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PREFACE

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TENSILE STRENGTH ANALYSIS OF AISI 1045 STEEL RESULTS OF SMAW WELDING USING VARIATIONS OF PREHEAT AND COOLING MEDIA

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Abstract. In the welding process, there are many factors that need to be considered, including heat input, cooling rate, the material being welded, and the use of added materials, if these factors are not considered, they can cause cracks in the American Iron & Steel Institute (AISI) 1045 material. to determine the effect of preheat variations on tensile strength, the effect of cooling media on tensile strength, and to determine the interaction of preheat variations and cooling media on tensile strength. This research method used experimentally by varying the preheat temperature 250ºC, 325ºC, 400ºC, and the cooling medium was lime, sand, and normal air, then tensile test was carried out. The results showed that the cooling medium affected the tensile strength with the highest tensile strength of 64.35 kg/mm^2 on the sand cooling medium, while the preheat variation had no effect on the tensile strength as shown by a graph close to the horizontal straight at the tensile strength ranging from 60 kg/mm^2, interaction between preheat and cooling medium has no effect on tensile strength. This is indicated by the tensile strength values that are almost close to each preheat point, namely at a temperature of 250ºC between 53-67 kg/mm^2, at 325ºC between 56-60 kg/mm^2, and a temperature of 400ºC between 51-64 kg/mm^2. In this study it can be concluded that a good cooling medium uses sand media with a preheat temperature of 250ºC.

Keywords : Tensile Strength, Cooling Media, Welding, Preheat, SMAW.

1. INTRODUCTION

Welding is widely used commercially for joining of metals and alloys at economical rates in various industries. [1]. In manufacturing, welding is an important process, because it is a part of component maintenance and repair activities. Despite, certain challenges associated with high hardness of heat affected zone and cold cracking susceptibility of joints, are the main barriers for this process to be implemented successfully within high integrity structure. [2]. One of the important indicators of metal welding is the strength of the welded joint. [3]. If the welded connection is not strong then there is a risk of structural failure. In the welding process, many factors must be considered, including the incoming heat, cooling rate, the material to be welded, and the use of additional materials. Therefore, welding must also pay attention to the mechanical properties and characteristics of the material being welded, such as whether a material requires heat treatment or not before being welded. [4]. Where the heat treatment will affect the cooling rate of the welded product, which then changes the material properties due to heat treatment and cooling rate. [5].

In an electric arc welding process, the heat distribution through the material at the beginning of the welding it is not homogeneous. This condition is known as a transient state. In theory, after a period of time and a certain distance it becomes uniform, meaning that the quasi-stationary state has been reached. The heat flow during the welding process has an important hole about phases transformations and consequentially about resulting

microstructure and materials mechanical properties. [6, 7, 8]. Preheat or preheating [9] is heat given to the parent metal at a certain temperature which is done to slow down the cooling rate so as to produce a metal structure that is more ductile and resistant to cracking. [10]. Research conducted by [11] and [12] early application of heat can increase the value of its tensile strength because the material will become more ductile. Moreover, preheating aims the reduction of the cooling rates and martensitic microstructure within the weld seam. [13, 14].

The importance of AISI 1045 Steel as engineering materials is reflected by the fact that out of the vast majority of engineering grade ferrous alloys available and used in the market today. AISI 1045 Steel is more resistive to cutting, welding, and forming as compared to low carbon steels. Improved tribological and mechanical properties [15] consisting of impact resistance, stiffness, abrasion, and strength are the main reasons for the increased attention of this steel in various industries. In the present scenario for the consolidation of important aspects of various heat treatments and effects on mechanical properties of this steel, a review of different research papers has been attempted. [16]. This study aims to determine the effect of variations in preheat and cooling media on the tensile strength of SMAW welding results. So that in its application it is expected to increase the strength of welded joints in a manufacturing process.

2. METHODS

2.1 Research Concept Framework

This research is included in experimental research because it is to find out the cause and effect relationship caused by the influence on the research process carried out. The independent variables in this study are variation of preheat (250°C, 325°C, and 400°C) and cooling medium (lime, sand, and normal air). The controlled variables in this study are the type of material and flow control. The dependent variable in this study is tensile strength.

Research methods at least describe the approaches used in research, population and research samples, explain the operational definition of variables along with data measurement tools or how to collect data, and data analysis methods. If the data measurement tool uses a questionnaire, it is necessary to include the results of the validity and reliability of the research instrument.

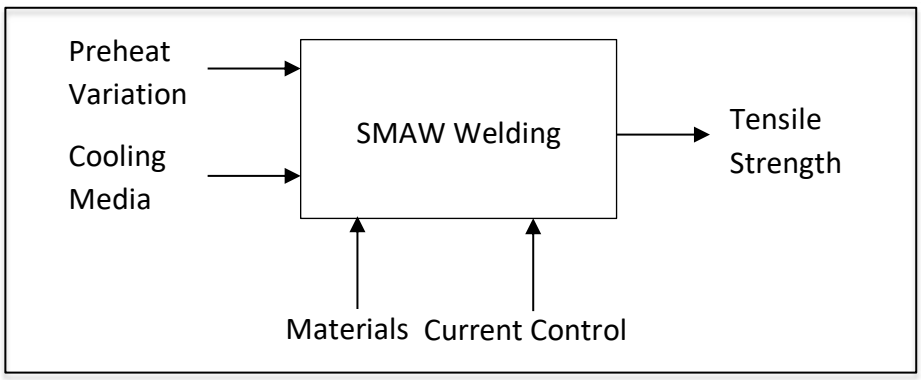

Figure 1. Research Concept Framework

2.2 Tools and Materials

Some of the tools and materials used in this research are:

1. SMAW and OAW welding machine
2. Electrode E7016
3. Welding glasses and hand grinder
4. Pliers, slag hammer, and steel brush
5. Thermocouple and vernier caliper
6. Drilling machine and tensile testing machine

2.3 Research Flowchart

The steps in conducting research follow the sequence of work as follows:

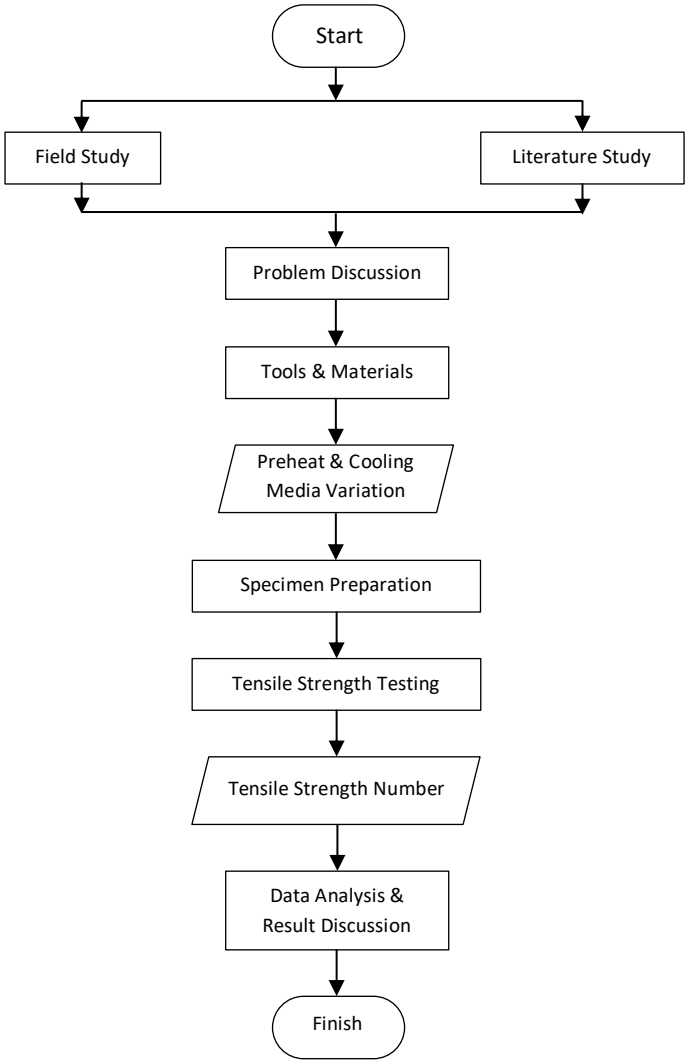

Figure 2. Research Flowchart

Research steps:

1. Learn the background of the problem and the concept of data collection.
2. Direct observation of the object of research and literature study is a literature study of books, journals and previous research.
3. Identify problems to find solutions to problems based on problem identification.
4. Prepare all equipment and materials that will be used as research variables.
5. Preheating is carried out before welding begins using preheat temperatures of 250°C, 325°C, and 400°C.
6. The media used to cool the material after preheating and welding SMAW with lime, sand, and normal air as cooling media.
7. Making tensile test specimens in accordance with British standards.
8. Tests to determine the tensile strength of SMAW welding results with variations in preheat and cooling media.
9. Analyze the data obtained from the tensile test and find out the influence of each variable. The data processing method used in this study is factorial ANOVA which is to determine the effect of variations in preheat and cooling media on the tensile strength of SMAW welding results.

3. RESULTS AND DISCUSSION

3.1 Tensile Strength Results

In this study, the tensile strength resulted in 4 discussions, namely tensile strength, yield value, total elongation, and plastic elongation, where all these parameters refer to previous research. [17]. The data obtained from the test is then calculated and processed, then displayed in the form of tables and graphs below:

Table 1. Tensile Strength Data

Preheat Temp.	Cooling Media		
	Lime	Sand	Normal Air
250⁰C	60.92	68.28	52.15
	47.19	67.09	60.53
	51.92	67.85	55.77
Average	**53.34 kg/mm²**	**67.74 kg/mm²**	**56.15 kg/mm²**
325⁰C	59.56	58.16	45.92
	53.01	62.82	69.29
	56.68	60.31	58.60
Average	**56.41 kg/mm²**	**60.43 kg/mm²**	**57.93 kg/mm²**
400⁰C	51.18	65.95	53.48
	52	65.70	50.98
	57.01	63.03	51.46
Average	**53.39 kg/mm²**	**64.89 kg/mm²**	**51.97 kg/mm²**

Table 2. Annova and Summary Model of Tensile Strength

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	8	700.23	87.53	3.37	0.015
Linear	4	569.01	142.25	5.47	0.005
Preheat	2	25.00	12.5	0.48	0.626
Cooling Media	2	544.01	272.00	10.46	0.001
2-Way Interactions	4	131.22	32.81	1.26	0.321
Preheat*Cooling Media	4	131.22	32.81	1.26	0.321
Error	18	468.20	26.01		
Total	26	1168.44			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
5.10013	59.93%	42.12%	9.84%

The ANOVA results show that the preheat variation has no significant effect where P-value > then the null hypothesis (H_0) is accepted, while the cooling medium shows the results where the cooling medium has a significant effect on the response P-value < then the null hypothesis (H_0) is rejected and the interaction of the two independent variables on the dependent variable (response) has no significant effect, then the null hypothesis (H_0) is accepted. The value of the determinant coefficient (R^2) is 59.93% where the two independent variables have a significant effect on the response, while 40.07% is influenced by errors and other factors that influence during the research.

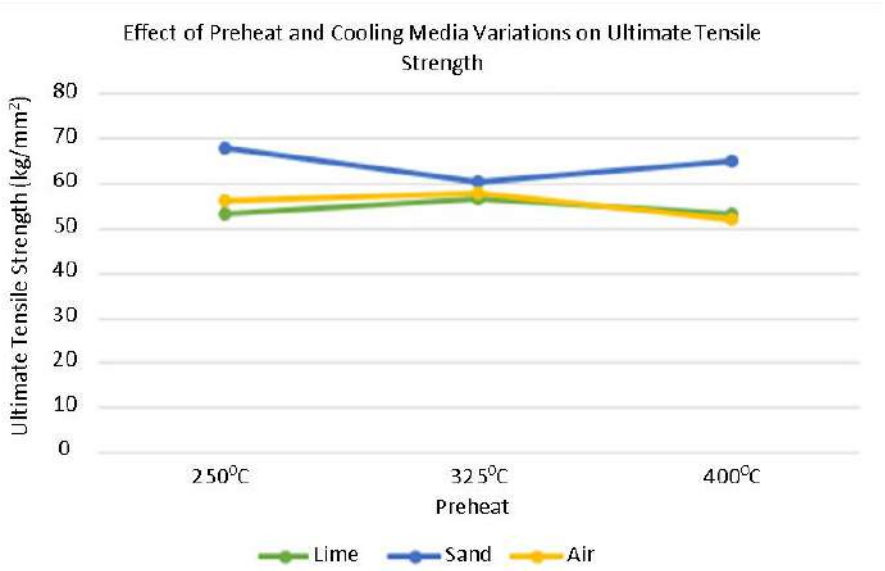

Figure 3. Ultimate Tensile Strength

The results on the graph show that the highest tensile strength value is produced at a temperature of 250°C and the cooling medium is sand at 67.74 kg/mm² while the lowest tensile strength value is 51.97 kg/mm² at a temperature of 400°C with normal air cooling. The results of the increase can be seen because the material is said to be brittle because of the fast cooling rate and it is possible to transform into mertensite so that it increases the tensile strength value, while the result is a decrease in tensile strength because the cooling rate of the material is slow so that it produces a ductile structure, because if the stress value is increases, the strain value will tend to decrease more. In the other words, the temperature distribution was affected by preheat temperatures, increasing the preheat temperatures leads to decrease the cooling rates. [18].

3.2 Yield Strength Results

The test results data for the yield strength values are shown in the following table.

Table 3. Yield Strength Data

Preheat Temp.	Cooling Media		
	Lime	Sand	Normal Air
250°C	60.28	66.52	50.70
	44.64	61.99	53.34
	48.71	62.85	50.09
Average	**51.21 kg/mm²**	**63.79 kg/mm²**	**51.38 kg/mm²**
325°C	58.18	54.92	36.05
	51.70	57.48	67.28
	52.89	55.28	51.19
Average	**54.25 kg/mm²**	**55.89 kg/mm²**	**51.51 kg/mm²**
400°C	43.79	65.29	53.24
	48.09	61.52	46.54
	45.39	57.33	47.15
Average	**45.76 kg/mm²**	**1.38 kg/mm²**	**48.98 kg/mm²**

Table 4. Annova and Summary Model of Yield Strength

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	8	803.1	100.38	2.46	0.053
Linear	4	634.15	158.54	3.89	0.019
Preheat	2	52.78	26.39	0.65	0.535
Cooling Media	2	581.37	290.69	7.13	0.005
2-Way Interactions	4	168.86	42.21	1.04	0.416
Preheat*Cooling Media	4	168.86	42.21	1.04	0.416
Error	18	733.50	40.75		
Total	26	1536.51			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
6.38359	52.26%	31.04%	0.00%

The ANOVA results show that the preheat variation has no significant effect where P-value > then the null hypothesis (H_0) is accepted, while the cooling medium shows the results where the cooling medium has a significant effect on the response P-value < then the null hypothesis (H_0) is rejected and the interaction of the two independent variables on the dependent variable (response) has no significant effect, so the hypothesis is null (H_0). The value of the determinant coefficient (R^2) in the study was 52.26% where the two independent variables had a significant effect on the response, while 47.74% was influenced by errors and other factors that influenced the research.

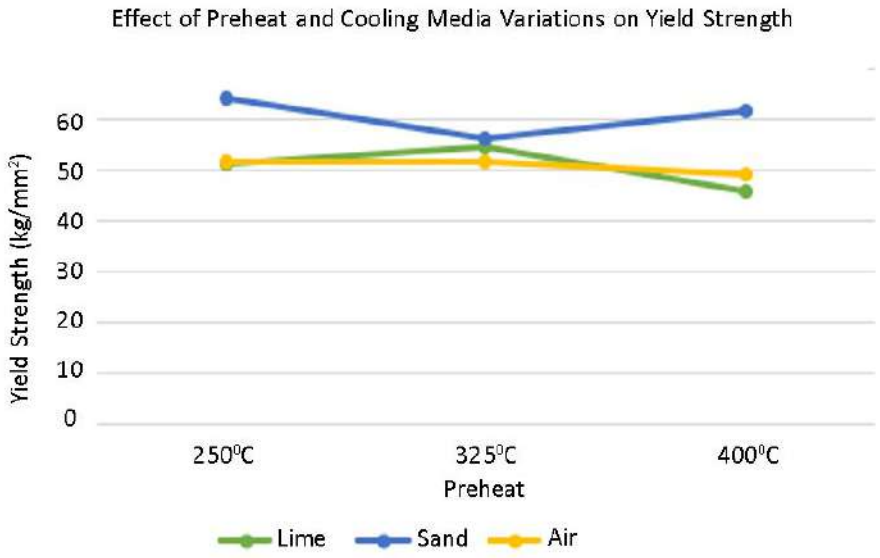

Figure 4. Yield Strength

Figure 4 shows the results where the yield value generated from the scrambled test is the highest yield value of 63.7924 kg/mm² produced at a preheat temperature of 250°C with sand cooling media while the lowest yield value of 45.7589 kg/mm² is produced at a preheat temperature 400°C with lime cooling medium. Yield value or also known as yield strength is the limit or point where the material continues to deform without any additional load, yielding symptoms that occur in a material are generally shown in ductile materials, then the yield value for ductile materials is the elasticity limit of the material before turn plastic. [19]

3.3 Total Elongation Results

The test results data for the total elongation value are as follows.

Table 5. Total Elongation Data

Preheat Temp.	Cooling Media		
	Lime	Sand	Normal Air
250⁰C	20	14	12
	16	16	8
	16	14	10
Average	**17.33 %**	**14.66 %**	**10 %**
325⁰C	14	14	17
	14	18	22
	14	14	20
Average	**14 %**	**15.33 %**	**21.66 %**
400⁰C	10	16	15
	12	10	12
	12	12	12
Average	**12.66 %**	**12.66 %**	**13 %**

Table 6. Annova and Summary Model of Total Elongation

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	8	220.074	27.5093	8.07	0.000
Linear	4	80.815	20.2037	5.93	0.003
Preheat	2	80.519	40.2593	11.82	0.001
Cooling Media	2	0.296	0.1481	0.04	0.958
2-Way Interactions	4	139.259	34.8148	10.22	0.000
Preheat*Cooling Media	4	139.259	34.8148	10.22	0.000
Error	18	61.333	3.4074		
Total	26	281.407			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
1.84592	78.20%	68.52%	50.96%

The ANOVA results show that the preheat variation has a significant effect on the dependent variable (response) where P-value < then the null hypothesis (H_0) is rejected, while the cooling medium shows the result where the cooling medium has no significant effect on the response P-value > then the null hypothesis (H_0) is accepted and the interaction of the two independent variables on the dependent variable (response) has a significant effect, then the null hypothesis (H_0) is rejected. The value of the determinant coefficient (R^2) in the study was 78.20% where the two independent variables had a significant influence on the response, while 21.80% was influenced by errors and other factors that influenced the research.

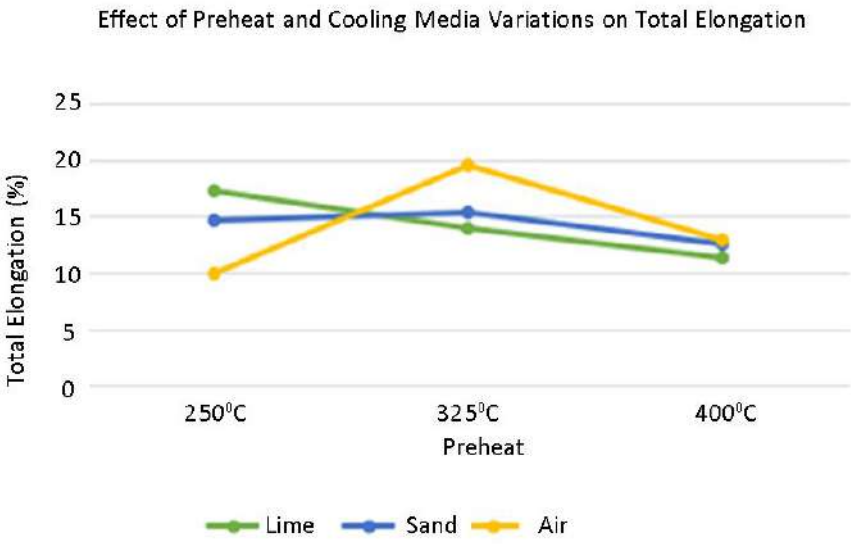

Figure 5. Total Elongation

Figure 5 shows the total elongation results where the interaction temperature of 325°C with normal air cooling produces the highest elongation value of 19.66% while the lowest elongation of 10% is produced at a preheat temperature of 250°C with normal air cooling. An increase in the elongation value is influenced by the high preheat temperature where the higher the preheat temperature the material will be more ductile due to slow cooling and allows for more ferrite transformations while other factors that influence are the density or density of the cooling medium where the density is getting smaller, the cooling rate will be slower [20].

3.4 Plastic Elongation Results

The test results for plastic elongation are as follows.

Table 7. Plastic Elongation Data

Preheat Temp.	Cooling Media		
	Lime	Sand	Normal Air
250⁰C	0.06	0.06	0.06
	0.06	0.06	0.06
	0.06	0.06	0.06
Average	**0.06 mm**	**0.06 mm**	**0.06 mm**
325⁰C	0.04	0.02	0.04
	0.08	0.02	0.1
	0.06	0.02	0.08
Average	**0.06 mm**	**0.02 mm**	**0.07 mm**
400⁰C	0.04	0.04	0.04
	0.04	0.04	0.02
	0.04	0.04	0.04
Average	**0.04 mm**	**0.04 mm**	**0.03 mm**

Table 8. Annova and Summary Model of Plastic Elongation

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	8	0.006963	0.000870	5.34	0.002
Linear	4	0.003526	0.000881	5.41	0.005
Preheat	2	0.002252	0.001126	6.91	0.006
Cooling Media	2	0.001274	0.000637	3.91	0.039
2-Way Interactions	4	0.003437	0.000859	5.27	0.005
Preheat*Cooling Media	4	0.003437	0.000859	5.27	0.005
Error	18	0.002933	0.000163		
Total	26	0.009896			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.0127657	70.36%	57.19%	33.31%

The ANOVA results show that the preheat variation has a significant effect on the dependent variable (response) where P-value < then the null hypothesis (H_0) is rejected, while the cooling medium shows the results where the cooling medium has a significant effect on the response P-value < then the null hypothesis (H_0) is rejected and the interaction of the two independent variables on the dependent variable (response) has a significant effect, so the null hypothesis (H_0) is rejected. The value of the determinant coefficient (R^2) in the study was 70.36% where the two independent variables had a significant effect on the response, while 29.64% was influenced by errors and other factors that influenced the research.

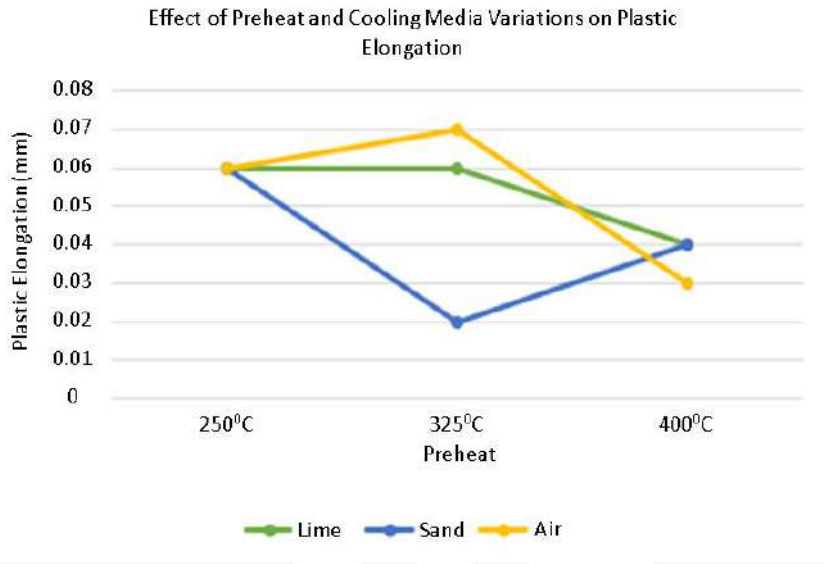

Figure 6. Plastic Elongation

Figure 6 shows a graph where the interaction at a preheat temperature of 325°C with normal air cooling produces a plastic elongation value of 0.07 mm while the lowest plastic elongation of 0.02 mm is produced at a preheat temperature of 325°C with lime cooling media. The increase in the plastic elongation value is influenced by the nature of the more ductile material due to the slow cooling rate and it is possible to transform to more ferrite so that the material is more ductile, so the plastic elongation value will be higher.

4. CONCLUSION

Based on the research that has been done, it can be concluded several things below:

a. The results of the study on the effect of the interaction between variations of preheat and cooling media on tensile strength showed that at a preheat temperature of 250^{0}C with the interaction of the sand cooling medium, the highest tensile strength was 67.74 kg/mm^2, while the lowest tensile strength was at the interaction of preheat temperature of 400^{0}C with air cooling. normal value is 51.97 kg/mm^2, where it is possible that there is a change in the brittle nature with more martensite transformation and a slow cooling rate which is influenced by variations in preheat and cooling media so that the material is ductile so that if the stress value increases, the strain value will tend to decrease.

b. The results of the discussion in the study above show that the interaction between preheat and cooling media variations on the yield value shows the highest yield value of 63.7924 kg/mm^2 using a temperature of 250^{0}C with sand cooling media while the lowest yield value is 45.7589 kg/mm^2 using a temperature 400^{0}C preheat and lime cooling medium.

c. In the above study, the results of the interaction between variations of preheat and cooling media on total elongation showed the highest elongation value of 19.66% at a preheat temperature of 325^{0}C with normal air cooling, while the lowest elongation value was 10% at a preheat interaction of 250^{0}C with normal air cooling.

d. Based on the results of the research above, the results of the interaction of variations in preheat and cooling media on plastic elongation show that the highest plastic elongation is at a preheat temperature of 325^{0}C with normal air cooling with a plastic elongation value of 0.07 mm while the lowest elongation value is at a preheat temperature of 325^{0}C with cooling media. lime with a plastic elongation value of 0.02 mm, where an increase in elongation value or a decrease can also be influenced by several factors, including preheat temperature, the effect of the density of each cooling medium and the transformation of microstructure.

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DESIGN AND BUILD AN INTERNET OF THINGS (IOT) AUTOMATIC TV BROADCASTING ANTENNA SYSTEM

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Abstract. Nowadays, television is used for educational purposes. It is easily accessible through air-to-air broadcasts and can be connected via satellite. What is witnessed on a television screen is all image and sound elements. Many people feel uncomfortable watching television shows because when the television is used, the broadcasts that appear are not all images and sounds that can be seen and heard properly. Most antennas used by every household are patented in a certain position. Based on the existing description, the problem that would be solved is how to design an IoT-based TV broadcasting antenna system to make it easier to watch television with clear broadcasts and good sound without changing the antenna's position manually. With the design method, the tool to be made consists of a flowchart and a circuit design, namely, building a system with inputs, processes, and outputs. The automatic TV broadcasting antenna system based on the internet of things (IoT) is a system that points the antenna in the best position for each selected broadcast that can be controlled via Android using the Blynk IoT Application. After that, the test was carried out by taking data at two locations for the IoT antenna. The assessment results showed that each location was different, and the position of the antenna direction would also be different, so the location of the antenna must be changed by changing the angle contained in the Arduino IDE software.

Keywords: NodeMcu, Motor Servo, Lcd, Smartphone, Blynk, Arduino IDE

1. INTRODUCTION

Television is an electronic system that transmits still and live images alongside sound via cable or space. Nowadays, television is used for educational purposes. It is easily accessible through broadcasts from air to air and can be connected via satellite. What is witnessed on a television screen is all image and sound elements. The function of television is to provide information, educate, entertain, and persuade. But the entertaining function is more dominant in television media. The main characteristic of television is that it is audio-visual, which means that it can be seen and heard[1].

Along with the development of technology today, which is increasingly developing, Many people feel uncomfortable watching television shows[2]. When the television is used, broadcasts that appear are not all images and sounds that can be seen and heard properly. Also, most antennas each household uses are patented at a certain position. Therefore, the quality of the broadcast received by each channel is different, while changing the antenna's position every time it moves a channel on the television can cause inconvenience to users[3].

A television antenna is a device for capturing pr[4]ograms broadcast on a television channel, but not at the same time, meaning that television broadcasts will appear one by one according to the broadcast chosen by the viewer in front of the television[3]. To get a good broadcast, the antenna is moved manually. Consequently, additional equipment is needed on the antenna to automatically adjust the position of the antenna when the television channel is moved.

To make it easier to find the signal on each channel on the television. One of them can design a system with the Internet of Things that can connect everyday objects such as smartphones, internet TVs, sensors, and actuators to the internet, where devices are connected to automatically adjust the antenna's position when the

television channel is moved. Based on the existing description, the problem that will be solved is how to design an IoT-based broadcasting TV antenna system to make it easier to watch television with clear broadcasts and good sound without changing the antenna's position manually[5].

This study discusses how to direct the antenna position according to television broadcasts that can produce the best TV image and sound quality. This study used the Blynk IoT application to make remote control and sensor data read from NodeMCU or ESP826 devices and Arduino. This system consisted of a television antenna drive, which is later controlled with a servo motor that functions as a rotary actuator, automatically controlled by NodeMCU, which receives commands from a smartphone[6].

Compared to the previous study, the advantage of this tool is the TV Receiver Antenna Controller System Using Arduino[7] by using the control panel contained in the antenna system. In addition, the tool in this study can be operated more easily and effectively because it can direct the antenna through a smartphone or remotely with the Blynk application connected to the NodeMcu in the antenna system.

2. METHODS

This research used an experimental method, which was a research method used in designing an Io-based TV broadcasting antenna system, creating a research framework, hardware design, and software design.

2.1 Research Framework

The research framework is the most important part because it can know the stages to be achieved. At the research stage, it followed the research framework in figure 1 as a reference to facilitate and not confuse the design process and produce a system.

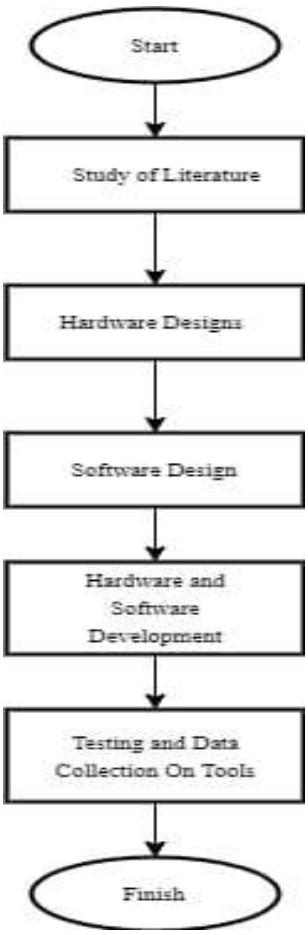

Figure 1 Flow Chart

2.2 Hardware Design

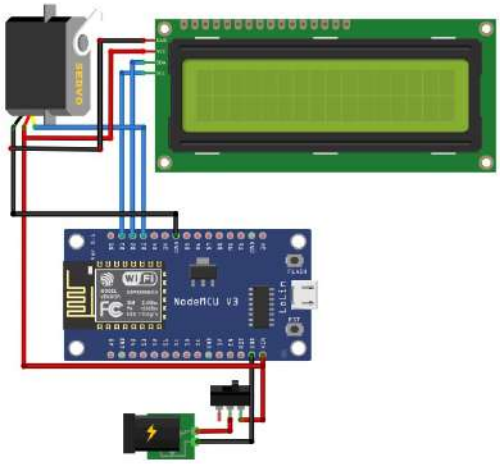

Figure 2 Schematic of the Antenna System Circuit

The figure below is a schematic of the network of automatic TV broadcasting antenna systems based on the internet of things that displays the paths on the circuit. At the source, it was connected to a socket that enters the switch on the positive leg, while the second switch leg was connected to the NodeMcu pin, and the GND socket was connected to the NodeMcu GND. The servo motor had three legs where the data legs were connected to the VIN D3 on NodeMcu, the VCC was connected to the NodeMcu VIN, and the GND legs on the servo motor were connected to the GND contained in NodeMcu, while the legs contained in the LCD were 3, namely, GND, VCC, SDA, and SCL. First, the SDA leg was connected to D2 on NodeMcu, while the SCL leg was connected to D1 on NodeMcu, then the VCC leg was connected to NodeMcu VIN, and the GND leg was connected to GND on NodeMcu.

2.3 Software Design

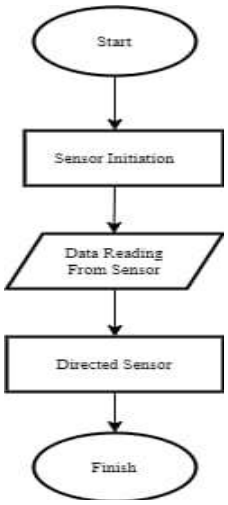

Figure 3 Flow Chart

Starting with initialization, then looking for the strongest signal by looking for the direction of the angle using the compass application, then making a command using the Arduino IDE software and connecting it to the Blink IoT application that has been installed on Android, then connecting the USB cable to NodeMcu and uploading it after successfully checking if the network can be operated or not if the Blink IoT application on Android can already direct the antenna according to the selected channel and the image and sound are good. The software design in this study used Blynk IoT, the operating steps of the Blynk IoT Application, to connect to the antenna system.

1. Installed the Blynk IoT app on the smartphone
2. Clicked Sign In
3. Entered your email and password
4. Clicked Settings, then clicked + and selected the icon you want to use
5. Clicked + Add New Device to connect to NodeMcu
6. Clicked Connect to Wi-Fi
7. Clicked the Star
8. Selected the Wi-Fi to use
9. Entered the Wi-Fi password
10. Waited until the 3 tick is green
11. If the status was online, it meant that it had successfully connected to NodeMcu

3. RESULTS AND DISCUSSION

3.1 Design Results

The automatic TV broadcasting antenna system based on the internet of things (IoT) is a system that directs the antenna in the best position for each selected broadcast. It can be controlled via Android using the Blynk IoT Application, and the selected broadcast will be seen on the antenna system's LCD screen.

3.2 Hardware Build Results

The result of the hardware circuit is a circuit that can find the direction of the strongest antenna angle in each broadcast using NodeMcu, which can be connected to Android to be controlled remotely.

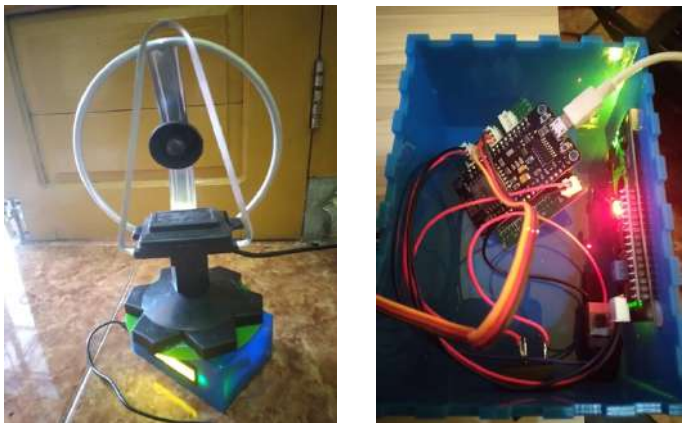

Figure 4 System Circuit Result

3.3 Software Build Result

The results of the software design in this study using the Blynk IoT application appear as shown in figure 4.2, where, using 15 broadcast TV broadcasting, the display on the application and the LCD on the system will show the direction of the antenna according to the broadcast on the selected TV.

Figure 5 Blynk Application Display

3.4 Tool Testing Results

The results in Table 1 are the same angle arrangement in both locations; the first location was in Bukit Palembang with an initial angle of 90° westward on all canals; the second location was in Skip Palembang with an angle of 90° westward on the 15th canal. It was found that the images and sounds produced on each channel showed different images and sounds that were good, some were less good, and some were even unclear if the angle was set at 90° on all channels.

Tabel 1 Anggel Setting Corner

Canals	Corner	IoT Antenna Detection Location 1; Bukit Palembang	IoT Antenna Detection Location 2; Sekip Palembang
TRANS 7	90˚		
RCTI	90˚		
ANTV	90˚		
INDOSIAR	90˚		
TRANSTV	90˚		
SCTV	90˚		
METROTV	90˚		
GTV	90˚		

Canals	Corner	IoT Antenna Detection Location 1; Bukit Palembang	IoT Antenna Detection Location 2; Sekip Palembang
MNCTV	90°		
TV ONE	90°		
INEWS	90°		
TVRI SUMSEL	90°		
NET.	90°		
Rtv	90°		
KOMPAS	90°		

Tabel 2 Result of Using Antenna System

IoT Antenna Detection Location 1; Bukit Palembang	Corner Location 1; Bukit Palembang	IoT Antenna Detection Location 2; Sekip Palembang	Corner Location 2; Sekip Palembang
Good	115°	Less Good	90°
Good	115°	Good	95°
Good	115°	Good	103°

IoT Antenna Detection Location 1; Bukit Palembang	Corner Location 1; Bukit Palembang	IoT Antenna Detection Location 2; Sekip Palembang	Corner Location 2; Sekip Palembang
Less Good	60°	Less Good	90°
Good	130°	Good	90°
Good	130°	Less Good	65°
Less Good	0°	Good	90°
Good	90°	Less Good	110°
Good	90°	Good	90°
Good	0°	Good	95°
Good	60°	Good	85°
Good	90°	Less Good	50°
Good	110°	Good	50°
Good	75°	Less Good	70°
Good	100°	Good	90°

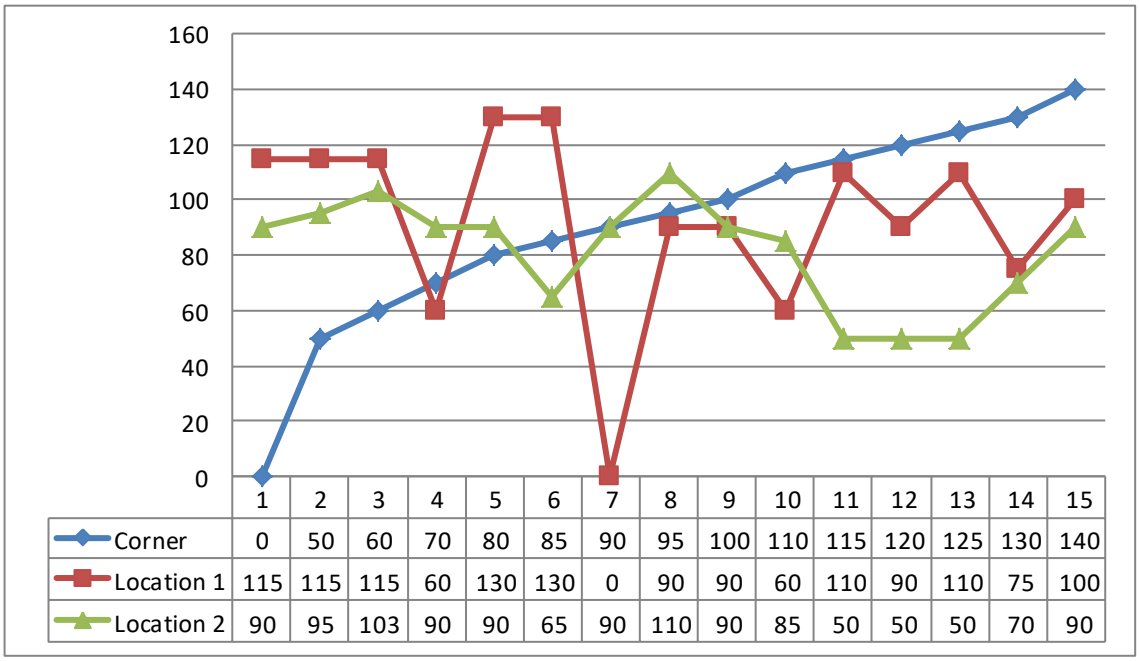

Figure 6 Corner Result

The results of the study obtained in table 2 show that at different locations of TV broadcasting, the angle on the antenna would also change, where it can be seen in the 1st image, namely on the TRANS7 channel, at the location 1 at an angle of 115° with good images and sounds, while at the location 2 in Skip it is at an angle of 90° with less good images and sounds. The 2nd image on the RCTI channel at location 1 with an angle of 115° and the location 2 with an angle of 95° shows the image and sound that good produces in both locations. The 3rd picture is on the ANTV channel with an angle of 15° at the location 1 and 103° at the location 2, which produces a good image and sound. On the 4th channel, namely INDOSIAR, with an angle of 60° at location 1 and an angle of 90° at location 2, and producing fewer good images and sounds. Then on the 5th channel, there is TRANS TV with a 130° angle at location 1 and a 90° angle at the location 2, with the image and sound produced by both good. On the 6th channel, location 1 with an angle of 130° and the location 2 with an angle of 65°, namely on the SCTV channel at location 1 of good image and sound and in the 2nd position of less good image and sound, The

7th channel is METRO TV with an angle of 0°, and at the location 2 with an angle of 90°, the image and sound produced at location 1 are Less Good while at the location 2 is good, On channel 8 at location 1 with an angle of 90° and location 2 with an angle of 110° on the GTV channel, the sound, and image produced at location 1 are good, while at location 2, they are less good. On the 9th channel, MNCTV, with both angles at 90°, the image and sound produced are good for both. On channel 10th, namely TVONE with an angle of 0° and the location 2 with an angle of 95°, the results can all be good for both locations. On the 11th channel, the angle at the location 1 is 60°, and the location 2 with an angle of 85°, produced a good image and sound. The 12th channel is TVRI SUMSEL. The first location is 90° and the second location has a 50° angle. The results can be at the location 1 while the location 2 is good. At the 13th location, namely NET, an angle of 110° at location 1 and 50° at the second location can be achieved for both locations. Then on the 14th channel, there is RTV with a location of 1 image and good sound in the location 2 of the image and less good sound with an angular position of 75° at location 1 and 70° at location 2. The 15th channel at a 100° angle at location 1 and a 90° angle at the location 2. The resulting image and sound can be reached in both good locations.

3.5 Overall Result Analysis

From the results of the tests carried out, it can be seen that for each TV broadcasting that used an indoor type antenna, a design can be made to automatically deploy the antenna on each channel using NodeMcu, Servo motor, LCD, and Blynk IoT Application. Thus, the angle settings that we wanted can be done using Arduino IDE software after designing the device, which was divided into three stages, namely the first stage of hardware design, "the second stage of software design," and the third stage of integration between hardware and software into an IoT antenna system. The test was carried out by taking data at two locations for the IoT antenna; Without manually rotating or moving the antenna. Application development is necessary to improve quality and keep up with the flow of technological developments. the first in Bukit Palembang and the second in Skip Palembang. The study results showed that each location was different, and the antenna's position would also be different, so the location was different. Therefore, the antenna's position must be changed by changing the angle contained in the Arduino IDE software. The antenna will rotate as expected so that the image quality will look clearer, and the sound will be better. In addition, this will result in more accurate antenna parameters[8]

In addition, this study also compared the results with the images and sounds that used outdoor-type antennas. The images and the sound produced turned out to be better and clearer channels obtained more than TVs that used indoor antennas. This research shows that the IoT-based antenna controller system using the Blynk application can be more efficient than previous studies. Namely, the TV Receiver Antenna Controller System Using Arduino. Because in previous studies, the antenna was still directed using the control panel on the TV antenna system.Maintenance on this tool is very easy. Place the antenna system at room temperature and ensure the NodeMcu contained in the system is always connected to an internet connection. This antenna system is produced in large quantities and is marketed for the price of this antenna system which is Rp. 300,000.

4. CONCLUSION

In this study, it can be seen that for each TV broadcasting that uses an indoor type antenna, design can be done to move the antenna automatically on each channel using NodeMcu, Servo motor, LCD, and Blynk IoT Application. Thus, the angle settings we want can be done using Arduino IDE software. The test is carried out by taking data at two different locations for the IoT antenna. The first location is in Bukit Palembang, and the second location is in Skip Palembang. The results of the study show that each location is different. Therefore, the position of the antenna direction will also be different. Since the location is different, the antenna's position must be changed by changing the angle in the Arduino IDE software.

The tools in this study can be well implemented according to the design carried out for the next study. The author hopes this antenna system can also be applied to the outdoor antenna.

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EXPERIMENTAL DESIGN FACTORIAL PARAMETERS OF HONEY WATER CONTENT LEVELS TO IMPROVE HONEY PROCESSING PRODUCTIVITY

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Abstract. In producing honey products, must meet all SNI quality standards (8665:2018), one of which is honey water content of less than 22%. Honey from farmers has a moisture content of more than 22% so the water content must be reduced. On of the technique that use in a company to meet those standard uses a dehumidification system combined with air conditioning and a honey rain device. With the current machine configuration, the required honey moisture reduction process time is 11 days. This study focuses on finding a combination of degrees Celsius temperature factor and relative humidity percentage factor that results in the optimal rate of reduction in water content. The results showed that temperature and relative humidity each had an effect on the rate of decrease in the water content of honey and no interaction effect was found between the factors of temperature and relative humidity on the rate of decrease in the water content of honey. The combination of selected temperature and relative humidity factors, namely 27°C and 40%, in the most optimal rate of decrease in water content with an average of 0.416667% per hour. When compared with the combination of temperature and relative humidity in the company, namely 30°C and 60%, the selected treatment combination can reduce the processing time for reducing the honey moisture content and increases productivity by 50%.

Keywords : honey, temperature, relative humidity, drying, reduced moisture content, dehumidification, experimental design, factorial experiment.

1. INTRODUCTION

Honey is a natural liquid usually has a sweet taste produced by honey bee (Apis sp.) from flower essence or parts other plants [1]. Honey has many benefits in the field of industry, food, health, and cosmetics which has been widely known by the public [2]. According to [3], consumers' desire to improve immune system causes high demand honey today. However, not accompanied by production to meet this demand. This indicates that there is potential promising industry due to production honey has not been able to meet the many requests consumer

Because honey is a product that has been standardized by National Standardization Body so product must meet honey quality standards which has been determined in Indonesia National Standard (SNI) (SNI 8664: 2018) One of them is the water content of honey does not exceed 22%. However, based on the information from the farmers an average percentage water content level was24%. High water content of harvested honey caused by the tropical climate of Indonesia so that the high humidity of the surrounding air affects the high water content of honey [4]. For meet the SNI quality standards, then honey must be carried out the process of reducing the water content so that does not exceed 22%. One of the system that particularly use was dehumidification of the process to reducing levels their honey water. This dehumidification system combined with a rain gear made of stainless steel, i.e. honey flows into the container large capacity to be dropped later in the form of droplets like rain. System dehumidification applied using AC as temperature

controller and refrigerant machine dehumidifier as a humidity regulator. System dehumidification allows the reduction of levels water in honey due to suction water by air (evaporation of water) caused by inequality of ambient air moisture content and moisture content honey. If the water content of the air is low enough it means air has low relative humidity so that the probability of evaporation will be the greater it is. The further the difference in vapor content water in the air with the material, will be more and more the moisture content of the material that can be evaporated due to the capacity to hold water in the air is getting bigger [5]. The process that the forest honey goes through is first the honey is received from the farmer and immediately carried out the filtering process for 1 day. Then, forest honey goes through the process reduction in water content. To lower the water level forest honey 600kg of the average initial moisture content of 24% to 20% according to company standard, needed time 9 days. After the process of reducing the water content carried out, bottling and packing processes Jungle honey is done for 2 days and is ready to eat marketed to consumers.

According to [6], there are some things related to time The reduction in the water content of honey includes: water content at the beginning and end of the process, the total weight of honey which you want to reduce the water content, as well as the rate of reduction in water content. Percentage of initial water content of honey before processing and the final moisture content of honey after the process is related to the process of reducing the water content of honey. The greater the difference between the initial moisture content and the moisture content to be achieved, then the processing time will be longer it takes [7]. The water content of honey must be achieved after the process of reducing the water content is less than 22% according to SNI standards. While the water content of honey before has variations this is caused by honey came forest honey that collect by honey farmers. Furthermore, processing time reduction in the water content of honey is associated with the amount of honey weight to be reduced, the greater the amount of honey that will carried out the process of reducing the water content, it will take longer the processing time [8]. For remarks, time to process the reduction of the water content of honey inline with the rate of reduction of the water content so that to achieve a short processing time, the rate of water content reduction should be increased [6]. In general, in order to increase the rate The reduction in the water content of the material can include: by increasing the velocity of the air flow, expand the surface of the material to bedried, and temperature and humidity settings [9]. Flow speed air can be increased by using exhaust fan or fan because the air moving will avoid saturation so that the material will dry faster [9]. However, the procurement of exhaust fans and the fan will cost some money. In addition, the rate of decrease in the water content of the material can also be accelerated by expanding the surface of the material to be dried due to material surface contact with drying medium will be wider so that the water will be easier diffuses so that the material dries faster [9]. Increase in surface area in the solution can be done by reducing the size of the solution into granules [10]

There are other ways to speed up the pace reduction of the water content of the material, namely by regulate the temperature and relative humidity of the air (Relative Humidity/RH) [11]. The increase in temperature will increase the rate of heat transfer to the material which is dried and the rate of evaporation of water at dried material [12] Will however, there is a quality-degrading impact on honey because high temperatures can reduce levels diastase enzymes and increase levels of 5 hydroxymethyl-2-furfural (HMF) [13][14] To avoid dropping honey quality, honey should not be heated above 45°C [15]. On the other hand, humidity relatively low air will help movement of water from the dried material [12]. Relative humidity determines the ability of the drying air to accommodate moisture content of the material that has been evaporated so that if the lower the RH, the more water vapor absorbed by the drying air [11]. Therefore, the temperature and humidity can theoretically affect the rate decrease in water content in honey. Darmawan et. al. [16] stated that temperature affects the rate of decline dehumidification system honey moisture content. Temperature set using air conditioning and relative humidity percentage regulated using a refrigerant dehumidifier. The use of trays arranged as containers honey concludes that combination of 25°C AC temperature and relative humidity dehumidifier 40% can reduce the water content of honey faster than the temperature combination AC 30°C at relative humidity percentage the same dehumidifier. Singh et. al. [17] states that the rate of decrease in water content at honey temperature 40°C faster than temperature 35°C. The temperature is set using hot water which is circulated around the honey container and honey is mixed with a disc that rotates to expand the surface of the honey exposed to drying air due to honey attached to the disc. While the type The dehumidifier used is a desiccant dehumidifier with silica gel.

There are some related differences research conducted [1][6] compared to [17]. These differences include low temperature on [16] produces the fastest rate of decrease in water content while in [17] the temperature high is the fastest. Next difference depends on the type of dehumidifier used and given temperature treatment. Singh [17] specifically to change the temperature honey by circulating hot water around the honey container while doing mixing in the honey. However, the temperature the air is fickle because of what is maintained is the temperature of the honey not the temperature of the air. Whereas [16] regulate temperature treatment using AC but does not provide specific information about the data. Therefore, it is necessary to design experiment to find the right combination between temperature and humidity so that the rate of decrease water content in the rain reducer water content honey

2. METHODS

The process of collecting data in this study are:

a. Selection of dependent, independent, control, and confounding research variables are divided based on the nature of the relationship between variables, in this case is dependent variable and independent variable. In addition, there are control variable whose value is kept constant for controlling the relationship between independent and dependent variables. The following variables are used in this study is:

1. Variable temperature and relative humidity will be the independent variable because manipulation of these two variables judged to be easy to do and does not require the procurement of tools addition. Temperature related changes carried out using air conditioning and change in relative humidity is regulated with a dehumidifier. Then monitoring related to air temperature and actual relative humidity monitored with a thermos hygrograph digital.
2. The dependent variable measured in this study, the rate of reduction in the water content of honey will be known of the total reduction in water content per time unit.
3. Control variables in this study taken from other factors that affect the rate of decline water levels are:
   a) Time span for control drop in levels water.
   b) Weight of honey in each treatment.
   c) Honey granules that come out from the honey raindrops.
   d) Airflow velocity in room during processing experiments were carried out.
4. Confounding variables in the study this is the initial water content of honey varies due to using forest honey from farmers directly

b. Selection of factors and free variable factor levels

The selection of the number of factors and the factor level will affect the level of difficulty in doing experiment. The number of factors and the level of the factors more and more will lead to experimentation and data processing takes longer and can increase costs. Darmawan et. al. [16] stated that the AC temperature of 25°C which combined with relative humidity dehumidifier 40% can reduce the water content of honey faster than the combination of 30°C and AC temperature the percentage of the dehumidifier's relative humidity same. However, research conducted by Singh [17] stated that rate of decrease in water content at a honey temperature of more than 40°C faster than 35°C. Temperature set using hot circulating water around the honey container and stirred honey so that the temperature can be maintained. While the type of dehumidifier used is a desiccant dehumidifier that is with silica gel. Chua et. al [12] said that the increase in temperature will increase the rate of transfer heat to the material being dried and the rate of diffusion water on the dried material. As well as low relative humidity of the air will help move water away from the material dried [12]. Then on company, previously used configuration 30°C and 60% relative humidity. Based on these considerations, in In this study, 2 factors will be used, namely the degrees celsius temperature and percentage factor relative humidity. AC temperature degree celsius factor has a level of 27°C and 28°C. While the factor dehumidifier relative humidity percentage have a level of 40% and 53%

c. Selection of experimental design method

This study will simultaneously investigate effect of several different factors. Each factor consists of several levels so that the combination certain level of each factor is called a combination treatment. All combinations between levels of each factor will be noticed. Therefore, this research suitable for using factorial experimental design [18].

d. Preliminary trial stage

The preliminary experimental stage was carried out for know in advance the rate of decrease in water content honey in the conditions that have been applied to company. This preliminary experimental stage will done by testing the reduction of water content of 50 kg of honey with a temperature configuration of 30°C and the relative humidity is 60% of the honey water content 24% until it reaches the company standard i.e. 20%. Preliminary experiments carried out one time replication. By doing preliminary experiment, it can be seen how much the length of time the experiment must be carried out and also the benchmark measure the rate of decrease in the water content of honey as comparison to actual experimental results which will be done later.

e. Determination of factors and variable factor levels independent as well as the variables considered constant. Factors tested on in this study, the temperature and relative humidity. Both factors can theoretically affect the rate of decline water content and was chosen because it was rated relatively easy to do manipulation using AC and existing dehumidifier. Then for factor level selection is set 2 levels, namely 27°C and 28°C for temperature factor while for the relative humidity factor will be 2 factor levels are set, namely 40% and 53%. Factor level number. This temperature was chosen because there is a difference between the temperature hotter or more cold that can produce rate of reduction in water content optimal. Room temperature reducing the water content of honey is regulated using AC as in the research done by Darmawan et al. [16]. Arrangement temperature using air conditioning has limitations, namely it cannot be set up to decimal number accuracy and only positive

integers of 16°C to 30°C. Therefore, this experiment uses temperature level 27°C and 28°C with the basis that the two numbers it is the middle value which not a decimal number between temperature of 25°C and 30°C which previously researched by Darmawan et. al. [16]. While the level number the relative humidity is selected based on machine limitation dehumidifier generate the condition of the most relative humidity low at 40% and 53% units

Variables that are considered constant in this study are:

1. The difference in the weight of the material dried then time what is needed is different also [8]. By therefore, to minimize bias on results in this study limited amount of honey which will be reduced its water content were 50 kg in each treatment.
2. Time becomes variable control in this study. Because this experiment will monitor percentage decrease in water content in certain time span. Based interview with user it takes 18 hours for the reduction process honey water content of 50 kg and will be validated back while doing preliminary experiment. By Therefore, this research will take time span 18 hours on each combination treatment. Besides, will related observations were made honey water content at the time the experiment was run on every 3 hours as data addition showing rate of reduction of water content per unit time for each treatment.
3. Honey granules that come out from the raindrops hole honey is assumed to have surface area uniform. Surface area just be a variable control because there is only a honey rain tool so related modification this tool is difficult to do and worried about interfere with the way production activities company.
4. Reduction of honey water content done in the room closed size 6.96×4.90×3.15 meters by using only rain gear, machine dehumidifiers, and air conditioners. Settings against air speed can use exhaust fan or fan, however will add cost procurement and installation. By Therefore, air speed considered uniform for each treatment.
5. Initial water content of honey when received from honey farmer can be different so can affect the results experiment so must control is carried out. According to Purnomo et. al. [19] honey water content found in temperate climates tropical areas such as Riau and the surroundings have an average 24%. Accepted honey can be done mixing between jerry cans honey to get initial water content before experiment that is 24%
6. Determination of the number of replications is carried out for provide an estimate of the experimental error can be used to determine the hose trust, resulting in more estimates accurate for experimental error, and allows researchers to obtain estimates better about the mean effect of a factor [18] In this study, researchers perform a 2×2 factorial experimental design with each 3 times of replication plus 1 preliminary trials, which means there are a total of 13 trials. Experiment with each combination the treatment was carried out randomly (not sequentially).

f. Stage of preparation of test objects and equipment Tools and materials prepared for this research is:

Honey as much as 50 kg in each treatment combination. Study this requires a combination 4 kinds of treatment

which was replicated 3 times and added one try prelude 1 time so there are 650 kg of honey needed.

1. Honey water reducing device in the form of a honey raining device, dehumidifiers, and air conditioners.
2. Refractometer to measure honey water content before and after the combination experiment treatment is done.
3. Thermohygrograph for knowing the temperature and humidity relatively actual room.

g. Experimental stage

Experiments in this study were carried out according to company production time fo save costs and cannot be done parallel because there is only one raindropper honey. Each sample of treatment combination does not have a relationship with each other. After all replications of each treatment have been get a turn, calculate the difference of subtraction initial and final moisture content then divide by the total amount of time the experiment was carried out in each treatment that is 18 hours for get the rate of reduction of water content in each treatment replication

Data Processing Techniques. Data on the rate of reduction of water content can be illustrated by the reduction in the water content of honey per time unit. Data processing is done by factorial experimental design analysis with using the Minitab 17 software help. At this stage, the influence of the factors that has been determined by looking fulfilled or whether or not the following hypotheses:

a. H01: the temperature factor has no significant effect significant on the rate of reduction of water content honey dehumidification system
b. H11: the temperature factor has a strong influence significant on the rate of reduction of water content honey dehumidification system
c. H02: relative humidity factor is not significantly affect the rate honey water content reduction system dehumidification
d. H12: the relative humidity factor has significant effect on the rate honey water content reduction system

dehumidification

e. H03: temperature and relative humidity factor no significant effect on system honey water content reduction rate dehumidification

f. H13: temperature and relative humidity factor have a significant effect on rate reduction of honey moisture content system dehumidification

Here are the various tests that used in this research are:

a. Test assumptions The first step in analysis using design factorial experiment is testing data on assumptions, namely normality, homogeneity, and independence. If the assumption test is not met, then the results of the analysis of variance do not apply.

1. Normality test Normality test is used to check whether population normal distribution or not. Data that normally distributed will reduce the possibility of bias [20]. Test Normality was carried out by using the Shapiro Wilk. The Shapiro Wilk test was used because the number of samples in this study was less than 50 [21].
2. Homogeneity test to see 2 or more group of data that comes from a population that have the same variance. One test To find out the homogeneity of variance, with Bartlett's test.

b. ANOVA test of factorial experimental design in experimental design, the term variance analysis technique. Anova test can be done if the data has met the assumption test. Analysis technique variance (Anova) works to test whether the average of a classification or source of variation significantly different to some degree.

c. Advanced test Follow-up tests were carried out to find out more the relationship between variables, namely the large influence each independent variable on the variable certain. Tukey's test was carried out to determine differences between treatment combinations and which treatment combination is the most optimal. In addition, a comparison chart will also be presented between each treatment on the dependent variable i.e. the rate of reduction of the water content

Research methods at least describe the approaches used in research, population and research samples, explain the operational definition of variables along with data measurement tools or how to collect data, and data analysis methods. If the data measurement tool uses a questionnaire, it is necessary to include the results of the validity and reliability of the research instrument.

3. RESULTS AND DISCUSSION

Experiment Execution Before the experiment was carried out, honey first prepared on 13 jerry cans. Honey on each container can have different water content level. Therefore, mixing to all container of honey so it is obtained the initial water content before the experiment which was 24%. Then the experiment is carried out starting with a preliminary experiment then by randomizing the order of the experiments until all treatment combinations get a turn.

Before collecting experimental data for calculation and analysis, especially:
First, a preliminary experiment was carried out for knowing how long the experiment should take performed for each treatment combination. Preliminary experiments were carried out with combination of temperature and relative humidity this is done by the company that is 30°C and 60%.

Table 1 Preliminary Experiment Data

Experiment Time (hours)	Temperature Fluctuation (C)	RH Fluctuation	Water level (%)
0	30	60	24
3	29,7	59	23
6	29,9	57	22,5
9	30,5	60	21,5
12	31,3	58	21
15	31,7	58	21,5
18	31,1	59	20

After the preliminary experiments were carried out, to lower the water content of honey with water content 24% to 20% a total of 50 Kg using tools rain and dehumidification system is obtain time for 18 hours. The moisture content of 20% honey is the upper limit of the standard that the company sets for maintain the quality of honey and to meet the standards SNI quality. By knowing the 20% water content has been reached at the 18th hour, then the experiment preliminary was terminated and it was determined that The experiment will be carried out for 18 hours for each treatment combination Next, the experiment was carried out with the data collected in the form of reduction data honey moisture content, residual honey, and fluctuations in temperature and relative humidity in the reduction chamber water every 3 hours for 18 hours of experiment every treatment combinations were performed.

After all data is collected on during the experiment, the next step is perform data processing. Data of initial water content and the end is calculated the difference and divided by time the length of time the experiment was carried out on each combination of treatments, ie 18 hours. Whole these calculations are presented in Table 2. Then after getting the speed reduction of water content in each combination experimental treatment, test calculations are carried out assumptions to know the normality and homogeneity of data. When the data is declared normal and homogeneous, the data can be continued for testing ANOVA to determine the effect of each factor as well as its interaction with the dependent variable

Table 2. Difference and rate of reduction of honey moisture content after experiment

Temperature	RH(%)	Replication	Water Level (%) beginning	Water level end period (%)	Water level Difference	Water Level Reduction (%/Hours)
27	40	1	24	17	7	0.38889
		2	24	16	8	0.44444
		3	24	16.5	7.5	0.41667
	54	1	24	19	5	0.27778
		2	24	18.5	5.5	0.30556
		3	24	18	6	0.33333
28	40	1	24	17	7	0.38889
		2	24	17.5	6.5	0.36111
		3	24	18	6	0.33333
	54	1	24	19	5	0.27778
		2	24	18.5	5.5	0.30556
		3	24	19.5	4.5	0.25

Table 3. Temperature Fluctuations at the time of the experiment for each treatment

Temperature	RH(%)	Replication	Fluctuations in Actual Temperature Conditions (°C) after the experiment						
			0 hours	3 hours	6 hours	9 hours	12 hours	15 hours	18 hours
27	40	1	27	26	25.5	25	26	28	29.7
		2	27.2	27	26.2	25.4	25	24.9	24.7
		3	26.8	28.7	28.8	28.5	27.8	27.7	27.6
	54	1	27.3	20.9	26.8	27.7	27.1	27	27.1
		2	27.2	27	26.9	27.2	27.1	27.3	27.2
		3	27	27.4	27.1	26.8	27	27.1	27.3
28	40	1	28.3	29.3	28.3	28.5	28.6	28.7	28.1
		2	27.9	28.6	30.5	29.8	30.1	30.1	29.1
		3	28	28.9	29.5	30.2	32.6	32.2	30.3
	54	1	27.8	27.6	27.3	28	28.1	27.9	28.6
		2	28.1	27.8	27.2	28	28.1	27.7	28.8
		3	28	29.1	27.6	26.9	27.8	28.2	28.5

Table 4. Relative Humidity (RH) fluctuations at the time of the experiment for each treatment

Temperature	RH(%)	Replication	Fluctuations in Actual RH Conditions after the experiment						
			0 hours	3 hours	6 hours	9 hours	12 hours	15 hours	18 hours
27	40	1	43	41	41	41	40	40	41
		2	41	42	41	41	41	43	45
		3	40	43	40	39	38	41	43
	54	1	53	50	47	45	46	55	61
		2	52	49	42	54	57	56	54
		3	54	53	47	49	50	53	54
28	40	1	41	38	37	42	47	44	41
		2	40	41	39	38	39	38	37
		3	40	39	41	43	45	43	42
	54	1	54	46	45	57	48	47	51
		2	53	45	43	55	46	47	50
		3	54	55	53	50	49	49	52

Based on the interpretation of the output results calculations the temperature factor affects the rate of reduction honey water content. However, the influence given is different from the theory that the temperature directly proportional to the drying rate of the material which means that high temperatures cause the reduction in the water content of the material will be faster [22] While in this research the opposite is found. The experimental results show that the lower the temperature in the room, the lower the level water, the faster the rate of reduction of the water content. This happens allegedly because the AC engine plays a role to the results of this study. AC machines not only change the temperature, but also the humidity in the water reduction room. According to Gabriel [23] the higher the room temperature, then the relative humidity of the air also higher, and the lower the temperature, then the humidity is lower. This matter related to the working mechanism of the AC engine that sucks in warm and humid air to then be exchanged for more air drier and cooler temperatures. Based on the experiments conducted by Wirawan et. al. [24] the lower the target given temperature to the AC controller, then the performance of the AC compressor will be longer at a temperature of same start. In connection with that matter, performance of the air conditioner that tries to lower the temperature to achieving the target will also reduce relative humidity of the air so that in the end will also accelerate the decrease in water content in honey. Therefore, in this study It was found that the lower temperature i.e 27°C will cause a decrease in the water content of honey which is faster than 28°C. The results of this study are similar to research conducted by Darmawan et al. [16] namely lower temperatures (25°C) results in a further decrease in water content much higher than the higher temperature (30°C). Both of these studies use tools that are relatively the same, namely AC and refrigerant dehumidifier only, the only difference is in [16] used a tray container with different thicknesses of honey, whereas This study uses a rain tool to increase the water content of honey. Darmawan et. al. [16] concluded that at the same level of humidity i.e 40%, the temperature of 25°C can reduce the water content of honey by 0.82% per day compared to 30°C is only 0.42% per day. As well as in this study it was concluded that the low temperature ie 27°C resulted in a decrease in average water content of 0.36111% per hour, more than the higher temperature of 28°C only an average of 0.319444% per hour

The relative humidity factor affects the rate reduction in the water content of honey. In line with theory humidity effect on the evaporation of the material. Air with low relative humidity will be able to accommodate the water that comes out of honey to then be absorbed by the dehumidifier machine and air conditioning. The dehumidifier and air conditioner will restores dry air and has low relative humidity to return holds the water evaporated from the honey. Cycle This is repeated throughout the experiment. Air relative humidity 40% contains less water than 54% so 40% relative humidity will be more accommodate the water vapor from the evaporation of honey. By Therefore, 40% relative humidity can be reduce honey water content by an average of 0.388889% per hour, more than 54% relative humidity i.e. average only 0.291667% per hour in the same time interval. The results of this study are in accordance with previous studies which said that the relative humidity of the air was lower when reduction of the water content of the material was carried out, it will then speed up the reduction in the water content of the material or at the same time period, then the lowest percentage of air relative humidity which produces the most material moisture content low [8][9][11][12].

The interaction of temperature and relative humidity factors is not significant effect on the rate of reduction of levels of honey water. This is presumably due to the distance between the level at the temperature is too close

so it is relatively difficult to detect the interaction between the temperature factor and relative humidity at the time of the experiment. the distance not too far between the level of the temperature factor, namely by 1°C, causing the results between treatments does not have a significant difference statistics although in general it has an average (means) different.

Based on Tables 3 and 4 the recording results actual temperature and relative humidity at the time Experiments show that the temperature and relative humidity has a similar fluctuation So it is suspected that this is also the cause interactions between factors were not statistically detected. Theoretically, fluctuations in temperature and humidity relative indoors can occur due to climate and outdoor weather [25]. Hot weather affect the increase in indoor temperature while the rainy weather affects the rise indoor humidity. Even in closed room, outside air can still enter through door gaps and so on so that you can affect temperature and humidity fluctuations relatively indoors. In addition, the performance of the AC engine and a dehumidifier that gives off different air, suspected to be the cause of temperature fluctuations and relative humidity in the room. AC Machine letting out cold air in the meantime dehumidifier engine blows out air warm so there are differences and fluctuations factors in each observation carried out. By Therefore, the interaction effect on temperature andrelative humidity to rate of reduction honey water was not detected in this study. When compared to research previously done by Darmawan et. al. [16] and Singh [17], these two studies did not examine the effect of interaction of temperature and relative humidity factor.

Darmawan et. al. [16] examined 2 levels of temperature, namely 25°C and 30 with only one level relative humidity 40% so that the effect of interaction temperature and relative humidity cannot be studied. Singh [17] did research on decreasing the water content of honey with temperature of 35°C and 40°C combined with method of dehumidification desiccant dehumidifier type. The relative humidity of the air resulting from this type of This desiccant dehumidifier is not controlled, has quite a lot of variation compared to variations in relative humidity in this study, and the effect of the interaction between degrees Celsius temperature and percentage of relative humidity on reduction honey water content is not studied

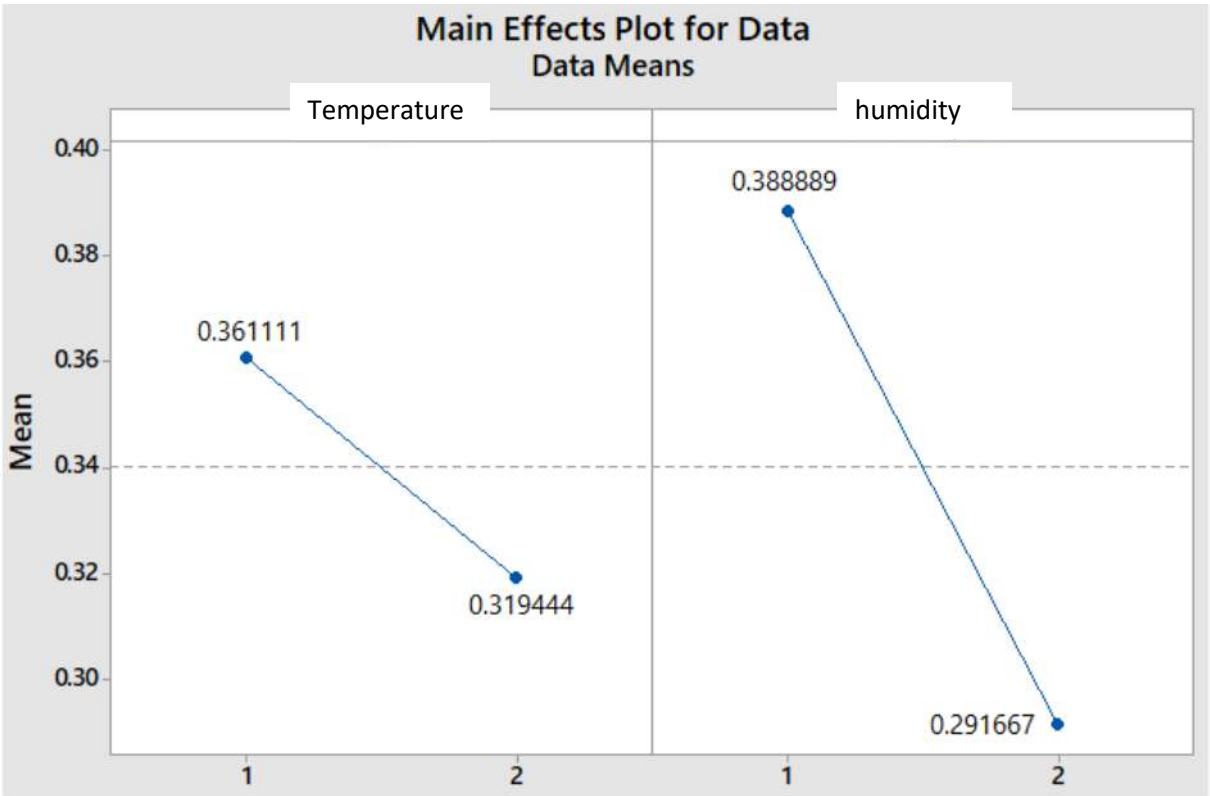

Figure 1. Main Effect Plot for Data Means (Temperature and Humidity)

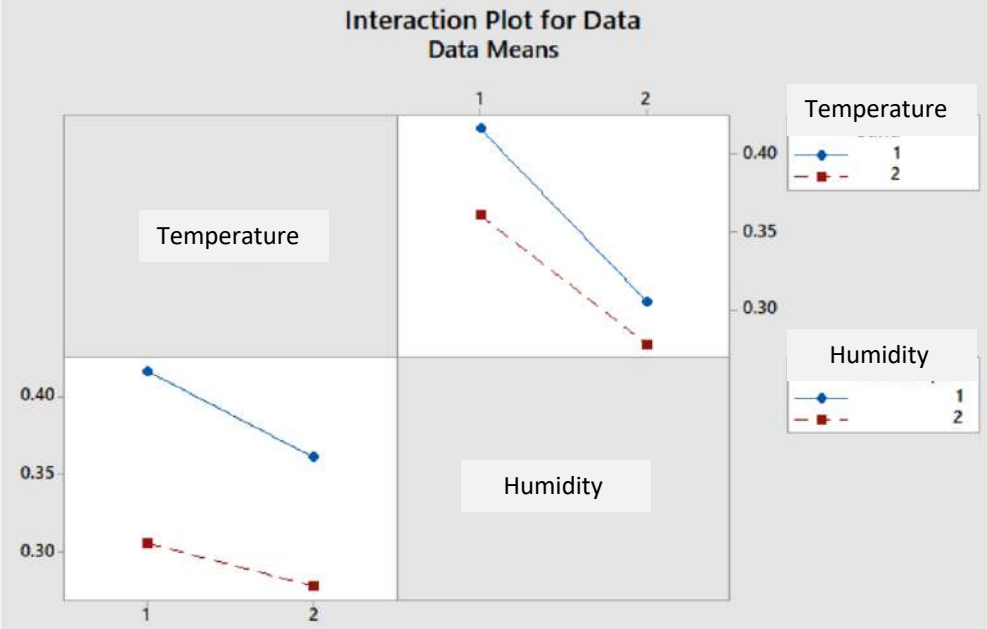

Figure 2. Graph of the effect of interaction between factors on the rate of reduction of levels honey water

Tukey Pairwise Comparisons: Response = Data, Term = Temperature*Humidity

Grouping Information Using the Tukey Method and 95% Confidence

Suhu*Kelembapan	N	Mean	Grouping
1 1	3	0.416667	A
2 1	3	0.361111	A B
1 2	3	0.305556	B C
2 2	3	0.277778	C

Means that do not share a letter are significantly different.

Figure 3. Tuker Pairwise Comparisons

Based on Figure 1 The chart on the left shows that the level of the temperature factor which has an average the highest level is level 1 which is 27°C with an average of 0.36111% per hour compared to level 2 i.e. a temperature of 28°C which only has an average 0.319444% per hour. While the next graph On the right described the level of the relative humidity factor which has the highest average is level 1 ie 40% with an average of 0.388889% per hour compared to level 2 which is 54% with an average of 0.291667% per hour

Next in Figure 2 Graph of the effect of interaction between factors on the rate of reduction of levels honey water relative as well as Figure 3 further test results using the Tukey test method shows that the treatment combination level 1 temperature 27°C and level 1 relative humidity 40% has the highest average of 0.416667% per hours followed by a combination of treatment level 1 temperature 27°C and level 2 relative humidity 54% which has an average of 0.361111% per hour. In the third and last is occupied by the combination treatment level 2 temperature 28°C and level 1 humidity relative 40% with an average of 0.305556% per hour and the combination of treatment level 2 temperature 28°C and level 2 relative humidity 54% with an average the smallest is 0.277778% per hour.

4. CONCLUSION

Based on these results, it can be it was concluded that the treatment combination the best is level 1 temperature 27°C and level 1 40% relative humidity due to having the highest mean among all combinations treatment. The highest mean indicates that the greatest rate of reduction in water content occurs optimal among other treatment combinations. If compared to the combination of temperature and The relative humidity previously applied to the company was 30°C and 60%, a combination of selected temperature and relative humidity 27°C and

40% can produce a high rate of reduction in water content faster. In Table 1 experimental results preliminaries that combine temperatures of 30℃ and 60% relative humidity of the air can be known that to achieve the standard water content honey 20%, the process of reducing the water content of honey must be carried out for 18 hours. While on combination of temperature and relative humidity treatment selected 27℃ and 40%, 20% moisture content was achieved at around 9 o'clock. Thus, it can be interpreted that the selected treatment combination can reduce honey water content reduction time and increase productivity by 50%.

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DESIGN & BUILD BANKNOTE NOMINAL IDENTIFICATION TOOLS FOR VISUAL IMPAIRMENT USING CONVOLUTIONAL NEURAL NETWORK ALGORITHM AND TENSORFLOW WITH ANDROID BASED

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Abstract. The buying and selling transactions that we usually do in our daily lives are difficult for people with visual impairment because it is difficult to distinguish the denomination of rupiah banknotes because of the limitation of sight, so it becomes one of the problems. This research focused on making a voice-based rupiah banknote nominal detection tool, using convolutional neural network algorithms in machine learning as the core of this system. This tool was also equipped with a voice-based android application to monitor the remaining money used when making buying and selling transactions-testing the tool used real test data of 20 images per class, producing an accuracy of 83%, as evidenced by Confusion matrix calculations.

Keywords: CNN, Visual Impairment, Android, Prediction, Confution Matrix

1. INTRODUCTION

Humans nowadays buy and sell transactions to meet their basic requirements. Cash payment instruments are used in this buying and selling transaction procedure to facilitate the transaction process[1].

Most humans can easily do buying and selling transactions because they have a clear vision. It is in contrast to people with visual impairment disabilities who have difficulty making payments using banknotes because it is difficult to distinguish the nominal that will be paid or received after a transaction. To distinguish each nominal banknote, they usually fold the money according to different folds in each nominal of money or ask people around about the nominal money held. How to distinguish nominal money has flaws in terms of memory for people with visual impairment and the honesty of people around them and sellers in buying and selling transactions[2]. In helping people with visual impairment, money is equipped with a blind code as a language code that contains information about the nominal amount of money. Basically, a blind code is included to make it easier for people with visual impairment to recognize and make transactions using money. However, some people with visual impairment still have difficulty recognizing the nominal money. Furthermore, the difference in the type of blind code in each nominal banknote circulating in the community makes it difficult for people with visual impairment to recognize and remember it[3]. Therefore, using digital image processing, a sound-based banknote nominal detection tool is needed to help people living with visual impairment conduct buying and selling transactions.

Digital image processing, in general, is two-dimensional image processing using a computer. In a broader context, image processing refers to two-dimensional processing data. A digital image is an array containing real and complex values presented with a certain series of bits[4]. Introducing nominal banknotes uses digital image processing with applications using machine learning. Machine learning is a computer application and mathematical algorithm that is taken using learning from various data and generating predictions[5]. In this study, we used deep learning, a machine learning development. Deep learning is a method of data learning that aims to create a multilevel representation (abstraction) of data using a layer of processing development in machine learning.

Deep learning is a method of data learning that aims to create a multilevel representation (abstraction) of data using a data processing layer. The important thing generated as material for data representation is not made explicitly by humans but by an algorithm[6]. This study used a convolutional neural network algorithm to detect the nominal banknote.

Algorithms using Convolutional Neural Networks (CNN) are one of the machine learning methods, which is a development of Multi-Layer Perceptron (MLP), designed to process or create data from two dimensions. CNN is also a type of deep learning method because it has a network level and many applications that are carried out at a network level[7].

In previous studies [8] using the Convolutional Neural Network (CNN) method in classifying vehicle types and resulting in an accuracy of 81.94%. The same method used for the systemization of the identification of coins [9] results in 100% accuracy with the identification of 1-3 objects, then the degree of accuracy decreases with an increase in the number of objects.

This study used the Convolutional Neural Network (CNN) algorithm and the Tensorflow framework, a library for expressing machine learning algorithms and executing commands using information about these objects or recognized targets and can distinguish objects from one another[10]. In addition, this rupiah banknote nominal detection tool was also equipped with an android application to monitor finances when buying and selling transactions.

Based on the previous two studies, the author hopes that the convolutional neural network (CNN) algorithm can identify banknotes, to help some people with visual impairment and can monitor finances during buying and selling transactions using android applications, so as to reduce fraud for blind people when making buying and selling transactions.

2. METHODS

In this study, two stages of implementation were carried out, namely the stage of hardware design and software design in recognition and object detection using the Convolutional Neural Network (CNN).

2.1 Research Framework

This research framework is based on figure 1 as a reference for designing and designing hardware and software that produces a system.

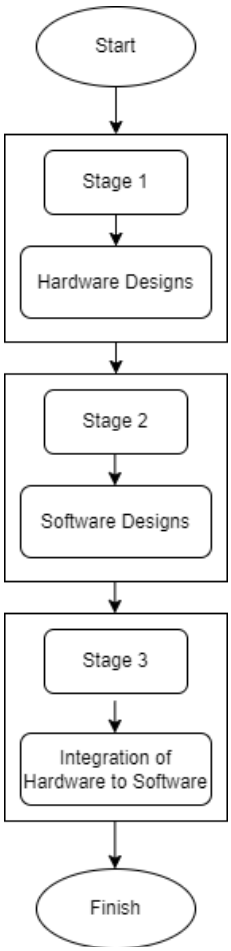


Figure 1. Flow Chart

2.2 Hardware Design

The hardware design used Raspberry Pi 3 model b+ as a microcontroller which is a computer mini device using an SD card for booting and long-term storage[11]. This raspberry pi is connected to other components such as a camera as a medium to detect the nominal money and a power bank as power. In addition, an LED is used to illuminate rupiah banknotes when conducting real test detection, and a button that stores financial history to the server and speakers as an output of the hardware design that mentions the nominal money that matches the money detected.

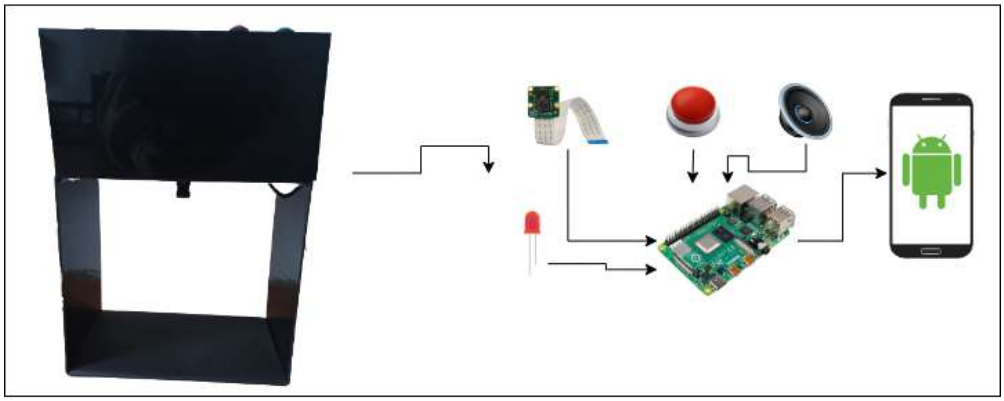


Figure 2. Tool Design and Hardware Circuit Schematic

2.3 Software Design

Software design was the most important thing in this study because it was the core of program processing using Convolutional Neural Network (CNN) algorithms in the detection process[12].

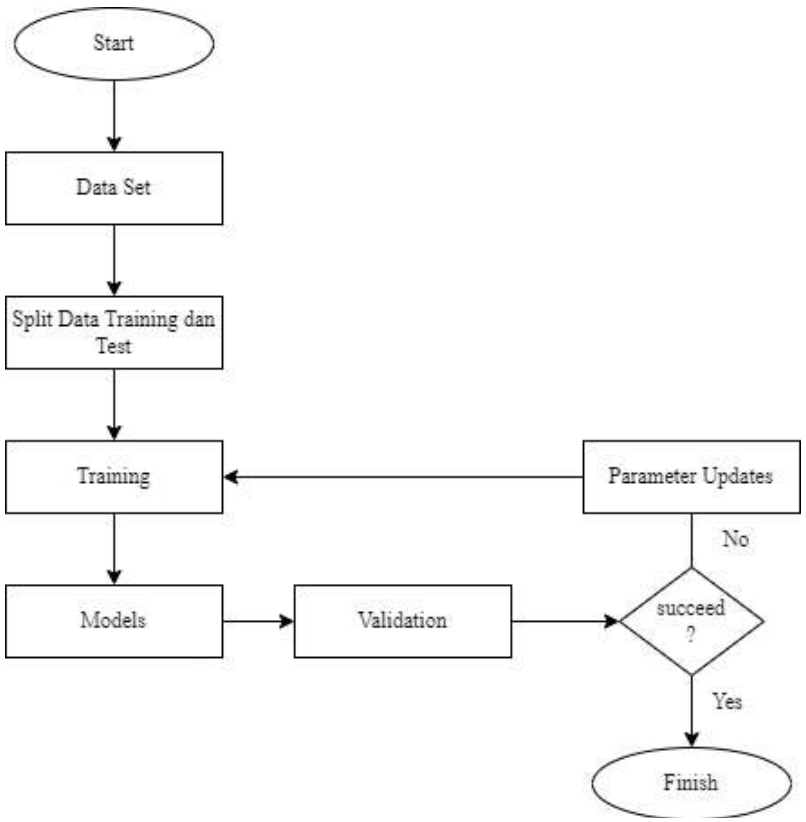


Figure 3. Software Flow Chart

a. Dataset

Dataset collection was carried out by taking pictures through Raspberry Pi cameras from each side of money ranging from 1000, 2000, 5000, 10000, 20000, 50000, and 100000 Indonesian currency, with as many as 40 images of each money.

b. Split Data Training and Testing
This stage first divided the training data and then the test data. Data training is a complete set of data containing classes divided into seven classes to be trained, from which the model can then be grouped into the correct classes. Meanwhile, the testing data contains real data that can be grouped based on a model to determine the system's accuracy. In other words, data training is data that is learned to form a model after learning the patterns and characteristics of a data set that has been collected before. In contrast, data testing is the process of testing a model that has been formed before.
c. Training
At this stage, training in machine learning was machine learning algorithms. The machine learning algorithm changed its parameters to match the data provided during the training process. The training process was needed so that the machine could recognize the characteristics and patterns of an image when going through the training/learning process.
d. Models
After the model was formed, the validation process was carried out, and the learning algorithm tested the image according to the model formed from each class.
e. Validation
The validation stage was carried out to test whether the learning algorithm has succeeded in recognizing the patterns and characteristics of an image. Model validation aims to measure the performance of a model with the ability to classify the data classes being tested. So that the performance of the model is obtained which can help optimize the parameters on the model so that the results obtained are much more accurate.

The software design was also equipped with an android application which is an operating system for Linux-based mobile devices with coverage in the form of operating systems, middleware and applications[13]. Android application for financial monitoring or to find out the remaining money that has been used after making buying and selling transactions. The design of the Android application system can be seen in the following flowchart:

Figure 4. Android Application System Design

2.4 How to Use The Tool
Here's how to use the rupiah banknote nominal detection tool

1. Press the "Power ON" button to turn on the tool.
2. Place the rupiah banknote in the detection place to start predicting how much the money is
3. The speaker will produce sound by mentioning the nominal money according to the predicted money
4. When making a buying and selling transaction, when predicting money in, press button one, while when predicting money out, press button 2. These two buttons are distinguished by braille letters intended for people with visual impairment.
5. After pressing the exit and entry buttons, the data will be stored on the database or server
6. The last process to see the remaining money after a transaction can be monitored using a voice-based android application by stating the amount of money left.

3. RESULTS AND DISCUSSION

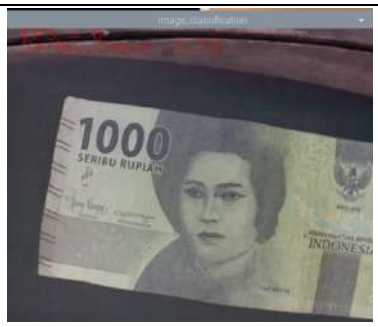
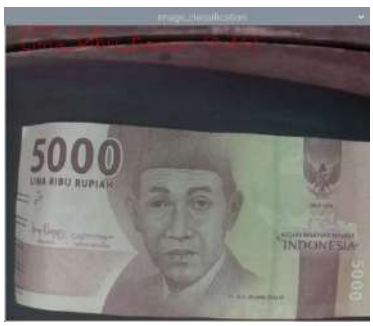
3.1 Design Results

The money nominal detection tool can be used by placing money in the place provided by the tool and can be used to monitor the amount of money used as expenses or entered and stored in the database. The monitoring process can be done through the android application.

3.2 Hardware Build Results

A real test was carried out to find out whether it is true that the tool can predict money according to a predetermined class.

Table 1. Testing of Banknote Nominal Detection Tool

Class	Prediction Results of Banknote Nominal Detection Tool	Descriptions
Seribu		successfully predicted
Dua Ribu		successfully predicted
Lima Ribu		successfully predicted
Sepuluh Ribu		successfully predicted

Class	Prediction Results of Banknote Nominal Detection Tool	Descriptions
Dua Puluh Ribu		successfully predicted
Lima Puluh Ribu		successfully predicted
Seratus Ribu		successfully predicted

In this study, real testing was carried out with data of 20 images per class (nominal money) with the following prediction results:

Table 2, Predicted Results

Class	**Correct Prediction Results**	**Incorrect Prediction Results**
Seribu	20	0
Dua Ribu	17	3
Lima Ribu	15	5
Sepuluh Ribu	15	5
Dua Puluh Ribu	14	6
Lima Puluh Ribu	18	2
Seratus Ribu	18	2

3.3 Calculation of Cnn Algorithm Using Confusion Matrix

Based on the results of predictions using real testing on the tool, we can calculate using the confusion matrix by determining several conditions as in the following table:

Table 3. Confution Matrix

Class	TP	FP	FN	TN	Total
Seribu	20	0	0	0	20
Dua Ribu	17	3	0	0	20
Lima Ribu	15	5	0	0	20
Sepuluh Ribu	15	5	0	0	20
Dua Puluh Ribu	14	6	0	0	20
Lima Puluh Ribu	18	2	0	0	20
Seratus Ribu	18	2	0	0	20

1. TP is True Positive, the amount of positive data correctly predicted by the system.
2. TN is True Negative, negative data correctly predicted by the system (in this case, no testing was carried out).
3. FN is False Negative, the amount of negative data predicted to be incorrect by the system (in this case, no testing was carried out).
4. FP is False Positive, the amount of positive data predicted correctly by the system[14].

To calculate the confusion matrix value based on the table, we can calculate each class's precision, recall, and accuracy values and calculate the average of all classes[15].

a. Precision is used to measure the accuracy between the information requested by the user and the answers given by the system. with the equation as follows:

$$\text{Precision} = \frac{TP}{(TP + FP)} x100\%$$

b. Recall is used to measure the success of a system in rediscovering information with the following equation:

$$\text{Recall} = \frac{TP}{(TP + FN)} x100\%$$

c. Acuracy is used to organize a work method. with the equation as follows:

$$\text{Acuracy} = \frac{TP + TN}{(TP + TN + FP + FN)} x100\%$$

Based on the equation above, the calculation results of each class are obtained as shown in the following table:

Table 4. Confution Matrix Results

Class	**Number of Test Data**	**Precision**	**Recall**	**Acuracy**
Seribu	20	100%	100%	100%
Dua Ribu	20	85%	100%	85%
Lima Ribu	20	75%	100%	75%
Sepuluh Ribu	20	75%	100%	75%
Dua Puluh Ribu	20	70%	100%	70%
Lima Puluh Ribu	20	90%	100%	90%
Seratus Ribu	20	90%	100%	90%
Reform Avarage		83%	100%	83%

3.4 Software Build Results

The software design results were in the form of a voice-based application that sends data in accordance with the results of the buying and selling transaction process that has been stored in the database. For example, the android app looks as follows:

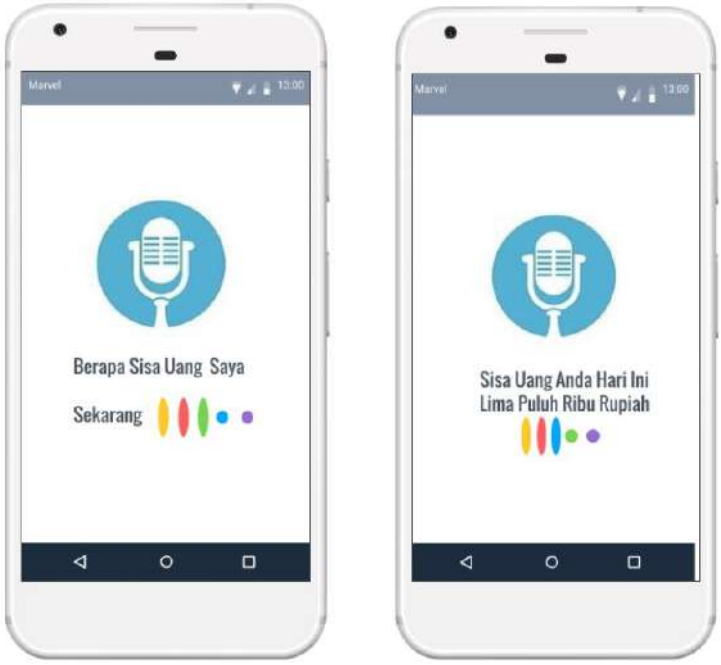


Figure 5. Android App View

4. CONCLUSION

From the research, it can be concluded that the Convolutional Neural Network algorithm can predict the nominal rupiah with an accuracy rate of 83%. In this study, the output or predictions produced are influenced by the datasets used to carry out the training and validation processes in the machine learning process to recognize the patterns and image characteristics of each class.

From this study, it can also be concluded that the money nominal detection tool can predict correctly even with the presentation of errors in predicting as low as 17%. Furthermore, the Android application as support in monitoring money can also be run properly, as evidenced by the amount of money left when making voice-based buying and selling transactions by the application when run. Thus, in its implementation, the process of using the correct tool is required to produce accurate data.

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GREENSHIP ASSESSMENT OF INDOOR HEALTH AND COMFORT AT GREENHUB SUITED OFFICES

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Abstract. Implementation of Green Building can reduce global warming and create health and comfort workplace in order to improve employee performance. Greenhub Suited Office has the potential to get high points in achieving the Indoor Health and Comfort Aspect on the Greenship Interior Space 1.0. This research was done during work activities with 60% occupancyrate. This paper aims to analyze the achievements on indoor health and comfortaspect based on the Greenship rating tools Interior Space version 1.0. The descriptive approach on this reasearch was implemented by collecting data through the interview with an expert and occupants, literature study, the data retrieval with comparative study according to GBCI standard, fields survey directly, and field measurements. Based on the assessment, almost all the Indoor health and comfort criterias had been achieved by Greenhub Suited Offices. The results showed that Greenhub obtained a total index of 23 points with a percentage of 85%. Greenhub must earn 85% of Greenship Rating Toolspercentage for the other five aspects on the GBCI standard to get a platinum rating.

Keywords: green building; greenship interior space 1.0; indoor health and comfort aspect

1. INTRODUCTION

Most of people spend about 70–90% of their time activities indoors [1]. A health and productivity of users can be affected by Indoor environment quality [2]. This reason makes indoor health and comfort aspect is very important for users and has become the concern of Green Building Council Indonesia with a focus on assessing Greenship Interior Space 1.0. Buildings with a green building concept not only give the impression of comfort, but as a solution to create a healthy life for the future [3] .Greenship interior space 1.0 is a rating tools that utilized in ensuring more sustainable, healthy and comfort indoor space [4]. Green Building Council Indonesia (GBCI) is required as a reference and assessment to optimize building design [5].

According to the GBCI Standard, total point based on the Greenship ratings tool for Interior Space are 103 points. The following rankings can be accomplised namely Platinum with a percentage of 73% with a minimum score of 75 points; Gold with a percentage of 57% with a minimum score of 59 points; Si lver with a percentage of 46% with a minimum score of 47 points; Bronze with a percentage of 35% with a minimum score of 36 points [6]. The assessment for Greenship interior space contains 6 aspects. The aspects are Appropriate site development, Energy efficiency and conservation, Water conservation, Material and resources cycle, Building and environment management, Indoor health and comfort (IHC) which is the category with the highest rating points and index.

These aspects are intended to be the main reference for sustainable building design due to its ability to ensure energy and resource savings, reduce building costs, improve health, achievement and productivity of building occupants. "The Business Case for Green Building" declares The buildings with a green concept have the ability to improve the health and productivity of their occupants [7].

The research aims to analyze the achievements on indoor health and comfort aspect based on the Greenship rating tools Interior Space version 1.0. Moreover, it is conducted to determine the achievement potential and references for Greenhub Suited Offices on following Green Building Certification. Several studies have discussed The Greenship Existing Buildings at Universities [8] , indoor health and quality in University [9], alternative to reduce level of noise at office [10], occupants' perception of Office green building [11], indoor pollutant source

control [12], factors that influencing level of the comfort in a University [13], indoor health and comfort effects for tenants productivities [14], and optimizing indoor health and comfort index point [15].

2. METHODS

The research was conducted at Greenhub Suited Offices in Tower A Kota Kasablanka, Jakarta using the descriptive analysis method with data collected through interview, observation, measurements, literature study and the data retrieval with comparative study according to GBCI standard. The research is focused on the Greenship interior space 1.0 assessment of the Indoor Health and Comfort aspect.

The stages carried out in this research are 5 stages. Stage I is the preparation stage. steps taken are identifying and formulating problems, determining research objectives, digging literature and making checklist

forms as data collection instruments; Stage II is called the stage of finding data and collecting data; Stage III is the recapitulation of data that has been collected, and scoring against the catagory that have been met by the project, as well as calculating the point value of each scope of the catagory; Stage IV is called the data analysis stage. The steps that taken are processing the results of the assessment from the recapitulated data to obtain the predicate results; Stage V is the stage of discussing the results of the data that has been analyzed. The steps that taken are discussing and describing the results of the analysis regarding the evaluation of the greenship catagory, making conclusions, and giving suggestions.

The following is a flow diagram of the research (Figure.1)

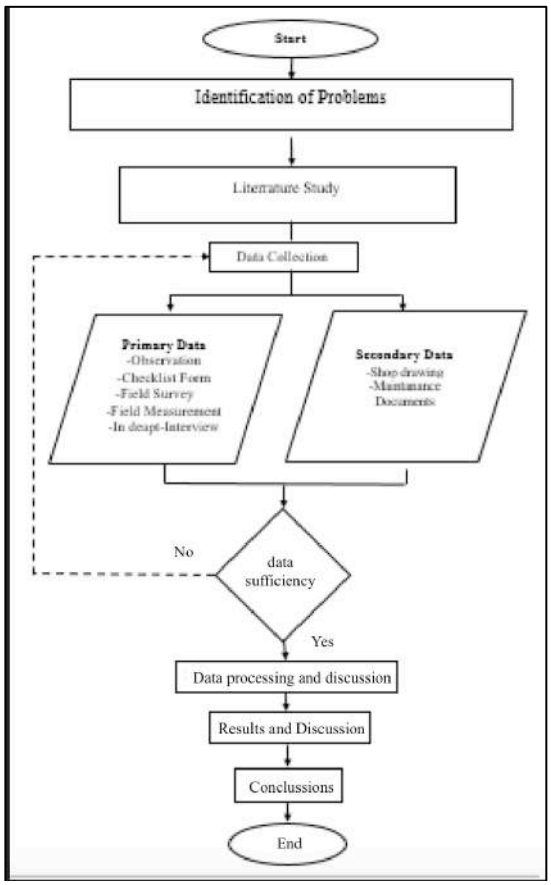

Figure 1. Flow Diagram Research

The primary data in this study were data obtained by the authors of the Greenhub Suited Offices which is related to the Greenship assessment. Several instruments were used to collect data. The visual comfort of lighting level was rated using lux meter. The thermal and humidity comfort was evaluated using a digital room thermometer and anemo meter, acoustic level was measured using sound level meter, biological pollutant was measured by using air sampler and colony counter though the blood agar plate, indoor air quality was measured using air quality meter and CO meter. The chemical quality was evaluated using air quality detector (Figure 2).

Figure 2. Measuring Tools

The results from the observation and measurements were compared with the Greenship Interior Space standards.

3. RESULTS AND DISCUSSION

3.1 Indoor Health and Comfort

Field measurement data in this research was conducted from 33 sample rooms and 90 measured point (Figure 3).

Figure 3. Sample Measured Rooms And Points.

Based on the results of collecting data though observations and field measurements, after being compared using the Greenship Interior Space 1.0 catagory, specially the Indoor Health Comfort, It can be explained as follows:

1. No Smoking Campaigns (IHC P)

The benchmark for Indoor Health and Comfort had been fulfilled by the commitment of management to set all rooms in the office smoke-free. No-smoking campaigns were proven in the form of stickers placed in several areas such as toilet and meeting rooms (point : P).

2. Outdoor Air Introduction (IHC 1)

Benchmark for IHC 1 had not been fulfilled due to the the lack of clean air circulation at some small room area. This assessment was conducted by estimating the number of accupants calculated from the Net Lettable Area with Occupancy Density in accordance to the formula on ASHRAE Standard 62.1-2007 Ventilation for Acceptabel Indoor Air Quality. The results showed there were only 67% of the sample measured room reached the Standard .(point : 0).

3. CO2 Monittoring (IHC 2)
This benchmark for IHC 2 had been fulfilled since Greenhub Indonesia had CO2 sensors installation as preventing shortages of fresh air and maintaining the health of the occupants. It had been discovered that good indoor air quality and low levels of CO2. Greenhub is also equipped smoke alarm detector installation that has a high level of sensitivity to ethanol gas or hydrogen gas. (point: 1). However, the sensors installation were not found in each room so that the second benchmark had not been fullfiled. This, therefore, meant this benchmark had not been fulfilled (point :0). IHC 2 assessment was supported by measurements of indoor air quality. The measurement result showed that 100% of the indoor air quality reached the standard which were less than 8 ppm for the CO parameter and the results were less than 65 µgram/m3 for the PM 2.5 parameter.

4. Chemical Pollutant (IHC 3)
Based on the observation, building finishing material documents and in -deapth interview with Detail Engineering Design (DED) Building Consultant , Chemical Pollutantn criterion earned the maximum points for its benchmark, Greenhub Suited Offices useses almost all sustainable building finishing material . The wall uses bricks with low formaldehyde material and a-low VOC-containted finishing paint which has listed on greenlist product and SNI 3564:2009, the homogenous tile and carpet are used for the floor finishing material in accordance to The Carpet and Rug Institute.1999. The ceiling uses gypsum with low contents of VOC and formaldehyde, the furnish uses interior furnitur in accordance to SNI-01-7206-2006. There is no asbestos in the interior parts of the building and all the materials used were observed to had fulfilled the chemical pollutant criteria and were awarded 9 points (point: 9).
IHC 3 assessment was supported by measurements of chemical quality in accordance to SNI 19-0232-2005. The measurement result showed that 100% of the chemical quality reached the standard which are less than 0,37 mg/m3 for the TVOC parameter.

5. Indoor Pollutant Source Control (IHC 4)
Greenhub Suited Office did not earn the point in this criterion due to the lack of access to the exterior building because it is located on the 38th floor.

6. Biological Pollutant (IHC 5)
Based on the observation, the results showed that it was very rare to find dust on the furnitures and items in the room (Point:1). IHC 5 assessment was supported by the documents of repot cleaning filter, AC WCPU and cooling coils from dust, mold and dirt. The assessment was also supported by measurements of bilogical quality. The measurement result showed that 100% of biological quality reaches the standard which were less than 700 CFU in accordance to Permenkes RI Number 1077/Menkes/Per/V/2011.

7. Visual Comfort (IHC 6)
Benchmark for IHC 6 had not been fulfilled due to the lack of exposure to artificial lighting at some small roomss area. This assessment was conducted by measuring each measured point using lux meter in accordance to SNI 03-6197-2000 of Energy Conservation in Lightning System. The result showed there were only 76% of the sample measured room reached the standard (point: 0).
As observated, all individual rooms provide light settings easily accessible and there is a zonation system for lighting control system for multi occupant area (Point:1). There are some integrated automatic curtains for natural lighting at some office rooms (Point :1).

8. Outside View and Daylight (IHC 7)
As calculated, the spaces that had an outside view were 606,3 m2 (58,5 %). However, the percentage of result was less than 75%. This, therefore, meant this benchmark had not been fulfilled (point :0). Second benchmark for IHC 7 had been fulfilled by Greenhub Indonesia . As measured, 100% office rooms that had an outside view get natural light instensity more than 300 lux in accordance to SNI 03-6197-2000 of Energy Conservation in Lightning System (Point :1).

9. Thermal Comfort (IHC 8)
This criterion aims to ensure stable room temperature and humidity conditions to increase user productivity as measured, the result showed the office temperature and humidity wereset in line with greenship benchmark which is 25 ° C ± 1°C and 60% ± 10% respectively in accordance to SNI 03-6390-2011 (Point:1). As Observated, the office building uses a central AC WCPU system with AC ducting in the central of the office (Point: 1). There is

an individual air temperature control system following the needs and preferences users (Point:1) Individual air temperature control system is in front of each room (Figure 4).

Figure 4. General Conditioning of room tempetarure

10. Acoustic Level (IHC 9)
Based on the measurement, the results showed noise level at Greenhub Suited Offices was 100% in accordance to the design criteria recommended by SNI 03-6386-2000 (Point: 1).

11. Interior Plants (IHC 10)
Workers with indoor plants have better mood levels and feel more comfortable in the office than without plants (Larsen et al. 1998). Based on the observation, Greenhub Suited Offices had fulfilled all the benchmarks for interior plants criterion. There are plants in every office room and many vertical green walls at the office (Point :1) (Figure 5).

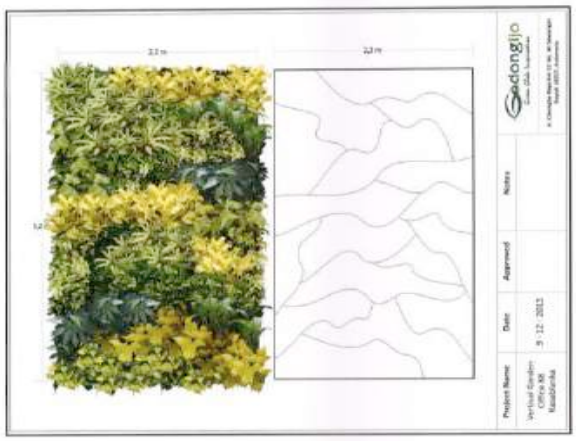

Figure 5. Green Wall Layout

All plants that is used has been based on the interior plants lists (Point: 1). The office management has implemented regular indoor plant maintenance once a week to ensure the plants in a healthy condition (Point 1).

12. Pest Management
As interviewed, Greenhub Suited Office management have and apply SOP/ Standard Operating Procedures to manage and control pests regularly (Point :1) (Figure 6).

Figure 6. Maintanence Documents

13. Room Occupant Survey

As interviewed, the office management had conducted a survey of room tenant' comfort by distributing quetioneries. There were 5 catagories that was asked on the questionnaire such as about air temperature, room cleanliness, room lighting levels, glare and noise levels (Point 1). The results showed there were 1,9 % of respondents felt not comfortable , about 32,8 % of respondents felt comfortable and 65,3 % of respondents felt very comfortable working at the Greenhub Suited Offices (Point :1).

3.2 Indoor Health and Comfort at Greenhub Suited Offices

Table 1. Indoor Health and Comfort Aspects in Greenhub Suited Offices

Code	Creteria	Max. Point	Credit
IHC P	No Smoking Campaign	P	P
IHC 1	Outdoor Air Introduction	1	0
IHC 2	CO_2 Monitoring	2	1
IHC 3	Chemical Pollutant	9	9
IHC 4	Indoor Pollutant Source Control	-	-
IHC 5	Biological Pollutant	1	1
IHC 6	Visual Confort	3	2
IHC 7	Outside View and Daylight	2	1
IHC 8	Thermal Confort	2	2
IHC 9	Acoustic Level	1	1
IHC 10	Interior Plant	2	2
IHC 11	Pest Management	1	1
IHC 12	Room Occupant Survey	3	3
	Point Total	27	23

IHC aspect as the highest rating points, has become an important element for Greenship Interior Space 1.0 assessment. This study showed Greenhub Inonesia was able to get 23 points out of 27 total points of assessment.

4. CONCLUSION

Greenhub Suited Office at Jakarta has many potentials to get a platinum rating on GBCI certification. This potential had been proven by obtaining a high score in Indoor Health and Comfort assessment . Greenhub had fullfilled almost all the criterias for Indoor Health and Comfort on Greenship Rating Tools 1.0. It is also possible to maximize the visual comfort by using office room lights with a greater power and replace the wooden door to the frameless glass door and another alternative is to make air ventilation between 2 small rooms in order to maximize the outdoor air introduction points and maintain better air circulation for room occupants. Further research is required on efforts to enhance the index of indoor health and comfort towards green building. The focus

of improving performances of the aspect can be reviewed from many aspects, such as social, economic, environmental conditions, and city policies.

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FILTRATION DESIGN MODELING STUDY WITH VARIATION IN NUMBER OF FILTERS, PALM OIL MILL EFFLUENT MESHING

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Abstract. Processing activities of oil palm fruit into CPO produce liquid waste that can pollute the environment, so there is a need for liquid waste processing in palm oil mills. This study aims to determine the best design of the variety of mesh and the number of sieves based on Ansys analysis. The mesh variation is 0.105 mm, 0.088 mm, and 0.074 mm, while the number of filters is 3, 4, and 5, with random order variations. The results obtained are the 3 filter formation (ABC formation) has the highest speed of 6,419 m/s, with a low cross flow rate. Meshing formation with a small size in the first position can increase speed and pressure.

Keywords: liquid waste, pollute, filtration

1. INTRODUCTION

Processing activities of oil palm fruit into CPO produce liquid waste that can pollute the environment, so it is necessary to process liquid waste in palm oil mills [1]. This study aims to overcome the pollution in the palm oil mill to meet their daily needs. Most people in the palm oil mill area use pure water. However, the surrounding communities don't know whether the healthy water is suitable for everyday use or not. Based on the research results, groundwater in the South Kalimantan area does not meet health if the water is consumed because it is acidic. Due to unfavorable situations and conditions, humans are forced to use water that does not meet the requirements for life. To give an idea of the properties of water, we must know the content of substances contained in water. Based on the clean water quality standards according to the Regulation of the Minister of Health of the Republic of Indonesia Number: 416/MENKES/PER/IX/1990 concerning the requirements for clean water quality, substances that are important to be chemically examined are Iron, Calcium, Magnesium, Arsenic, Flouride, Chloride, Sulfate, Nitrates and Hardness. In addition, the water must not contain other hazardous materials such as heavy metals and harmful bacteria [2].

The use of water whose degree of turbidity exceeds the permissible threshold can cause adverse effects on health, mainly because high turbidity is a reasonably good medium for the development of micro-organisms and can protect it from the influence of various threats so that the effect of disinfectants expects micro-organisms to be in the environment. the surface of the particles that cause turbidity, therefore the disinfection process requires stirring (mixing) and optimum contact time. One of the current clean water supply strategies is to utilize appropriate technology. Appropriate technology is the most suitable solution for addressing water and sanitation needs through innovative technology and empowering communities to achieve the desired goals [3]. Water content harmful to the human body needs to be filtered or filtered. Filtration is one of the physical water treatments. Filtration is a solid-liquid separation process by passing the liquid through a porous medium or materials to remove or remove as many fine particles of suspended solids as possible from the liquid [4][5].

In this purification process, several layers of membranes are needed to remove dissolved organic substances [6][7]. The Membranes filtration is suitable for the filtration of peat water, which contains a lot of dissolved organic compounds that cause water to turn brown and have an acidic nature. MBR With the hydrophobic PVDF membrane, the cake layer removal efficiencies are at 97% [8][9].

2. METHODS

The research method used is the first is a simulation to analyze the design results of the filtration device A set of computers for simulation

Tools and materials used

a) ANSYS Simulation;

b) Palm oil waste water data:

Density 876 kg/m3 [10].

Viscosity of palm oil waste is 3.53 Pa.s data is taken when the temperature of palm oil waste is 83.19^{o}C [11].

Table 1. Filter Name and Size

No.	Filter Name	Material	Mesh	Size (*meshing*)		
				in.	mm	µm
1.	Filter A	Nilon	140	0,0041	0,105	105
2.	Filter B	Nilon	170	0,0035	0,088	88
3.	Filter C	Nilon	200	0,0029	0,074	74

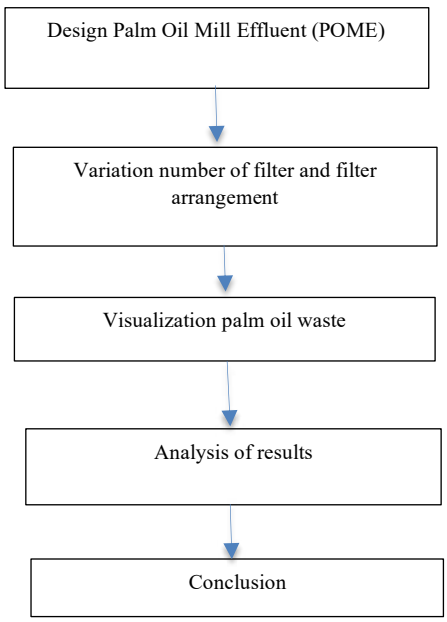


Figure 1. Research flow chart

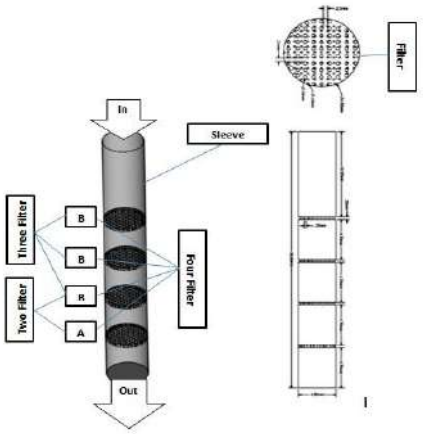


Figure 2. Palm Oil Wastewater Filtration Design

Variation of the number of filtration filters:

a. Variation of the Three filter type with the number and arrangement of 3 filters
b. Variation of the Four filter type with the number and arrangement of 4 filters
c. Five filter type variations with the number and arrangement of 5 filters

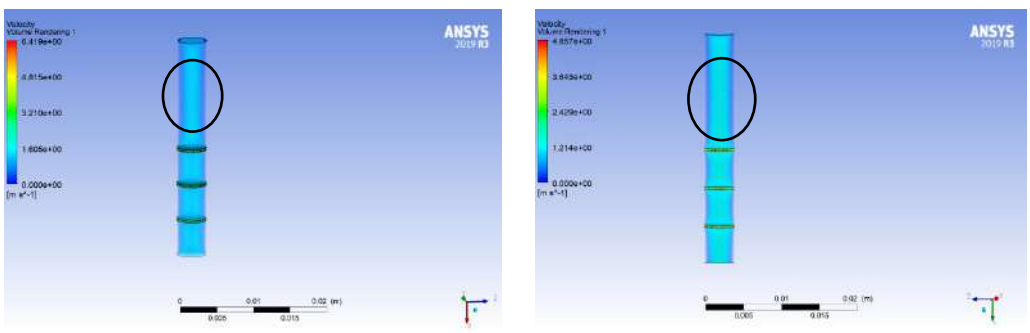
3. RESULTS AND DISCUSSION

The filtration simulation results on various filters 3, 4, and 5 are shown in Table 2. Each type with a filter arrangement: ABC, CBA, ABCA, CBAC, ABCAB, and CBACB. On the inlet side, a pressure of 1 atm is given, and a speed of 1 m/s, so the results are as in Table 2, where the effect of increasing the number of filters will increase the pressure and velocity in the filtration tube.

Table 2. Simulation Result using ANSYS Software

	Formation	Velocity (m/s)	Pressure (MPa)
1	ABC (3 filter)	6,419	15,58
2	CBA (3 filter)	4,857	13,48
3	CBAC (4 filter)	5,85	17,36
4	ABCA (4 filter)	6,84	32,14
5	ABCAB (5 filter)	4,87	25,48
6	CBACB (5 filter)	5,084	17,33

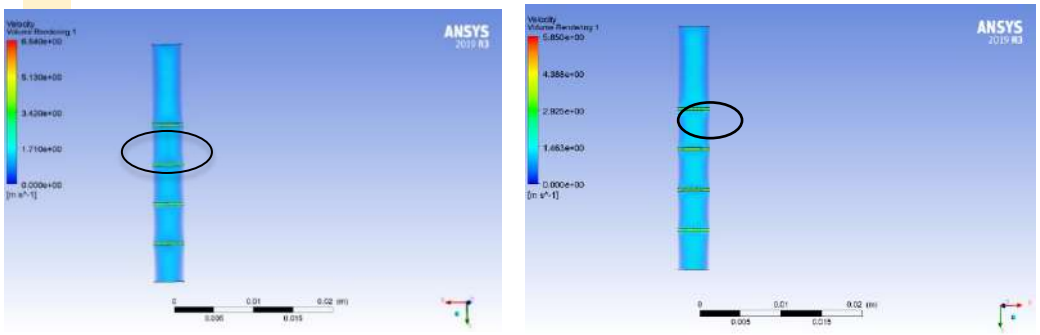
Filter Size Filter A : 0,105 mm
Filter B : 0,088 mm
Filter C : 0,074 mm



Formation ABC Formation CBA

Figure 3. Velocity Disribution three filter formation

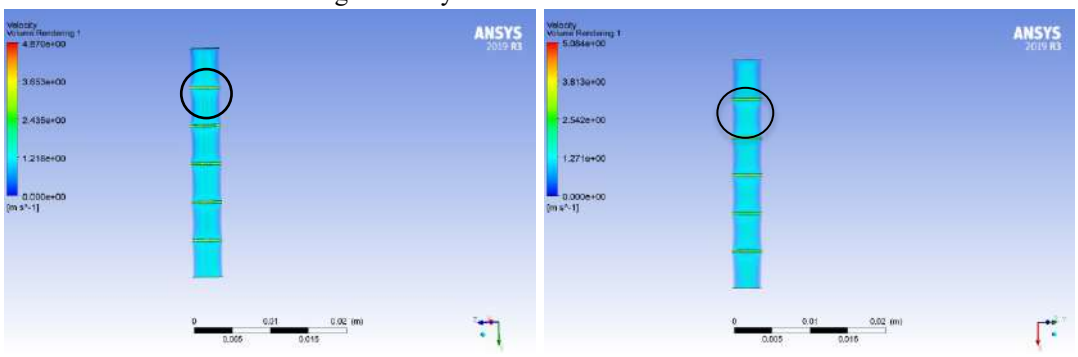
The velocity distribution in the ABC formation filter is more homogeneous in all filtration areas in the pipe, while the high velocity value CBA formation is concentrated in the middle.



Formation ABCA Formation CBAC

Figure 4. Velocity Disribution three filter formation

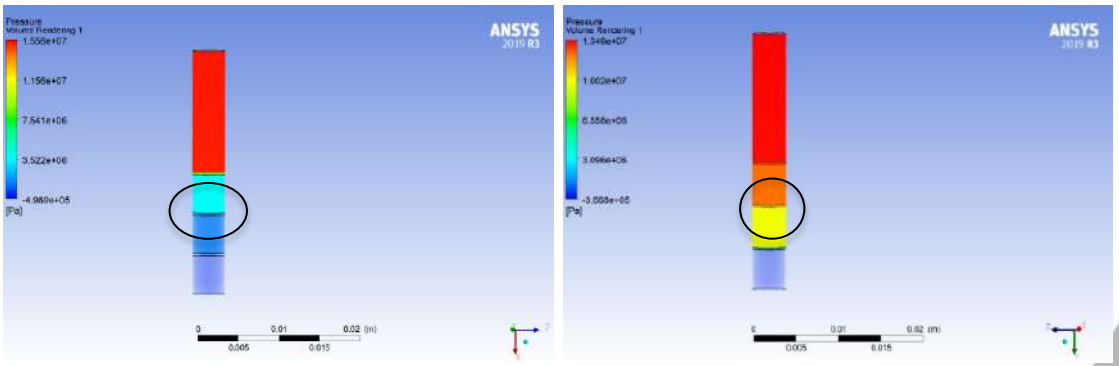
The velocity distribution in the ABCA formation filter is more homogeneous in all filtration areas in the pipe, while the CBAC formation - high velocity values are concentrated in the middle.



Formation ABCAB Formation CBACB

Figure 5z. Velocity Disribution three filter formation

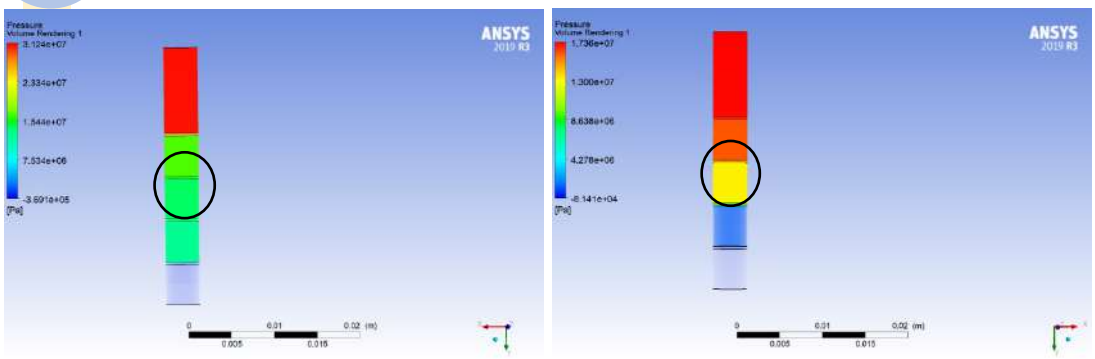
Velocity distribution in the filter formations ABCAB and CBACB high velocity values are concentrated in the middle Pressure analysis



Formation ABC Formation CBA

Figure 6. Pressure Disribution three filter formation

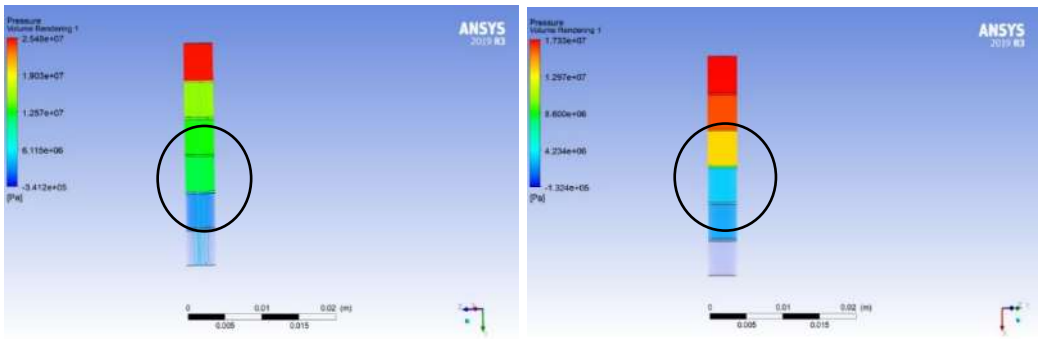
The ABC Formation has lower pressure than the CBA Formation, the ABC Formation has a more even distribution of pressure.



Formation ABCA Formation CBAC

Figure 7. Pressure Disribution three filter formation

The pressure distribution in the ABCA formation is more homogeneous than in the CBAC formation. It can see from the figure that the ABCA formation has a higher pressure value than the CBAC formation. Because diffusion has a very significant effect on filtration at high temperatures, the porosity of the filter cake is larger, which has less effect on filtration efficiency [12], [13].

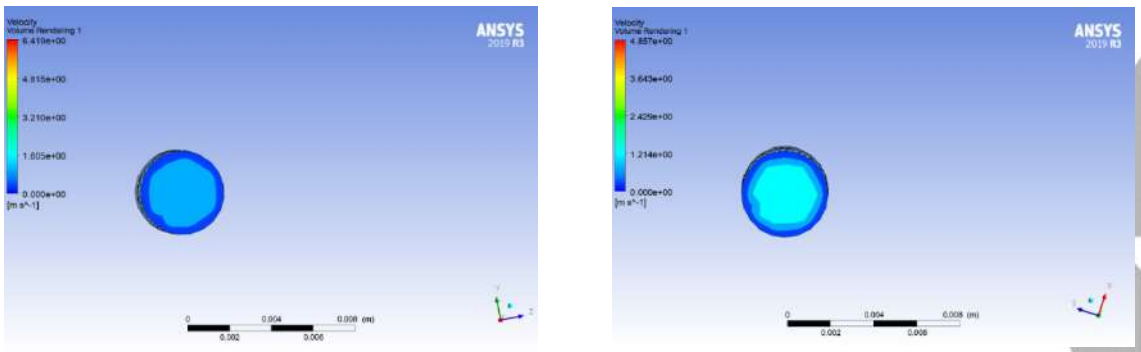


Formation ABCAB Formation CBACB

Figure 8. Pressure Distribution three filter formation

The pressure distribution in the ABCAB formation is more homogeneous than in the CBACB formation, as seen in figure 8. Besides that, the formation of ABCAB has a higher pressure than the CBAC formation. Therefore, cross Flow Reversal (CFR) occurs at condition 5 filters in the CBACB formation.

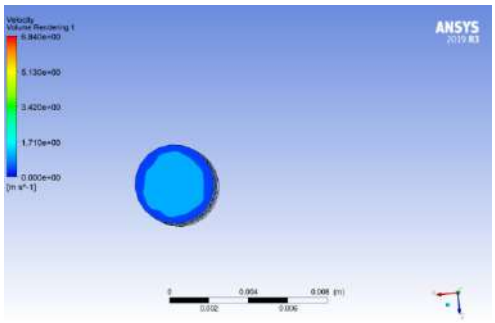
The highest speed with each value in the ABC formation is 6,419 m/s. It happened because of the most effective flow where only two colors are formed, indicating friction loss is the smallest than the other formations. Installation of a small meshing filter at the end of the filtration provides the advantage of reducing friction. At the last level, there is a reversal of the flow direction of fluid that causes an increase in pressure. When the pressure increases, it can reduce the friction loss on the filter, which is advantageous in the filtration process. There are three types of conditions according to [14], namely: filtration type at high pressure and low inlet velocity, high pressure and high inlet velocity, and low pressure and high inlet velocity. In the case of this study, it falls into the third category, namely pressure low and high entry speed. It is caused Cross Flow Reversal (CFR) reversal of flow direction.

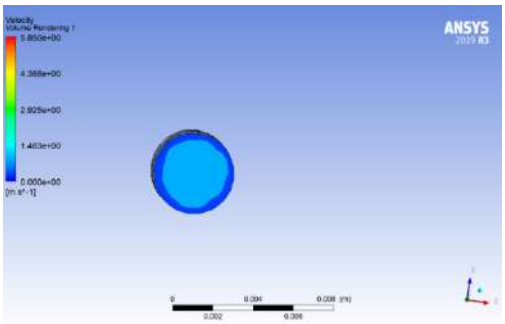


Formation ABC Formation CBA

Figure 9. Pressure Distribution three filter formation

From the cross-sectional image of the filtration, it can be seen that the image of the ABC formation is more homogeneous than the CBA formation, besides that the speed of ABC is higher than that of CBA.

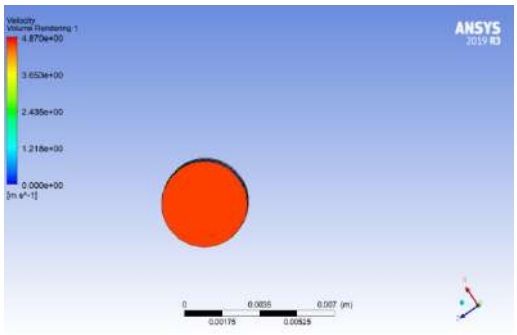


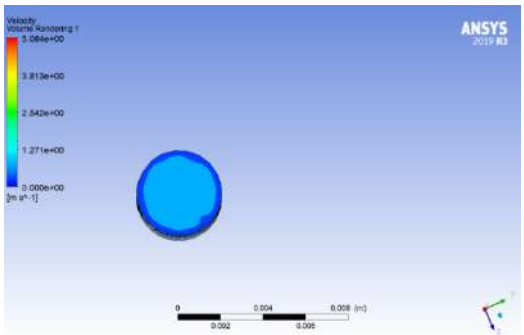


Formation ABCA Formation CBAC

Figure 10. Pressure Distribution three filter formation

From the Figure 10, can be seen that the ABCA and CBAC formations have an even velocity value (homogeneous). it is same with a single and four layers of fabric using linen to simulating cross-flow filtration with fabric filter medium, was also absolutely efficacious [15].





Formation ABCAB Formation CBACB

Figure 11. Pressure Distribution three filter formation

From the picture we can see that the ABCAB formation is more uniform than the CBACB formation, however, the CBACB formation has a higher speed than the ABCAB formation. The table shows the formation of 3 filter ABC formations has the highest speed of 6,419 m/s. When we place a large meshing hole on the first level, the speed and speed are smaller, this can be seen in the CBA, CBAC and CBACB formations. The meshing formation with a small size in the first position can increase the speed and pressure, we can see this in the ABC, ABCA and ABCAB formations. The addition of the amount of filtration can increase the pressure value, this can be seen in the formation of ABCA, CBAB, ABCAB, CBACB. While the reduction in the number of filters will reduce the pressure value, this can be seen in the ABC and CBA formations.

3.3 Citation and References

1. Definition of Filtration

Filtration is a process used to separate solids from liquids or gases using a filter medium that allows the liquid to pass, but not the solids. The term “filtration” applies whether the filter is mechanical, biological, or physical. The liquid that passes through the filter is called the filtrate. The filter medium can be a surface filter, which is a solid that traps solid particles, or a deep filter, which is a base material that traps solids. Filtration is usually an imperfect process. Some of the liquid remains on the feed side of the filter or remains in the filter media and some small solids pass through the filter. As a chemical engineer there is always some product lost, whether it's a liquid or a solid that collects [3] [16].

2. Filtration Types

Broadly speaking, Filtration is divided into three, namely: The filtration process without pressure or simple: is a filtering process using filter paper filter media. The way to do this is to cut the filter paper in a circle, then fold it in half, up to three or four times as much. Next, open it and place it into the separatory funnel so that it adheres to the separatory funnel.

Pour in the heterogeneous mixture to be separated little by little. The result of filtration is a solid called the resident and the liquid is called the filtrate.

a) The filtration process uses pressure: generally carried out by vacuum (aspirated using a vacuum pump). The separation process using this technique is most appropriate when the number of solid particles is much greater than that of the liquid..
b) Filtration process using a membrane: is a separation process using a pore size (0.1 micron) membrane. The principle of this membrane filtration technique is to filter the liquid in the form of a sample through the thinnest filter and made of cellulose-like material. The advantages of membrane filtration are: It can analyze large volumes of samples in a short time which is limited by the viscosity and turbidity of the sample liquid. Can analyze samples with a small number of microbes (improved microbial detection accuracy) [1]. Inhibitors on the sample that can inhibit microbial growth such as antibiotics, chlorine or preservatives can be rinsed off. In general, the cup used is small (50mm) so it can save the use of media and space in the incubator. Practical in preparation, it can be filtered repeatedly (multiply the funnel branch) and is reproducible. Through a certain drying process, membrane paper that has been overgrown with colonies can be used as permanent documents or data for the purpose of recording data. Disadvantages of using membrane filtration are: It is not suitable for counting samples with the number of microbes that are too concentrated, although dilutions can be carried out with graded dilutions. Several types of microbes with a diameter smaller than the pores such as Rickettsia and Mycoplasma are able to escape from the pores of the membrane paper.

3. Benefits and Purpose of Filtration

The addition of the amount of filtration can increase the pressure value, this can be seen in the formation of ABCA, CBAB, ABCAB, CBACB. While the reduction in the number of filters will reduce the pressure value, this can be seen in the ABC and CBA formations. Four Factors affecting filtration in the filtration process there is a physical and chemical reaction, so there are many interrelated factors that will also affect the quality of the efficiency, filtration etc. Some of these factors include: Filtration discharge causes the filter not to function efficiently, so it cannot occur perfectly, and causes some too fine particles to escape from the filter, the highest turbidity concentration in raw water results in clogging of the pores of the media (the occurrence of clogging) [17]. Any change in temperature or temperature causes the density, kinematic and absolute viscosity in water to change, so that there are differences in the size of the particles to be filtered. Depth of size, media, and material The selection of media and size is the most important decision in designing a filter structure. The thickness of the media determines the length of flow and filterability. The water level above the media and the loss of pressure on the condition of the high water surface above the media affect the amount of discharge and the rate of filtration in the media [18].

5. Filtration Research Method

Filtration methods are most often used in laboratories according to the sample being handled and the expected results. In general, there are two filtration methods that are often used, namely: the hot filtration method, which is used to separate solids and liquids, which in the process is not expected to produce crystals in the filter funnel area and other equipment. Cold filtration method, is used to separate between solids and liquids, where after filtration is expected to occur crystal formation. This method uses ice to cool the apparatus to be used, so that the temperature in the system will decrease drastically and can trigger crystal growth [19].

The current filtration method has undergone many modifications, including by combining the flow direction and the filtering media. the slow sand filter technology that is widely applied in Indonesia is the slow sand filter with the flow direction from top to bottom (down flow) [20]. The slow sand filter method can also be used with the up flow direction, namely the flow direction from bottom to top with the media arrangement being reversed as well. The excess of up flow if the filter is saturated or clogged, washing can be done by opening the drain valve. Clean water is entered from above then the sediment will go down by itself and come out through the faucet. In the area near the wall, the pressure tends to slow down due to CFR and friction with the wall [11].

6. Utilization of membranes for filtration

Comparison between cellulose membrane filtration and milliphore filter paper in filtration applications was carried out. The results showed that cellulose membranes were effective in the textile waste management filtration process. Cellulose membranes without a vacuum in the filtration process have better efficiency than other treatments [14]. Conducted research on filtration with chitosan and rice husk silica (biosilica) membranes using the phase inverse technique. The purpose of this study is to analyze the characteristics of the membrane flux, which

is one indicator of the quality of the membrane performance. The variation of the mass ratio of chitosan and biosilica is 1; 1.5; 2 and 3 for membranes A, B, C, and D [21].

4. CONCLUSION

The formation of 3 filter ABC formations has the highest speed of 6,419 m/s. When we place a large meshing hole on the first level, the speed and speed are smaller, this can be seen in the CBA, CBAC and CBACB formations. The meshing formation with a small size in the first position can increase the speed and pressure, we can see this in the ABC, ABCA and ABCAB formations. The addition of the amount of filtration can increase the pressure value, this can be seen in the formation of ABCA, CBAB, ABCAB, CBACB. While the reduction in the number of filters will reduce the pressure value, this can be seen in the ABC and CBA formations.

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CORROSION RATE AND RESIDUAL STRESS ON GMAW WELD JOINT OF SUS 304 STEEL WITH STATIC THERMAL TENSIONING TREATMENT

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Abstract. One of the biggest problems in the metal welding process, especially for stainless steel, is the occurrence of large distortions. To reduce distortion during the welding process, it is recommended to provide secondary thermal like Static Thermal Tensioning. However, the provision of secondary thermal is allegedly able to decrease residual stress but reduce the corrosion resistance of stainless steel . In this study, variations in temperature of static thermal tensioning were applied during the GMAW process of SUS 304 plate. Furthermore, the results of the welding were made test specimens to determine the residual stress and corrosion rate of each temperature variation. The measurement of the residual stress using slitting method and measurements of the corrosion rate was carried out with the Autolab PGSTAT 204 potentiostat. The measurement results showed that residual stress of the welding results decrease along with the increase in the temperature of the Static Thermal Tensioning treatment where the treatment temperature of 200 ºC have highest residual stress at 113.79 MPa, followed by the treatment temperature of 250 ºC with 105.67 MPa value, and the lowest residual stress at temperature of 300 ºC with 77.82 MPa value. But, the corrosion rate value at the opposite way where the treatment temperature of 200 ºC produces the lowest corrosion rate, which is 0.70 mm/year, followed by the treatment temperature of 250 ºC of 0.99 mm/year and at a treatment temperature of 300 ºC with a corrosion rate of 1.27mm/year.

Keywords : GMAW, static thermal tensioning, corrotion rate, residual stress, SUS 304.

1. INTRODUCTION

SUS 304 steel is an austenitic material known for its resistance from rust. Therefore, this type of steel is widely used in various industries such as the chemical, food, and pharmaceutical industries [1]. In manufacturing SUS 304 steel, welding is often used to join two parts together. However, the welding process on SUS 304 steel has a weakness because high temperature involved results in thermal expansion, shrinkage, and microstructural transformation [2]. This makes SUS 304 steel prone to welding defects such as corrosion rates decreased due to sensitization and residual stresses.

The non-uniform heating and cooling during welding process creates non-uniform expansion and contraction of weld joint and base metal, resulting in residual stress [3]. Residual stress occurs when a material is affected to a non-uniform temperature change, which is called thermal stress [4]. The residual stress cannot be seen with the naked eye, but actually residual stress becomes a constant load which causes value of workload increase when there is an external load [5].

Various methods have been carried out to reduce weld defects, one of the method is static thermal tensioning which is proven to reduce distortion, increase fatigue resistance, and reduce residual stress [6,7]. Static thermal tensioning is a treatment when two base metals are heated to a certain temperature away from welding area and cooled behind the weld joint. Static thermal tensioning treatment can reduce longitudinal plastic stress formed during the welding process in the weld area and base metal [8].

However, the heat input can affect on microstructure of the material which can directly affect corrosion resistance of material [9]. Corrosion is damage that occurs to a material caused by environment where material is located. Corrosion is very detrimental both in economy and human livings. It is estimated that about 5% of the industry's national income is spent on corrosion prevention and maintenance of lost or contaminated products due to corrosion reactions [10]. One of the causes of corrosion is sensitization.

Sensitization itself causes degradation of corrosion resistance and mechanical properties [11]. Sensitization causes the deposition of chromium carbide upon cooling, so that the area around the grain boundaries is poor in chromium (<12%). So, when objects are in a corrosive environment, grain boundary corrosion tends to occur [12]. Therefore, further research is needed to overcome residual stresses and observe corrosion rates in welding SUS 304 steel, because this material use widely in industry.

2. METHODS

2.1 Specimen and Equipment Preparation

The material used in this research is SUS 304 steel. Size of the specimen used is 170 x 150mm with 5 mm material thickness. As shown at Fig 1. six points hole also made for the thermocouple sensor place with 2 mm hole diameter for the placement of 37.5 mm thermocouple sensor. In order to record the temperature every second when welding takes place, thermocouple sensor place back plate.

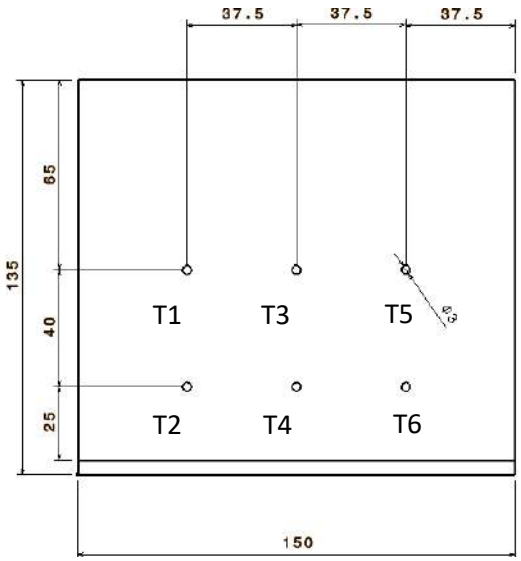


Figure 1. Thermocouple hole position

Tack welds are made on specimens at angle of 90° using a bevel protactor for more precise measurements. For the static thermal tensioning welding method, the heater installation is positioned on the T Joint specimen base metal using flat heater as in Fig 2. The welding process uses a travel motor as a welding aid so the welding speed can be determined constanly at 8.3mm/sec. The travel motor is placed parallel to the welding line

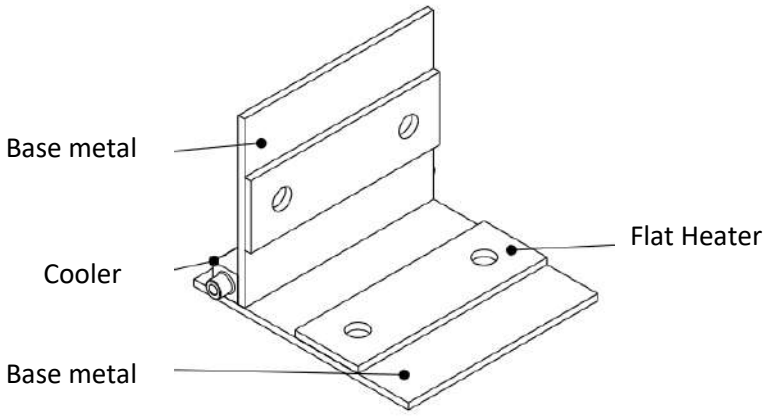
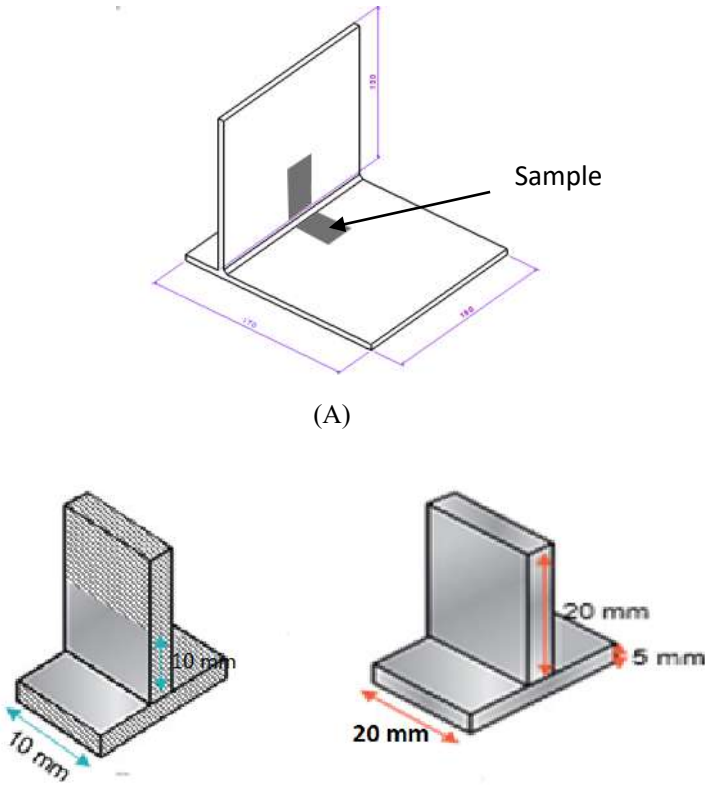


Figure 2. Electric Heater and Water Cooler Installation

The workpiece that has been prepared for testing is cut into smaller sizes both for corrosion rate testing and residual stress testing. Both are taken from the center point of the workpiece (a). The size of the specimen used for testing corrosion rate has dimensions of 10x10 cm in the area that is not shaded (b) and for slitting is 20x20 cm (c) which can be seen in Fig 3.



(A)

(B) (C)

Figure 3. Specimen Preparation

2.2 Method of Collecting Data

2.2.1. Welding Method

In this research, three variations of flat heater temperature was given including temperatures of 200℃, 250℃ and 300℃. Welding parameters are determined like travel speed 8.3m/s, current 75A, voltage 22 V and gas discharge 10 l/min. An illustration of the welding process can be seen in the Fig 4.

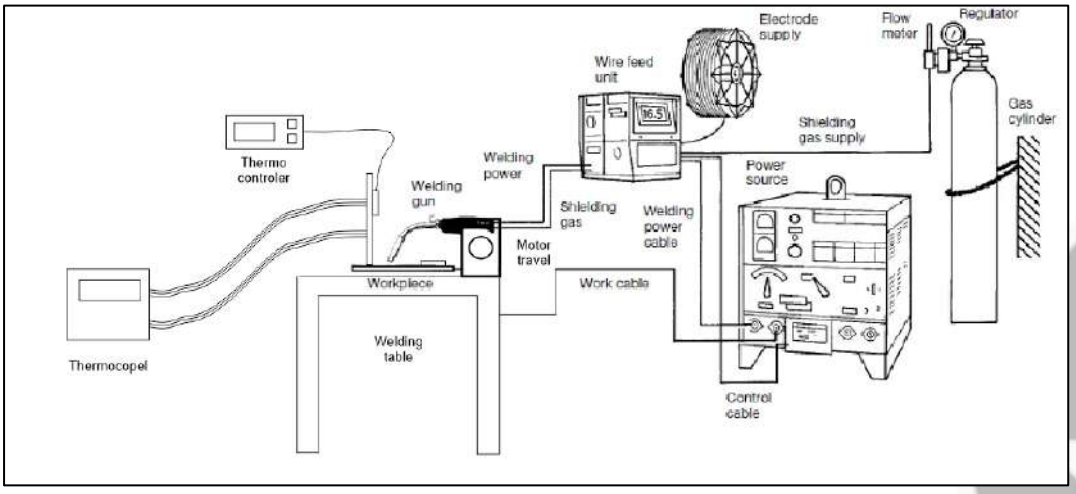


Figure 4. Welding Installation

2.2.2. Corrosion rate test

In order to determine corrosion rate on the SUS 304 test specimen, three electrodes are arranged by pairing each electrode. Then the three electrodes were immersed in test glass contained 150 ml of 3.5% NaCl liquid. From potentiostat, the cable connected to a computer that already contains NOVA 1.11.2 software version. The installation of corrosion testing equipment using a potentiostat can be seen in Fig 5. and standard for corrosion rate measurenemnts with electrochemical method using ASTM [13].

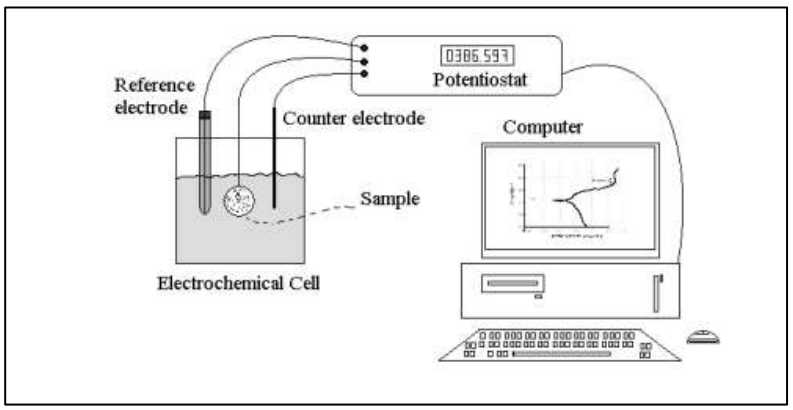


Figure 5. Potensiostat Installation

2.2.3. Slitting Test

In the slitting test, strain gage sensor is attached to the back of specimen as shown at Fig 6.Then an eighteen mm incision is made with a 45° slope using an wirecut electrical discharge machine. The results of each millimeter of strain are recorded using *wavejumper* software which is connected to a strain amplifier which reads the strain on the strain gage sensor.

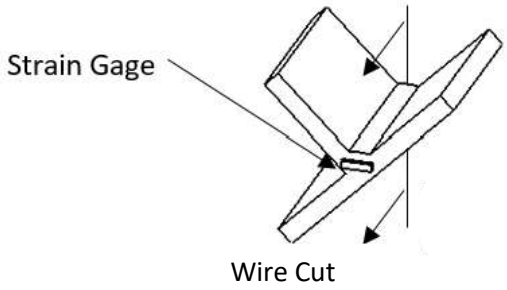


Figure 6. Slitting Method on T-Joint

3. RESULTS AND DISCUSSION

3.1 Distribution of Temperature

The temperature distribution during the welding process with static thermal tensioning temperatures at 200 ºC, 250 ºC, and 300 ºC shown in Fig 7. as a graphical form.

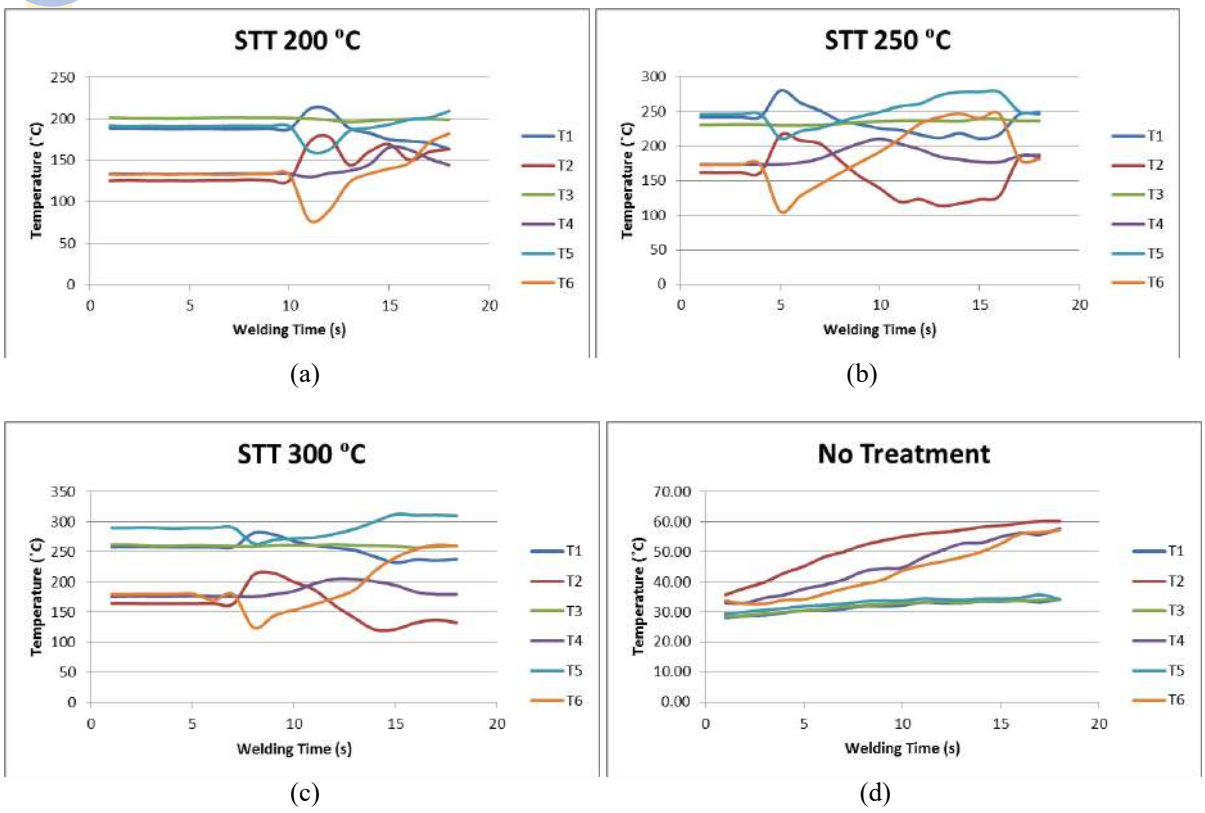


Figure 7. Distribution of Temperature During welding

From the welding process, the temperature from each thermocouple point is taken. It can be seen in Fig 7., when the heater temperature in the static thermal tensioning treatment is high, the temperature at the base metal is high too (T1, T3, T5). This behavior due to accumulation of heat that occurs in the welding area and the base metal. This behavior different in without treatment welding where the heat source is only found in the welding process, so heat accumulation wasn't high as static thermal tensioning method.

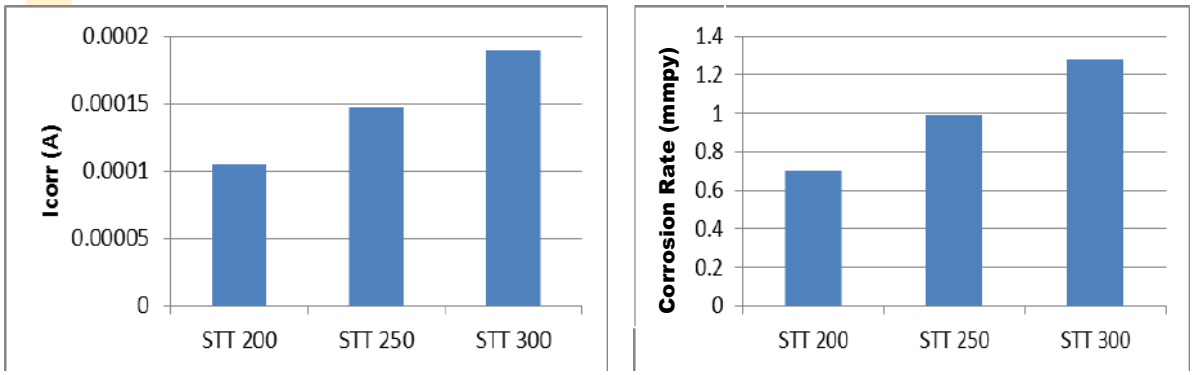
3.2 Corrosion Rate

The results of the measurement of corrotion rate on the SUS 304 plate from GMAW welding with T joints are presented in Table 2.

Table 2. Corrosion Rate of Static Thermal Tensioning Treatment with Temperature Variation

Treatment	ba(V)	bc(V)	jcorr (A/cm²)	icorr (A)	Corrosion rate (mm/year)	Polarization resistance (Ω)
No Treatment	0,17489	1,7783	$9,15x10^{-5}$	0,000183	1,2312	377,77
STT 200˚C	0,17589	0,80223	$5,23x10^{-5}$	0,000105	0,70303	599,36
STT 250˚C	0,2003	2,4682	$7,38x10^{-5}$	0,000148	0,99271	545,13
STT 300˚C	0,19609	1,6737	$9,50x10^{-5}$	0,00019	1,2773	401,41

In Fig 8. It is shown that the corrosion rate increases with increasing heater temperature in the static thermal tensioning treatment. The highest corrosion rate value is 1.2773 mm/year at temperature of 300˚C. While the lowest corrosion rate found at temperature of 200˚C with value of 0.70303 mm/year. The value of the corrosion rate (b) is closely related to the corrosion current (a) that occurs in the polarization of the potentiostat. This is because the corrosion process in metals is a spontaneous occurrence that takes place simultaneously with the presence of electrons flowing in the metal. the amount of electron flow is proportional to the height of the electric current. If the electric current increases, the corrosion rate also increases [14].



(A) (B)

Figure 8. Distribution of Temperature During welding

3.3 Residual Stress

The results of residual stress measurement according to the closest strain value from strain gage on the SUS 304 plate with T-Joint GMAW welding are presented in table 3.

Table 3. Residual Stress of Static Thermal Tensioning Treatment with Temperature Variation

Treatment	Young Modulus (MPa or N/mm2)	Micro Strain ($\mu\varepsilon$)	Stress (MPa)
No Treatment	187500	654.572963	122.7324306
STT 200 ˚C	187500	606.8958095	113.7929643
STT 250 ˚C	187500	563.6116825	105.6771905
STT 300 ˚C	187500	415.05	77.821875

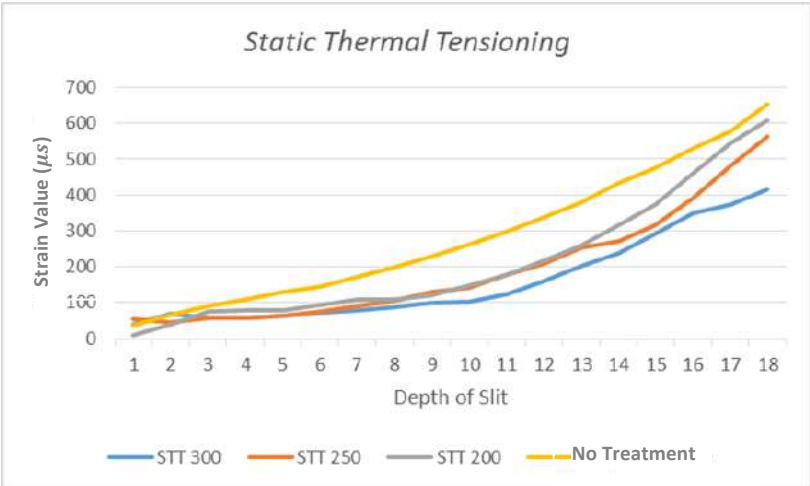


Figure 9. Strain Value Comparasion

According to the graph in Fig 9. when the cutting process on the specimen is deeper, the strain value is greater. The temperature of the static thermal tensioning treatment also affects the strain value. When heater temperature in the static thermal tensioning treatment is higher, the strain value in the cutting path also high. This is directly proportional to the residual stress value.

In Table. 3 it can be seen that the static thermal tensioning treatment at temperature of 200˚C has a stress value of 113.79Mpa, but it still lower than the without treatment welding method with value 122.73 Mpa. While the static thermal tensioning treatment at a temperature of 300˚C has the lowest stress value, which is 77.82 MPa. This is happen because the temperature difference between the base metal and the metal being welded is proportionally distributed, considering that the residual stress occurs due to unproportionally distribution of heat. Proportional heat distribution relief stress slowly [15].

4. CONCLUSION

Referring to the discusion of this study can be concluded as follows:

1. The most optimal temperature from static thermal tensioning treatment to reduce corrosion rate on 5 mm thickness of SUS 304 T-Join welding is at 200˚C with 0.7 mm/year corrosion rate.
2. The most optimal temperature from static thermal tensioning treatment to reduce residual stress on 5 mm thickness of SUS 304 T-Join welding is at 300˚C with 77.8 MPa residual stress.
3. Correlation between corrosion rate and residual stress is inversely proportional even though they are both affected by the treatment temperature

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ANALYSIS OF FINANCIAL FEASIBILITY OF TOURISM TRANSPORT AND SHUTTLE TRANSPORT BUSINESS (CASE STUDY: PT. PENJOR BALI TRANSPORT)

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Abstract. Before the Covid-19 pandemic, an increase in the number of foreign and domestic tourists. With the increase in the number of tourists, the number of tourist travel efforts to increase the mode of transportation, with the aim of travel and shuttle visits increases every year. The objectives of the study are to analyze most of the BOK of tourist and shuttle transportation, to analyze the revenue of financial transportation and shuttle transportation, and to analyze the feasibility of tourist and shuttle transportation. The data needed for this study are primary data obtained from questionnaire surveys and interviews, and secondary data obtained through related institutions. The total operational cost of the tourist transportation vehicle is Rp. 5,937,007,065 12 vehicles / year, shuttle transportation of Rp. 5,975,220,122 17 vehicles / year. The total tourism transportation revenue is Rp. 7,158,878,400 12 vehicles / year, and shuttle transportation of Rp. 8,978,130,221 17 vehicles / year. The financial feasibility of tourist transportation with an NPV value of Rp. 100,640,493,054> 0 (feasible), BCR value 1.95> 1 (feasible), IRR value 42.478%> 15% MARR (feasible), and PBP time of 7 years and 1 month. Shuttle transportation NPV value of Rp. 734,194,558> 0 (feasible), BCR value 1.02> 1 (feasible), IRR value 19.649%> 15% MARR (feasible), and PBP time of 6 years 4 months. Sensitivity analysis of tourist transportation costs increased by 34%, income decreased by 34% and shuttle costs increased by 1.5%, income decreased by 1.5%. Losses during 2020-2021, for tourist transportation amounted to -Rp. 10,782,606,379 12 vehicles / 2 years, shuttle transportation of -Rp. 16,866,802,314 17 vehicles / 2years

Keywords : Tourism Transportation, Shuttle Transportation, Vehicle Operating Costs, Financial Feasibility

1. INTRODUCTION

As a tourist destination, Bali consistently places the tourism sector as a mainstay sector and has a major impact on Bali's economic growth. Based on data from the Bali Province Central Statistics Agency (2020), the number of foreign tourists who came directly to Bali continued to increase in 2015 amounting to 4,001,835 people, then in 2019 it increased to 6,275,210 people. The number of domestic tourists who came directly to Bali in 2015 was 7,147,100 people, then in 2019 it increased by 10,545,039. Based on the data, the number of travel agents continued to grow in 2015 as many as 368 businesses, then in 2019 increased to 416 businesses [1][2]. Meanwhile, the number of bus fleets has increased, in 2015 there were 7,532 vehicles, then in 2019 it increased to 9,142 vehicles. Before the Covid-19 pandemic, the development of foreign tourists and domestic tourists greatly affected the income level of the community. So that people's incomes increase, the community's need for the tourism travel industry will increase.

This fact immediately received a response from business people, especially private business actors in the field of tourist travel transportation and travel agencies. In addition to tourists, residents need for tours and travel agencies such as conducting student study tours/students out of Bali and within Bali, praying (Tirtayatra), and

shuttle trips. By using the bus or minibus mode of transportation, travelers will be offered attractive packages at competitive prices [3][4]. The number of businesses from tourist transportation that do not pay attention to cost items that affect the financial feasibility of the business. When a problem occurs, the entrepreneur cannot make the necessary adjustments to survive in the business. Based on these conditions, investment in the form of bus transportation by business actors requires a large initial capital and of course needs to be carefully planned. Operational costs, fare pricing and unexpected costs are further considerations for travel entrepreneurs.

To overcome the problem of the financial feasibility of the shuttle tourism transportation as a first step, it is necessary to have a study on the financial feasibility of tourist transportation and shuttle transportation. Previous research, analysis of the Financial Feasibility of Tourism Transport in the Province of Bali [5][6]. Judging from the aspect of travel needs, the tourism transportation travels to tourist objects in the province of Bali. In terms of cost-benefit aspect, operating income is determined from different fares, based on local/archipelagic/international package names and bus types. Judging from the financial feasibility, the results of the study are said to be feasible, but sensitivity analysis is not calculated [7][8]. Further research, regarding the financial feasibility of city tour transportation in Denpasar City [9]. Judging from the aspect of travel needs, the city tour transportation travels to tourist objects in Denpasar City. Judging from the cost benefit aspect, operating income is determined from trial and error rates. Judging from the financial feasibility, the study did not calculate the Payback Period (PBP). With the current study, the study carried out two different travel characteristics. In real conditions, tourist transportation has a non-fixed route, while shuttle transportation has a fixed route, in terms of benefits, tourism transportation business income uses different rates depending on the needs of each trip, while shuttle transportation uses relatively fixed rates. Financial feasibility calculated NPV, BCR, IRR, PBP, and sensitivity analysis. The research was conducted at the company PT. Penjor Bali Transport. The reason the research was conducted on these companies is because they have different travel characteristics, both tourist transportation services within Bali and outside Bali, and shuttle services.

2. METHODS

The research steps are carried out in stages including preliminary studies, identification of problems and setting research objectives, literature review, data collection includes primary and secondary data, calculation of income for tourist transportation and shuttle transportation, calculation of operational costs of tourist transportation vehicles and shuttle transportation, financial feasibility analysis and sensitivity analysis. From the information and preliminary studies, problems can be identified in the travel agency business company. Furthermore, the objectives were set, namely to analyze vehicle operating costs [3], analyze the company's income, analyze the feasibility level of investing in the company, and analyze income losses due to the Covid-19 pandemic without the Covid-19 pandemic. Data collection starts from the Office of PT. Penjor Bali Transport and later on several other similar related agencies, to predict revenue and estimate the average demand growth per year.

Primary data obtained from interviews with PT. Penjor Bali Transport, to obtain vehicle operating costs while secondary data obtained from the Bali Provincial Statistics Agency, in the form of inflation data for Denpasar City, data on basic loan interest rates obtained from the Financial Services Authority, as well as data on the number of shuttle passengers, data on the amount of income per year of transportation. tourism is obtained from PT. Penjor Bali Transport. In accordance with the objectives to be achieved, the tabulation of data is based on the classification of initial investment costs, fixed operating costs and variable operating costs as well as revenue generation. In this study, the feasibility analysis carried out is NPV, BCR, IRR and PBP, with a technical age of 15 years for tourist transportation and 10 years for shuttle transportation. Sensitivity analysis to changes in loan interest is carried out if the investment has been declared feasible [10][11][12]. The results of the analysis are then concluded and suggestions are developed which are expected to improve the performance of the investment.

3. RESULTS AND DISCUSSION

Vehicle Operating Expenses

From the results of questionnaires and interviews conducted with the owner of PT. Penjor Bali Transport then obtained the operational costs of tourist transportation vehicles and shuttle transportation. Tourist transportation has a total fleet of 3 units (45-50 seats) of the large type of Hino RK bus, a fleet of 4 units (35 seats) of the medium bus type Isuzu NQR, a fleet of 5 units (31 seats) of the medium bus type of the Mitsubishi Canter type. Shuttle transportation has a fleet of 17 units (13 seats) of the microbus type Isuzu ELF.

Tourism Transport

The operational costs of tourism transportation are grouped into several cost components, namely direct costs and indirect costs. Calculation of BOK + Margin 15% for large buses (capacity 45-50 seats) is Rp. 514,080,836.00 per bus, medium bus (capacity 35 seats) Rp. 484,331,339.00 per bus, and medium bus (capacity 31 seats) of Rp. 459,963,190.00 per bus. Large buses (capacity 45-50 seats) the average distance is 200 km/day, with the number of operations per month for 24 days, medium buses (capacity 35 seats and 31 seats) are 170 km/day, with the number of operations per month for 20 days. So that the distance traveled for 288 days (one year) for large bus vehicles (45-50 seats capacity) of 3 units is 57,600 km, medium bus vehicles (35 seats capacity) of 4 units is 48,960 km, medium bus vehicles (31st capacity) seat) of 5 units is 48,960 km. The results of the calculation of vehicle operating costs per kilometer, large buses are Rp. 9,000 per kilometer, medium bus (35 seats) vehicle operating costs per kilometer are Rp. 10,000, medium bus (31 seats) vehicle operating costs per kilometer of Rp. 9,500. The total total operating costs of tourist transport vehicles per year for 12 vehicles is Rp. 5,937,007,065, the projected income with an average inflation growth rate of 2.94% from 2022 - 2036, can be seen in Figure 1.

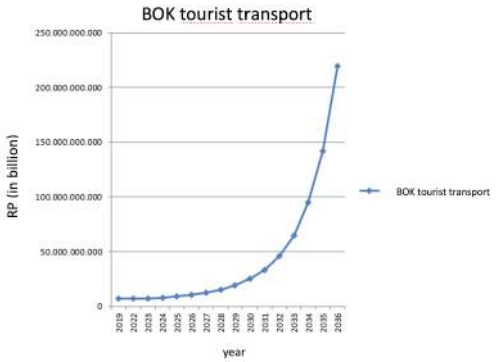

Figure 1. Operational Cost of Tourism Transport Vehicles

Shuttle Transport

The operational costs of shuttle transportation are grouped into several cost components, namely direct costs and indirect costs. Calculation of BOK + Margin 15% for microbus (capacity 13 seats) of Rp. 342.211.581.00 per bus. Microbus (13 seats capacity) the average mileage is 300 km/day, with the number of operations per month for 24 days, so that the distance traveled for 288 days (one year) for microbus vehicles (13 seats capacity) as many as 17 units is 86,400 km. The results of the calculation of vehicle operating costs per kilometer, microbus of Rp. 4,000 per kilometer. The total total operational cost of shuttle transportation vehicles per year for 17 vehicles is Rp. 5,975,220,122, the projected income with an average inflation growth rate of 2.94% from 2022 - 2031, can be seen in Figure 2.

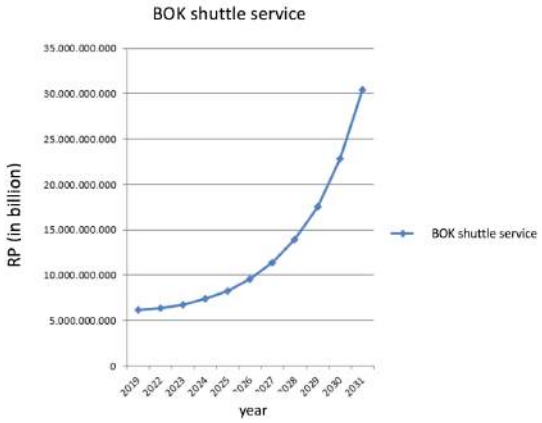

Figure 2. Operational Cost of Shuttle Transport Vehicles

Company Operating Income

Tourism Transport

Based on the results of the interview questionnaires conducted, the income of PT. Penjor Bali Transport comes from tourist transportation in 2019 amounting to Rp. 6,896,800,000. The tourism transportation revenue projection is calculated using data on the average income growth rate, where 2019 is the base year data [13]. From the calculation of income in 2019 as the base year, then income projections are carried out from 2022 to 2036. In

2020 and 2021 it is assumed that the economy has not returned to normal and in 2022 the economy will return to normal. This calculation does not use 2020 data, because the data is not significant for projecting income as a base year, and the income calculation does not take into account the price per travel package or per person, so that the projected income calculation that will be issued until the technical age of the vehicle is total revenue. per year plus the value of income with an average percentage of income growth rate from 2014 to 2019 of 3.8% based on revenue data from PT. Penjor Bali Transport. The results of the projected income from 2022 to 2036 can be seen in Figure 3. The total income from 2022 - 2036 is Rp. 1,562,035,827.201

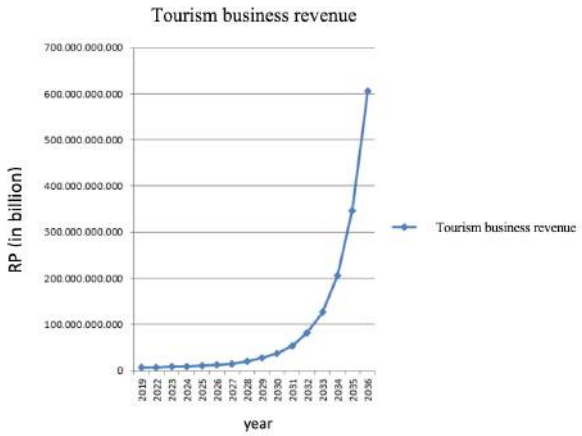

Figure 3. Tourism Transportation Business Income

Shuttle Transport

Shuttle transportation has travel package rates including Denpasar-Lumajang PP Rp. 210,000, Denpasar-Banyuwangi PP Rp. 180,000, Denpasar-Jember Rp. 190,000, Denpasar-Surabaya PP Rp. 220,000, Denpasar-Malang PP Rp. 220,000. The company does not have branches outside or within the province of Bali, but the home base for shuttle transportation is entrusted to each company agent in Lumajang, Banyuwangi, Jember, Surabaya, and Malang. Based on the results of interviews with PT. Penjor Bali Transport, the price of travel packages increased by Rp. 10,000 for the past 2 years, so it is assumed that the price increase for travel packages is Rp. 10,000/2 years. Furthermore, the calculation of passenger projections is carried out, by finding the average passenger growth rate that differs depending on each travel route from the data from 2014 to 2019. The results of the annual passenger projection are multiplied by the travel package, so that the annual revenue for each route is obtained. Figure 4 shows the increase in income from 2022 to 2031, the total revenue from 2022 - 2031 is Rp. 148,324,344,698.

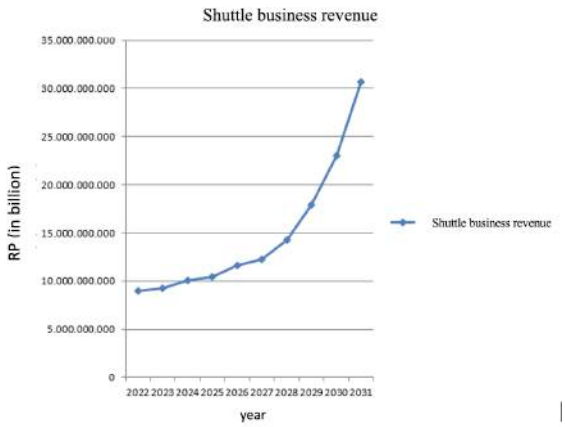

Figure 4. Shuttle Transportation Business Income

Financial Feasibility Analysis

Tourism Transport

The results of the financial feasibility analysis obtained NPV of Rp. Rp. 100,640,493,054 > 0, the BCR value is 1.95 > 1, the IRR is 42.478% > MARR 15%, and the PBP value for 7 years 1 month is smaller than the planned life of 15 years. It can be said that tourist transportation is financially feasible.

Shuttle Transport

The results of the financial feasibility analysis obtained NPV of Rp. Rp. 734,194,558 > 0, BCR of 1.02 > 1, IRR of 19.649% > MARR of 15%, and the PBP value for 6 years 4 months is smaller than the planned life of 10 years. It can be said that the shuttle is financially feasible.

Sensitivity Analysis

Sensitivity analysis on Tourism and Shuttle Transportation of PT. Penjor Bali Transport carried out a trial and error calculation of changes in income and costs, with three (3) sensitivity conditions carried out [14][15], namely: (1) With fixed income and increased costs. (2) With increased revenues and fixed costs. (3) With revenues and costs both increasing. Based on the calculation of the sensitivity analysis that has been carried out, the results of the sensitivity analysis are as follows:

The results of the sensitivity of tourism transportation, with costs rising 101% and fixed income investment are not feasible. Likewise, with revenue down by 50% and fixed costs, income down by 34% and costs increasing by 34%, the investment is not worth it. This is because the value of NPV < 1, BCR < 0, and IRR < MARR.

The results of the sensitivity of shuttle transportation, with costs increasing by 3% and fixed income investment are no longer feasible. Likewise, income decreased by 3% and fixed costs, income decreased by 1.5% and costs increased up to 1.5%. The investment is not feasible. This is because the value of NPV < 1, BCR < 0, and IRR < MARR.

Business Income During the Covid-19 Pandemic and Normal Conditions

Tourism Transport

From the secondary data, it was found that the income of PT. Penjor Bali Transport comes from tourist transportation in 2020 in the amount of Rp. 1,868,100,000 12 buses/year. The income is obtained from real conditions (the Covid-19 pandemic), while income under normal conditions in 2020 is Rp. 7,158,878,400 12 buses/year, assuming normal conditions in 2020 using an average income growth rate of 3.8% from 2014 to 2019. Then, tourism transportation revenue is projected with real conditions (the Covid-19 pandemic), compared to under normal conditions (without the Covid-19 pandemic), calculated using data on the average income growth rate as the base year data. From the calculation of income in 2020, then revenue projections for 2021 are carried out. In 2022 the economy will return to normal. In the calculation, we look for the amount of loss from real conditions (Covid-19 pandemic), compared to normal conditions (without Covid-19 pandemic), obtained from the difference in income from real conditions (Covid-19 pandemic), with normal conditions (without Covid-19 pandemic). . Total income in real conditions (covid-19 pandemic) is Rp. 3,807,187,800 12bus/2 years, the total income under normal conditions is Rp. 14,589,794,179 12bus/2 years. The results of the losses experienced from tourism transportation revenues on real conditions (the Covid-19 pandemic) had a major impact on the company's income, the losses totaled -Rp. 10,782,606,379 12bus/2 years from 2020 to 2021.

Shuttle Transport

The Covid-19 pandemic condition uses data on the number of passengers based on secondary data obtained from PT. Penjor Bali Transport. Normal conditions assuming a different passenger growth rate for each travel route using the 2019 passenger base year is projected to 2020. The calculation of income for the Covid-19 pandemic and normal conditions by multiplying the shuttle travel package rate, namely Denpasar-Lumajang PP Rp. 210,000, Denpasar-Banyuwangi PP Rp. 180,000, Denpasar-Jember Rp. 190,000, Denpasar-Surabaya PP Rp. 220,000, Denpasar-Malang PP Rp. 220,000. Furthermore, the total income from the year 2020-2021 due to the Covid-19 pandemic was Rp. 1,577,966,300 17 transportations/2 years, and the normal condition is Rp. 18,444,768,615 17 freight/2 years. Furthermore, if we look at the loss from the difference in income from real conditions and income from normal conditions of shuttle transportation, it is -Rp. 16,866,802,314 17 freight/2 years

4. CONCLUSION

.Amount of Vehicle Operating Costs: Tourism Transportation, 3 types of large bus vehicles, capacity 45-50 seats, vehicle operating costs per bus per year + 15% margin of Rp. 514,080,836, the type of medium bus as many as 4 units of vehicles, a capacity of 35 seats vehicle operating costs per bus per year + 15% margin of Rp. 484,331,339, and 5 medium-sized buses, 31 seats capacity, vehicle operating costs per bus per year + 15% margin of Rp. 459,963,190. So the total operational cost of tourist transportation vehicles is 12 units of vehicles per year, which is Rp. 5,937,007,065. Shuttle transportation, the type of microbus vehicle is 17 units of vehicles, a capacity of 13 seats, vehicle operating costs per bus per year + 15% margin of Rp. 342,211,581. So the total operational cost of shuttle transportation vehicles is 17 units of vehicles per year, which is Rp. 5,975,220,122.

Amount of operating income: Tourism Transportation, the amount of income during the technical life of the vehicle is 15 years at PT. Penjor Bali Transport is Rp. 6,896,800,000. By using projected income growth using the average income growth from 2014 to 2019 of 3.8%, then in 2022 to 2036 it is projected with a total income of Rp. 1,562,035,827.201. Shuttle Transportation, the amount of income during the technical life of the vehicle is 10 years at PT. Penjor Bali Transport is by projecting passenger growth using the average passenger growth from 2014 to 2019 for each travel route multiplied by the price of the shuttle travel package, and experiencing an increase in the price of travel packages every 2 years by Rp. 10,000. So in 2022 to 2036 passenger growth is projected and multiplied by the price of travel packages by the total revenue, which is Rp. 148,324434,698.

Financial Feasibility Analysis: Tourism Transportation, the financial feasibility of operating tourist transportation with an interest rate of 15% per year, using the income growth rate, the following results are obtained: NPV value of Rp. 100,640,493,054 whose value is greater than zero (0), the BCR value of 1.95 is greater than 1, the IRR value of 42.478% is greater than the set MARR of 15% and the PBP value for 7 years 1 month is smaller than The design life is 15 years. So this investment is categorized as financially feasible. The results of the sensitivity analysis carried out by trial and error calculations are sought what is the maximum percentage of sensitivity to the conditions of expenses and income costs, where the investment is not worth it. The results of the calculation show that the cost of expenses increased by 101% and fixed income costs, fixed expenses and income costs decreased by 50%, expenses increased by 34% and income costs decreased by 34%. Shuttle Transportation, the financial feasibility of operating tourist transportation with an interest rate of 15% per year, using the income growth rate, the following results are obtained: NPV value of Rp. 734,194,558 whose value is greater than zero (0), BCR value of 1.02 which value is greater than 1, IRR value of 19.649% greater than the set MARR of 15% and PBP value of 6 years 4 months less than The design life is 10 years. So this investment is categorized as financially feasible. The results of the sensitivity analysis carried out by trial and error calculations are sought what is the maximum percentage of sensitivity to the condition of expenses and income costs, where the investment is not worth it. The results of the calculation show that expenses increased by 3% and fixed income costs, fixed expenses and income costs decreased by 3%, expenses increased by 1.5% and income costs decreased by 1.5%.

The amount of loss of operating income in real conditions (covid-19 pandemic) and normal conditions: Tourism Transportation, total income in real conditions (covid-19 pandemic) is Rp. 3,807,187,800 12bus/2 years, the total income under normal conditions is Rp. 14,589,794,179 12bus/2 years. Meanwhile, the loss from tourism transportation revenue is -Rp. 10,782,606,379 12bus/2 years from 2020 to 2021. Shuttle Transportation, total income in real conditions (covid-19 pandemic) is Rp. 1,577,966,300 17 transportations/2 years, the total income under normal conditions is Rp. 18,444,768,615 17 freight/2 years. Meanwhile, the loss from tourism transportation revenue is -Rp. 16,866,802,314 17 transportations/2 years from 2020 to 2021.

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ANALYSIS OF MODIFICATION OF CAR AC COMPRESSOR TO SPLIT AC COMPRESSOR ON COOLING RATE

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Abstract. Refrigeration or cooling technology is increasing, especially regarding the coolant, almost all new vehicles now use air conditioning to condition the air in the vehicle cabin, but there are still many aspects that currently have not been paid much attention, especially to compressors, compressors for now still rely on the engine as a direct driver which makes fuel consumption more wasteful and reduces the performance of the vehicle. The purpose of this research is to modify a conventional compressor into an electric compressor by utilizing a split ac compressor. The research method uses the direct experimental method, can a split ac compressor replace a conventional compressor. Testing without changing a lot of the cooling system on the car, only changing the compressor without any other changes. The results of the research on split ac compressors can be applied to cars, but the cooling rate is slower than car ac compressors.

Keywords : refrigeration, compressor, air conditioning, car ac, split ac.

1. INTRODUCTION

Comfortable and coolness when driving, especially in a car is very necessary. Various ways and efforts made by humans so that driving comfort can be achieved. One of the more effective ways to get comfortable in the car is to installed air conditioning. The performance of the air conditioning system is strongly influenced by the compressor work [1]. Air conditioning is the process of treating air to regulate temperature, humidity, cleanliness and distribution simultaneously in order to achieve the comfortable conditions needed by the occupants inside [2]. Air refreshing is the process of cooling air so that it can reach the required temperature and humidity to the air condition of a particular room [3]. Every vehicle space, especially four-wheeled vehicles that carry cargo in the form of people or goods, really requires a certain level of comfort and fitness, both for passengers and goods [4]. almost all new vehicles now use air conditioning to make air of condition in the vehicle cabin, but there are still many aspects that currently have not been given much attention, especially to the compressor, the compressor currently relies on the engine as a direct driver which makes fuel consumption more wasteful. and reduce the performance of the vehicle. Air conditioning in the room serves to regulate air conditioning in the room, this conditioning aims to provide comfort, so as to reduce fatigue [5]. The use of the AC system in the car aims to maintain the air temperature in the car in comfortable conditions, especially for the driver and passengers. In addition, the installation of a car air conditioner can also be useful to avoid condensation on the windshield during the rainy season [6]. Air conditioning in a room regulates humidity, heating and cooling of indoor air. This conditioning aims to provide comfort, so as to reduce fatigue which has an effect on increasing fitness [7]. Thermal comfort is needed by the body so that humans can carry out activities properly (at home, school or in the office/work place). Szokolay in the 'Manual of Tropical Housing and Building' states that comfort depends on climate variables (sun/radiation, air temperature, humidity, and wind speed) and several individual/subjective factors such as clothing, acclimatization, age and gender, level of obesity, health level, type of food and drink consumed, and skin color [8]. Energy savings in the cooling system are carried out in several ways, namely improving compressor efficiency, varying compressor rotation, looking for alternative refrigerants, varying fan

rotation, and refrigerant control systems [9]. The main components of an air freshener are the compressor, condenser, expansion valve and evaporator. The function of the compressor is to flow and increase the pressure of the refrigerant gas which then enters the condenser, the condenser functions as a heat transfer device released from the hot refrigerant vapor to the cooling medium so that the refrigerant hot vapor will condense and change its phase from a vapor state to a liquid [10]. To increase the workability of the COP (Coefficient of Performance) cooling device, the condenser can be modified by using water media cooling, and the blower is no longer used so that it can save the driving power of the blower [11]. As technology develops, safety, comfort, and human safety should become a priority, and do not forget the environmental aspects which are the main targets [12]. Air refreshing is a process of cooling the air so that it can reach the required temperature and humidity for the air condition of a particular room. In addition to regulating airflow and cleanliness [13]. The use of air conditioning is considered capable of stabilizing the air temperature and humidity of an area with a cooling system [14]. The split ac compressor can be turned on using a dc to ac inverter but not all types of inverters are able to turn on a split ac compressor for the work process [15]. From the description and some of the research above, it is very necessary to use air conditioning to stabilize thermal conditions in a room especially vehicles, with a stable temperature it will make the mind calm and relaxed especially when driving, but the problem here is that the air conditioner in vehicles still uses a compressor driven by engine, the researchers here will change the car compressor to a split ac compressor.

2. METHODS

The method in this study uses experimental research which aims to analyze the modification of the split ac compressor applied to the car. The research framework is according to the picture below.

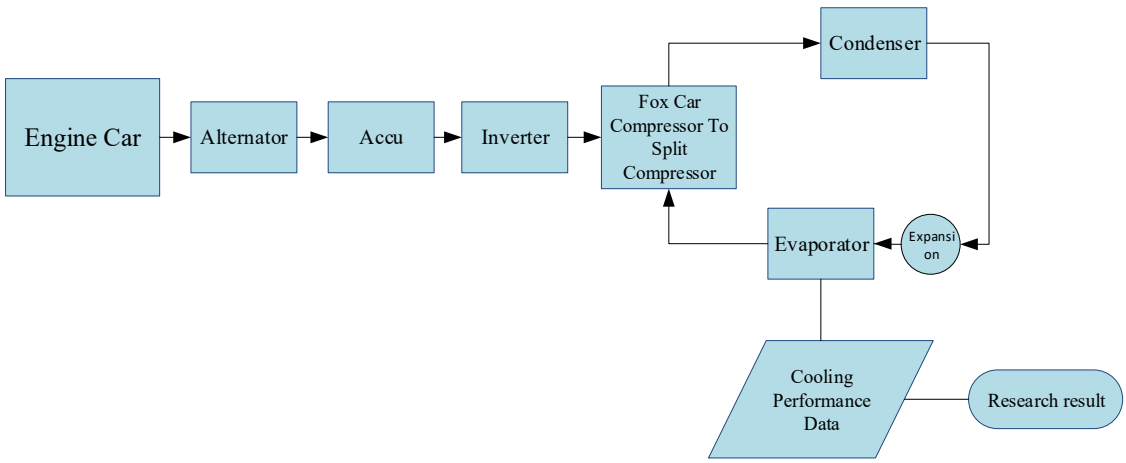

Figure 1. Research framework

The main cooling work system in a car is the compressor driven by the engine from the shaft pulley directly from the crankshaft, while in this framework the compressor that should be driven by the engine is converted into an electric compressor in split ac, the difference between a car compressor and an ac compressor split is on the piston player inside to compress the freon, namely the engine is rotated on the car compressor and the electric motor is driven on the split ac compressor. From the change in the compressor, it will circulate to the condenser – expansion valve – evaporator and then to the compressor again, the evaporator will see the temperature that comes out whether there will be a change in temperature which results in the cooling rate.

3. RESULTS AND DISCUSSION

3.1 Figure and Table

Figures and tables can be seen as follows.

Figure 2. Compressor modification data collection process

Figure 3. Cooling rate data collection process

Figure 2. shows the process of testing the compressor modification, with 1 can of freon R134a 390 grams for both tests, the pressure obtained is 15 psi for both tests, the modified compressor uses a split ac compressor 1/2 PK without making any changes. Figure 3 shows the data collection process in 4 places, the first in the evaporator, the second on the left ac lattice, the middle ac lattice and the right ac lattice.

Table 1. Cooling rate data with car compressor

Minutes	Temperature Evaporator (^{0}C)	Ac Grid Temperature (^{0}C)		
		Left	Middle	Right
0	32,3	36,9	35,8	35,9
0,5	27,7	34,5	31,9	33,9
1	25,8	32,6	29,5	32,4
1,5	23,2	31	27,7	30,9
2	20,4	29,6	26,3	29,8
2,5	19,4	28,5	25,3	28,8
3	18,5	27,8	24,7	28,1
3,5	18,1	27,2	24,2	27,5
4	17,5	26,1	23,8	27,1
4,5	17,5	26,3	23,6	26,7
5	17,2	26,1	23,4	26,4
5,5	16,8	25,8	23,1	26
6	16,7	25,6	22,9	25,9
6,5	16,2	25,3	22,7	25,7
7	15,5	25,1	22,5	25,6
7,5	15,5	24,9	22,3	25,2
8	15,5	24,8	22,1	25
8,5	15	24,5	21,9	24,9
9	15,1	24,5	21,9	24,8

Table 2. cooling rate data with split ac compressor / room ac

Minutes	Temperature Evaporator (^{0}C)	Ac Grid Temperature (^{0}C)		
		Left	Middle	Right
0	32,2	34,0	32,2	34,0
0,5	31,7	33,6	31,8	33,7
1	31,2	33,2	31,5	33,3
1,5	30,6	32,9	31,1	33,0
2	30,1	32,5	30,7	32,6
2,5	29,6	32,6	30,9	32,6
3	29,1	31,9	30	32
3,5	28,8	31,4	29,5	31,6
4	28,2	31	29,1	31,2
4,5	27,3	30,5	28,6	30,7
5	26,6	30,1	28,1	30,3
5,5	26,1	29,6	27,7	29,9
6	25,7	29,3	27,4	29,6
6,5	25,1	29	27	29,2
7	24,6	28,7	26,8	28,9
7,5	24,3	28,5	26,5	28,7
8	23,6	28,2	26,2	28,5
8,5	23,3	27,9	26	28,1
9	22,9	27,7	25,5	27,9

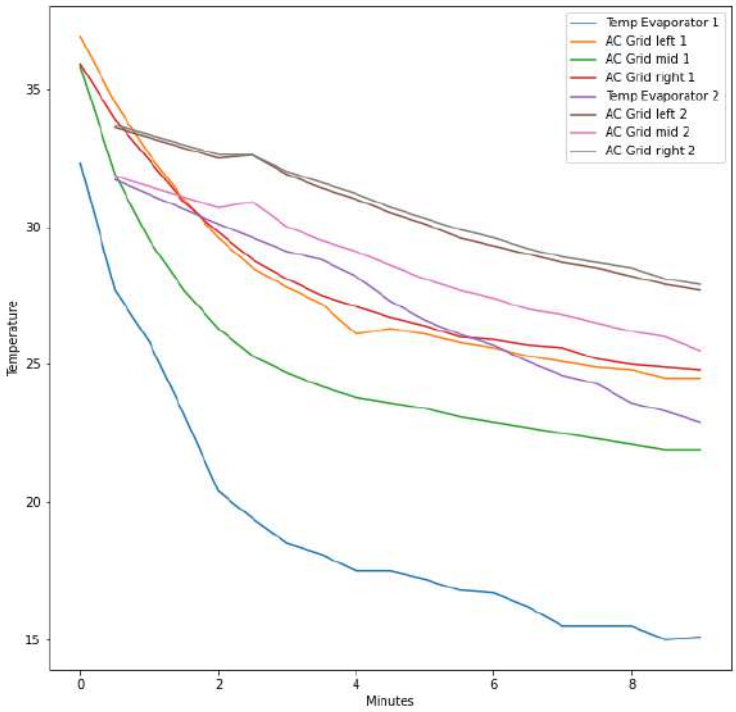

Figure 4. Cooling rate of car compressor 1 and split ac compressor 2

Figure 4 shows a graph of the cooling rate of a car compressor and a split ac compressor. Temp evaporator 1, ac grid left 1, ac grid mid1 and ac grid right 1 shows the cooling rate using a car ac compressor data collection is in accordance with figure 3. Meanwhile, at temp evaporator 2, ac grid left 2, ac grid mid2 and ac grid right 2 shows the cooling rate with a modified room/split ac compressor to the vehicle system.

3.2. Compressor Modification

The cooling system in the car has been redesigned based on the standard cooling work cycle, only making changes to the compressor using a ½ PK split ac compressor, in this design there are no changes to the condenser, evaporator, filter, expansion valve and piping. The coolant used for the test is R134a in the contents of 1 can of 390 grams and the contents are exactly the same for both tests, which have not been modified and those that have modified the compressor.

3.3. System Work

From the modification of a car ac compressor to a split ac compressor, different cooling is obtained, the cooling rate is faster than a conventional car ac compressor because without changes to other components such as freon, expansion falve and filters, but even without making significant changes it can still produce a sufficient cooling rate. The difference in cooling rate between the two in 9 minutes is 7^0C.

4. CONCLUSION

The result of this research is that the split ac compressor can be used to change the car ac compressor even without significant changes. The weakness in this study is that the cooling rate is different, the split ac compressor takes longer, this difference is because the refrigerant and the split ac compressor system are not exactly the same as the conventional car ac compressor system. In this research, it is necessary to further refine the split ac compressor change system, such as changing refrigerant, expansion valve to capillary pipe and filter.

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THERMAL COMFORT STUDY OF OUTDOOR SPACE FOR FACE-TO-FACE LEARNING SYSTEM

Study of Outdoor Thermal Comfort for Face-to-face Learning Systems

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Abstract. The transmission covid-19 virus is through droplets are splashed by people who have the virus. Therefore, activities that make crowding especially in closed rooms with poor air circulation are very avoided, because the rate of transmission in the inner room with poor air circulation has a higher presentation compared to transmission in the outside room. With new protocol to use maximum room capacity limit of 50%, using outdoor space can be good alternative solution to increase space for face to face learning system. But there is needed a study of thermal comfort for outdoor space. The object taken as a sample in this study was sitting area of the Undip Architect campus. This paper present measurements of dry temperature, humidity, and air movement with quantitative method. From the examine of effective temperature show that the object research have cozy thermal comfort according by Mom dan Wiesebron standards. This examination of effective temperature can also be exam for other outdoor environments.

Keywords: thermal, comfort, covid-19, mom and wiesebron

1. INTRODUCTION

In early 2020 covid-19 virus began to spread in Indonesia. This virus is very easily transmitted between humans. Transmission of the covid-19 virus is through droplets that are splashed by people who have the virus, and if inhaled by others then the virus will enter the lungs and live on the walls of the respiratory tract [1]. Therefore, activities that make crowding especially in closed rooms with poor air circulation are very avoided, because the rate of transmission in a room with poor air circulation has a higher presentation compared to transmission in outdoor spaces [2].

Semarang City Government has released information referring to the Semarang City Regulation No. 49 of 2021, the Minister of Home Affairs of the Republic of Indonesia 53 of 2021 and Inwal 7 of 2021 that PPKM in the city of Semarang entered into level-1, where for areas that have been categorized as level 1, in terms of teaching and learning activities can be implemented with face-to-face learning system with a maximum capacity of 50% and maintain the closest distance of 1.5 meters. In line with this, the spokesman for handling Covid-19 Wiko Adisasmito in Kompas News and The Ministry of Education said that the government encourages universities in areas with the predicate level-1 to level-3 to carry out face-to-face learning.[3][4]. In carrying out the advice from the government, Diponegoro University Semarang began preparing face-to-face learning system. To reveal this, Undip needs to prepare a safe space and remain comfortable for the implementation of the mining system during the covid-19 pandemic. With a maximum room capacity limit of 50%, the use of outdoor space can be used as an alternative good solution to increase the capacity of lecture capacity. But previously, there needed to be a study on the thermal comfort. This is necessary because from existing research uncomfortable air temperatures can reduce productivity by more than 80% [5].

The study took the outdoor sitting area as a sample of the object of the study. This outdoor space was chosen because it already has facilities that are able to support teaching and learning activities, such as roof coverings, chairs, tables and electrical terminals. This outdoor sitting area has a capacity of 72 people with 12 round tables, and each table is equipped with an electric terminal.

Figure 1. Object research

The purpose of this study is to examine the thermal comfort of outdoor spaces for teaching and learning activities. The object of the research taken is the outdoor sitting area of campus Diponegoro University Architects Semarang.

Comfort is a result of physiological and mental factors, but there is no objective benchmark for measuring comfort [6][7]. Thermal comfort is a state of mind that expresses satisfaction with the thermal environment and is usually subjectively assessed[8] [9][10]. Changes in heat on the surface of the body are influenced by environmental factors. There are four factors that affect thermal comfort: air temperature; humidity; Air movement and radiation. Of the four factors, air temperature is the most important factor for determining thermal comfort [11].

The thermal index used in Indonesia refers to effective temperature. Effective temperature will provide sensation that is then defined as comfort or discomfort [12]. Effective temperature can be determined by linking dry temperature and humidity in a Psychometric calculator to get wet temperature, which is then connected to the air movement on a nomogram chart [13][11]. Thermal comfort limits in equatorial areas range from 22.5ºC to 29.5ºC with relative humidity between 20%-50% [13]. Air humidity according to SNI 03-6572-2001 is a comparison between the amount of water vapor contained by the air compared to the amount of water vapor content in a saturated state at the air temperature of the room. For the tropics, the recommended relative humidity is between 40%~50%, but for rooms with a crowded of people such as meeting rooms, relative humidity is still allowed to range from 55%~60% [6].

The study will refer to Mom and Wes Brom standards with effective temperature comfort limits between 20ºC to 29ºC [14]. The selection of Mom and Wes Brom standards because MOM standard conducts a research area in Jakarta (6º LS) with the research subjects of Indonesian groups so that this standard is most appropriately applied as a reference in research objects located in the city of Semarang. The effective temperature criteria according to Mom and Wiesebron are as follows[14]:

a. Cool - Comfortable 20.5 º C - 22.8 º C ET
b. Comfortable – Optimal 22.8ºC – 25.8ºC ET
c. Heat – Comfortable 25.8ºC – 27.1ºC ET

Comfortable air humidity according to Mom and Wiesebron is 40%-70% with air movements of 0.1 m / s to 0.5 m / s [14], if it exceeds the limit (above / below) then the sensation is said to be uncomfortable.[15]

2. METHODS

Data collection methods

Data collection taken from primary empirical sources, obtained through observations into the object research, taking measurements, interviews, and documentation. The measurement methods of primary data is temperature, humidity and air movement speed carried out are as follows:

1. Measuring instruments are placed in the centre of the outer space,

2. The distance of measurement every 30 minutes from 08:00 WIB to 16:00 WIB. The time of taking measurements follows the working hours that have been determined by Diponegoro University.

This research uses several tools to help:

1. Thermometer to measure dry air temperature.
2. Hygrometer to measure humidity.
3. Digital anemometer to measure air movement.
4. Camera, to document activities.

Table 1. Parameters and Tools

Parameters	Tools
Dry Temperature	Thermometer
Humidity	Hygrometer
Air Movement	Anemometer digital
Wet Temperature	Psychometric Calculator
Effective Temperature	Nomogram
Thermal Comfort Standard	Mom dan Wiesebron

Research Methods In this study, using quantitative research methods. The stages of data analysis are carried out, dry temperature and humidity data that has been obtained from object research then processed with a psychometric calculator to get wet temperatures. The wet temperature figures that have been obtained are then connected to air movement speed by using a nomogram temperature to get the effective temperature. The effective temperature that has been obtained is then processed with excel to get graphs and diagrams to facilitate the process of data analysis.

3. RESULTS AND DISCUSSION

There are four data studies related to thermal comfort, there is: dry temperature, humidity, air movement and effective temperature. Measurements of temperature, humidity and air movement are carried out at the same time from 08:00 WIB to 16:00 WIB with the distance of each measurement each 30 minutes. With the following measurements:

Table 2. Measurement Result of Temperature, Humidity and Air Movement

No	Time	Temperature (°C)	Humidity (%)	Air Movement (m/s)
1	08:00	29,6	68	0,7
2	08:30	29,7	66	1,1
3	09:00	29,7	65	0,5
4	09:30	29,6	64	0,8
5	10:00	29,6	62	1,5
6	10:30	29,6	62	0,4
7	11:00	30	62	1,4
8	11:30	30,6	58	0,7
9	12:00	30,6	56	1,3
10	12:30	30,7	55	0,5
11	13:00	30,8	54	1,1
12	13:30	30,8	55	1,3
13	14:00	30,6	58	0,7
14	14:30	29,7	66	1,1
15	15:00	29,3	67	0,4
16	15:30	28,8	67	1,3
17	15:37	28,8	68	0,7
18	16:00	28,7	68	0,4

Remark : Highest result of Measurement

The measurement results in table 2 show that each parameter has the highest peak of the measurement value at different times. Dry temperatures are at their highest during the day, as opposed to humidity at the highest presentation in the morning and evening, while air movements tend to be more volatile.

3.1 Dry Themperature

Figure 2 shows the time series of dry temperatures. Dry temperatures tend to increase from 10:30 pm to 14:00 pm. It tends to continue to decline into the afternoon. The highest temperature is at 13:00 WIB to 13:30 pm which is 30.8ºC and the lowest temperature is 28.7 ºC which is 16:00 WIB with an average temperature of 29.84ºC.

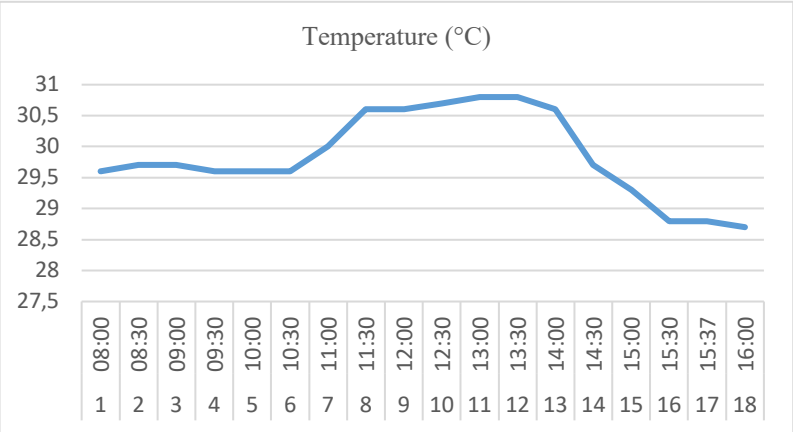

Figure 3. Time series of dry temperature

Dry temperatures are at a high level during the day, which is between 11:00 WIB to 14:30 WIB and the increase in temperature tends to be sharp, which is 1ºC at 10:30 WIB to 11:30 WIB. Dry temperature is not the only parameter of thermal comfort, it should include humidity and air movement in it. So that the air temperature above 29ºC does not mean uncomfortable, because it can not be included in the category of thermal comfort.

3.2 Humidity

The percentage of humidity tends to decrease from morning to noon at 1:00 WIB. With the lowest humidity reaching 54%. Then continue to increase until the afternoon. This is in appropriate with a statement from Lippsmeier which states, the higher the temperature, the higher the ability of air to absorb water, so that the percentage of moisture in the air becomes reduced.[13]

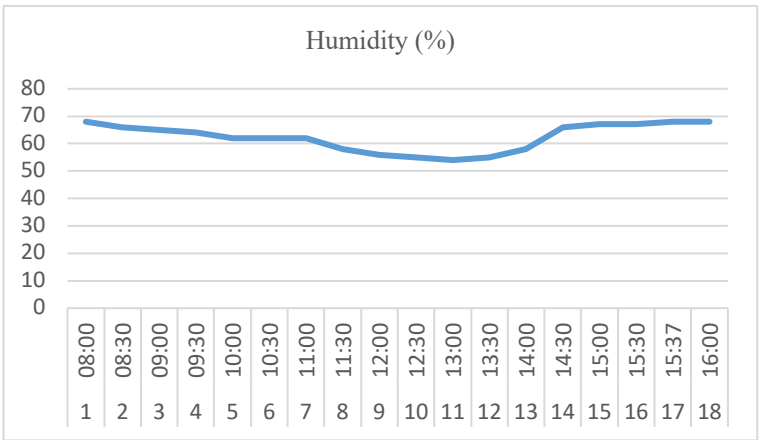

Figure 4. Time series of humidity

The highest humidity occurred at 08:00 WIB which is 68%, with an average value of 62.27%. According to Mom and Wiesebron standards, the humidity in this outdoor sitting area falls into the category of comfortable.

3.3 Air Movement

Time series of air movement measurements are shown in figure 5. Where the pattern of changes in air movement

is much different from the pattern of temperature changes and humidity. As noted early paper, changes in temperature and humidity are greatly influenced by time, with the results of numbers between measurements that are not far adrift. While the pattern of changes in air movement tends not to be influenced by time, with a fluctuating pattern.

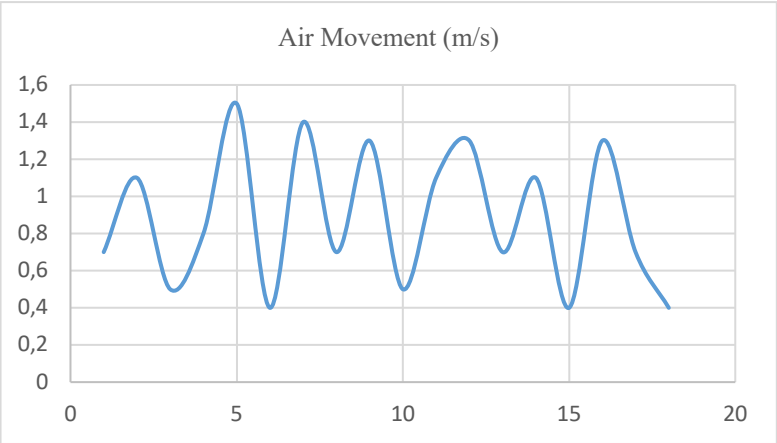

Figure 5. Time series of air movement

Highest air movement raise to 1.5 m/s at 10.00 WIB and the lowest being 0.4 m/s with an average of 0.883 m/s. Average air movement is above Mom and Wiesebron comfort standards, but air movement parameters cannot stand alone to be summed up into comfortable and uncomfortable criteria.

3.4 Effective Temperature

Effective temperature is obtained from the combination of measurements of dry temperature, humidity and air movement processed in psychometric calculators and nanograms, calculation results show at table 3.

Table 3. Calculation Result of Effective Temperature

No	Waktu	Effective Temperature (^{O}C)
1	08:00	24,3
2	08:30	24
3	09:00	23,9
4	09:30	23,6
5	10:00	23,3
6	10:30	23,3
7	11:00	23,6
8	11:30	23,5
9	12:00	23,1
10	12:30	23
11	13:00	22,9
12	13:30	23,1
13	14:00	23,5
14	14:30	24
15	15:00	23,9
16	15:30	23,4
17	15:37	23,6
18	16:00	23,5

The lowest effective temperature was 13:00 WIB at 22.9ºC ET, and the highest temperature in the morning was 24.3ºC ET, with an average effective temperature of 23.57ºC ET. The movement of effective temperature changes can be seen in figure 6.

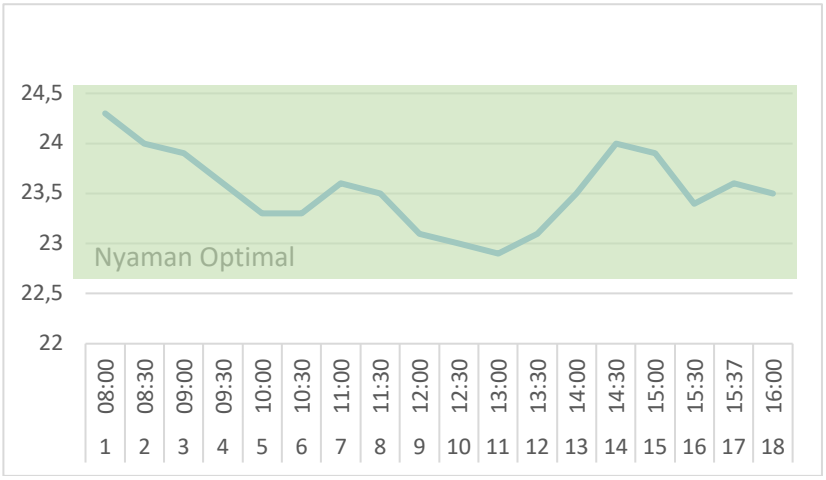

Figure 6. Effective temperature

Effective temperature change patterns tend to be volatile, where there are three decreases and two increases. But overall it falls into the criteria of optimal comfortable temperature, based on the comfortable criteria of Mom and Wiesebron with a range of 22.9 ºC ET to 24.3 ºC ET.

4. CONCLUSION

Based on the results of temperature, humidity and air movement measurements in the outdoor sitting area Campus Architects of Diponegoro University Semarang from 08:00 WIB to 16:00 WIB which is then processed to get effective temperatures according to the criteria of Mom and Wiesebron as a whole (100%) belong to optimal comfortable conditions. So this outdoor sitting area can be used to teaching and learning activities with comfortable thermal and can be a solution to increase the capacity of face-to-face learning system.

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