-Ha Phan, Indri Hapsari

In a bin-to-person warehouse, robots lift and then transport racks that contain items from the replenishment area to the storage area and from the storage area to the pickup area. In such an automated warehouse, it is necessary to ensure smooth item flows. One of the important decisions is on which racks...

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Comparison of Classification Machine Learning Models for Production Flow Analysis in a Semiconductor Fab

Ivan Kristianto Singgih, Stefanus Soegiharto, Arida Ferti Syafiandini

A semiconductor fab has complex wafer lot movements between machines and workstations. To ensure a smooth flow of the wafer lots, the system must be observed appropriately. Observation of such a complicated system

is possible using machine learning. In this study, various machine learning techniques...

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Circular Economy at LNG Bontang Company: Transforming Aluminum Jacketing Waste Into Sacrificial Anode Products

Defi Willy Simanjuntak, Moses Laksono Singgih

In the industrial activities of the company, one of the crucial considerations and management aspects is waste. At PT. Badak NGL, an existing environmental issue pertains to aluminum jacketing waste. This waste emanates from the factory's operational activities, thereby presenting an opportunity for...

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Restructuring Job Design Using Job Analysis to Balance Workload and Enhance Productivity

Revy Maghriza, Moses Laksono Singgih

One logistics company in Indonesia has experienced a drastic increase of 60% in the demand for imported goods from 2018 to 2022. This upward trend is expected to continue. The admin staff, leader, and supervisor of the Export-Import Department feel the direct impact and are experiencing a higher workload...

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Design of Mid Drive Electric Cargo Bike for Urban Area

Sunardi Tjandra, Susila Candra, Albertus Agung Jody Saputra, Yehezkiel D. Faraisc Putra

Some couriers use bicycles for work. However, it is not efficient because relies on their stamina, which can affect the delivery duration and capacity. E-bike can be a solution to this problem. However, its price is unaffordable for most couriers. It is necessary to modify the couriers' bicycles into...

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The House of Risk with Multi-Actor Approach Aligned with ISO 31000:2018 for Effective Risk Management in Business with Risky Environment

Evy Herowati, Rosita Meitha Surjani, I Made Panca Bayu Tarsa Ragacca

Effective risk management requires a thorough comprehension of risks and the involvement of multiple actors in the process. In conjunction with the internationally recognized ISO 31000 standard, the House of Risk (HOR) framework provides a robust approach to risk management. This article examines the...

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Centralized AGV Control Systems based on OutsealESP32 PLC and ESP-NOW Protocol

Fransiscus Xaverius Florenza, Hendi Wicaksono Agung

In this paper, a centralized wireless AGV control system is presented using the OE32-PLC board. The OutsealESP32 PLC (O32-PLC) is a combination of the Outseal PLC Mega and the ESP32. Wire-less communication is carried out using the ESP-NOW protocol. The system is divided into three sections according...

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Improving Loading and Unloading Performance at Patimban Port Car Terminal with a Lean Strategy

Yanuar Ardiansyah, Moses Laksono Singgih

Patimban Port located in Subang, West Java, has gained recognition as a National Strategic Project. Its operations, which commenced in December 2020, area primarily designed to optimize the Car Terminal's functionality. This terminal facilitates the loading and unloading of Completely Built Up (CBU)...

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The Influence of Noise Factors on Concentration Based on EEG Signal

Rahmaniyah Dwi Astuti, Rahma Sabilah Nurbi, Bambang Suhardi, Pringgo Widyo Laksono, Irwan Iftadi

The noise intensity with different levels can affect human cognitive abilities, performance, and brain activity. Human cognitive performance, especially concentration, is needed when doing work activities. However, there are still few studies related to the effect of continuous noise in the textile industry...

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Indonesia e-Bike Consumer Preference Trough Market Potential Research: A Choice-Based Conjoint Analysis

Andi Ameera Sayaka Cakravastia, Anas Ma'ruf

E-bike is gaining popularity and accelerating the bike industry to speed up new product development. This study aims to identify e-bike preferences desired by consumers through market research. The choice-based conjoint method analyzes consumer preferences, forecasts potential e-bike market share, and...

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Electric Vehicle Charging Allocation Considering Electricity Price Fluctuation

Ivan Kristianto Singgih, Christian Yavin Ibrahim, Stefanus Soegiharto, Olyvia Novawanda

Charging decisions on electric vehicles is an important aspect to consider for ensuring the continuity of the electric vehicle demand satisfaction. An electric vehicle system could not operate well without sufficient resources for charging each vehicle's battery after its use. In this study, we...

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Overview of Ergonomics and Safety Aspects of Human-

Cobot Interaction in the Manufacturing Industry

Muhammad Ragil Suryoputro, Tieling Zhang, Senevi Kiridena

The technological advancements accompanied by Industry 4.0 have created more opportunities for collaborative interactions between humans and machines. In work environments where humans work alongside collaborative robots (i.e., cobots), there is a critical need to address ergonomics and occupational...

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Affective-based Human Factors Design: Design Thinking & Sustainability Approach

Markus Hartono

This paper proposes a refined framework of affect/Kansei-based applied to product/service experience considering design thinking and sustainability approaches. Design thinking facilitates more comprehensive step-by-step methodology starting with more human basic needs, followed by the global issues which...

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Performance Evaluation of Roof Tile Solar PV under Tropical Climate of Surabaya, Indonesia

Elieser Tarigan, Fitri Dwi Kartikasari, Fenny Irawati, Rafina Destiarti Ainul, Pradiksa Pratyahara Kirana

This paper discusses the applications of roof tiles type of PV modules. Published researches on this topic were reviewed. In addition, performance

evaluation of a roof tile type of PV modules was conducted under the tropical climate of Surabaya, Indonesia. The objectives of present study are to review...

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Pillared Interlayered Clays (PILCs): Harnessing Their Potential as Adsorbents and Catalysts - A Mini Review

Restu Kartiko Widi

The Pillared Interlayered Clays (PILCs) have attracted significant attention in recent years due to their versatile applications as adsorbents and catalysts in various environmental and industrial processes. This mini review presents a comprehensive overview of the recent researches conducted on PILCs...

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Implementation of K-Means and K-Nearest Neighbor Methods for Laptop Recommendation Websites

Vincentius Riandaru Prasetyo, Mohammad Farid Naufal, Budiarjo

Along with technology development, laptops are becoming increasingly popular and are handy tools in everyday life. However, with so many brands and laptops available, people often find it difficult and need help choosing the laptop that best suits their needs and desires. A website-based system has been...

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Implementation of Recency, Frequency, and Monetary Patterns in Adaptive Blockchain-Based Transactions

Daniel Soesanto, Igi Ardiyanto, Teguh Bharata Adji

The development of cryptocurrency cannot be separated from the development of blockchain technology. However, problems arise related to the scalability of the blockchain itself. The long duration of the consensus process means that the scalability of the blockchain cannot increase. Various methods have...

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Electronic Election for Small Medium Non-Profit Organizations in Indonesian Cities

Felix Handani

Elections in Indonesia often include direct voting, enabling every community member to immediately contribute to the election process and support their chosen leader. The digital divide, the security of data and systems, verification and transparency, and the legal and social-cultural acceptance of online...

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Online Claim and Guarantee Mechanism for Electronics Peripheral in Urban Country

Liliana, Felix Handani, Daniel Soesanto, Maya Hilda Lestari Louk

According to consumer protection law, business actors must provide good services, including post-transaction services. Most of the current warranty claim process is still done conventionally, where consumers must come to the store to bring their documents and goods and ask the officer for the repair...

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Perceived Usability Evaluation of IRiS: an Integrated Recommendation Collection System

Jimmy, Kristian Tanuwijaya

This study evaluates the perceived usability of IRiS, which was developed to collect recommendations from senators related to the election of principals in the University of Surabaya (UBAYA). The primary question of this study was "Will IRiS be usable for all senators to use as intended?". The answer...

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Incorporating Interactive Elements into Children's Storybook to Improve Children's Motivation to Learn Bible: Case Study on the Parable of the Sower

Ng Melissa Angga, Tyrza Adelia, Jiechella Davidson

Christian children frequently show low enthusiasm in learning the Bible due to difficulties in understanding the language and unappealing content for their taste. Moreover, their motivation towards Bible studies getting even lower by the exposure to more captivating multimedia products available in this...

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Development of Artificial Immune System in Multi-Objective Vehicle Routing Problem with Time Windows

Iris Martin, Eric Wibisono

Setting logistics routes and product distribution in everyday problems, such as delivery of fresh products, requires an algorithm that can produce decisions in a short time. This type of problem belongs to a methodology popularly known as the vehicle routing problem (VRP). VRP is NP-Hard, and its complexity...

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Has Website Design using Website Builder Fulfilled Usability Aspects? A Study Case of Three Website Builders

Argo Hadi Kusumo

The significance of e-commerce is particularly crucial for businesses. The enhancement of sales can be achieved through the contribution of e-commerce. In the current era of digitalization, it is unnecessary for SMEs to develop e-commerce platforms from scratch. Instead, they can opt for affordable website...

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Design of Employee Bus Routes for Madiun City Government Based on Home Locations and Presence Location History

Daniel Hary Prasetyo, Arizia Aulia Aziiza, Endang Sulistiyani

Madiun City is strategically positioned as the center of regional activities in the western part of East Java Province. Based on the data presented for the City of Madiun in Figures for 2022, the number of residents and private vehicle units is almost the same. Hence, road congestion is likely to occur....

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Arabic Letter Classification Using Convolutional Neural Networks for Learning to Write Quran

Mohammad Farid Naufal, Muhammad Zain Fawwaz Nuruddin Siswantoro, Andre

Learning to write the Arabic language, particularly the Arabic letters used in the Quran, is essential for individuals who aim to understand and recite

the holy book accurately. In this research, we propose a classification method utilizing Convolutional Neural Networks (CNNs) with MobileNet architecture...

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Alveolar Bone Quality Classification from Dental Cone Beam Computed Tomography Images using YOLOv4-tiny

Monica Wideasri, Nanik Suciati, Chastine Fatichah, Eha Renwi Astuti, Ramadhan Hardani Putra, Agus Zainal Arifin

Bone quality is essential in dental implant planning for successful implant placement. Bone quality can be determined based on bone density observed from Beam Computed Tomography (CBCT) images which are commonly used in dental implant planning. The most accepted classification of alveolar bone quality...

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Exploring the Impact of Mobile-Based 3D Simulation on Student's Achievement and Satisfaction in Physics Education

Lisana Lisana, Edwin Pramana

The purpose of this study is to investigate the efficacy of utilizing a mobile-based 3D simulation to support students in the 11th grade in their learning of physics. The precise subject matter that was selected for this piece of research was the equilibrium of rigid bodies. There were 91 students from...

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An Encrypted QR Code Using Layered Numeral Calculation for Low Powered Devices

Rafina Destiarti Ainul, Susilo Wibowo, Irzal Zaini

Providing security system for every electronic data exchange through internet as the unsecured medium has become an essential regulation. Conventional Caesar Cipher had less computation complexity than other security method that really appropriate with low powered device requirement. However, it is susceptible...

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Spices Identification in Essential Oil Producers using Comparasion of KNN and Naïve Bayes Classifier

Fifin Ayu Mufarroha, Achmad Zain Nur, Mohammad Rizal Rahabillah, Achmad Jauhari, Devie Rosa Anamisa, Mulaab

Indonesia is a spice-growing country, providing a variety of spices with numerous health advantages. Aside from being a producer, Indonesia is the world's largest supplier of spices. Spices have a wide range of usage, including food ingredients, herbal medicines, and essential oils. Essential oils are...

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Long Short-Term Memory Method Based on Normalization

Data For Forecasting Analysis of Madura Ginger Selling Price

Devie Rosa Anamisa, Fifin Ayu Mufarroha, Achmad Jauhari, Muhammad Yusuf, Bain Khusnul Khotimah, Ahmad Farisul Haq

Forecasting is a method for estimating a future value using past data. The selling price of Madura ginger needs a forecasting analysis to predict future prices because, until now, the selling price has increased significantly. This analysis aims to increase trade business competition and maintain sales...

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Analyzing the Probability Density Distribution of Sustained Phoneme Voice Features in the PC-GITA Dataset for Parkinson's Disease Identification

Nemuel Daniel Pah, Veronica Indrawati, Dinesh K. Kumar, Mohammod A. Motin

One of the possibilities for developing computerized diagnostic tools for Parkinson's disease (PD) is to utilize the voice change known as Parkinsonian dysarthria. Voice features extracted from sustained phonemes have been statistically investigated as parameters for this purpose. However, the commonly...

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Drowsiness Eye Detection using Convolutional Neural Network

Heru Arwoko, Susana Limanto, Endah Asmawati

Eye fatigue while driving can cause drivers to be drowsy and less alert, which can potentially increase the risk of an accident. Existing data shows that the number of accidents in the world is increasing from year to year. One of the most common causes of accidents is fatigue and the leading cause of...

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