FULL PRACTICUM REPORT
ELECTRICITY AND AGRICULTURAL ELECTRIFICATION
(19G04122501)

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LABORATORY AUTOMATIC CONTROL SYSTEM
AGRICULTURAL ENGINEERING STUDY PROGRAM
DEPARTMENT OF AGRICULTURAL TECHNOLOGY
FACULTY OF AGRICULTURE
HASANUDDIN UNIVERSITY
MAKASSAR
2023

ENDORSEMENT PAGE

TITLE: COMPLETE ELECTRICAL PRACTICUM REPORT AND ELECTRIFICATION OF AGRICULTURE
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GROUP : V (FIVE)

This Full Report Is Prepared AsOne of the Requirements
To Pass the Agricultural Electrical and Electrification Practicum Course
(19G04122501)

At

Agricultural Engineering Study Program
Department of Agricultural Technology
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Hasanuddin University
Makassar
2023

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FOREWORD

Praise and gratitude for the presence of God Almighty for His blessings and mercy, the report which is one of the requirements for taking the laboratory exam Praktikum Electricity and Agricultural Electrification can be completed properly. The author would like to express his deepest gratitude to Mr. Muhammad Tahir Sapsal, I, S.TP., M.Si as the supervisor of the Agricultural Electrical Practicum and Electrification course and to all parties involved such as assistants, especially Irman and Fia who always take the time to guide, teach and provide direction during the preparation of this practicum report.

The author understands that this report is still very far from perfect, so the author really expects criticism and suggestions from readers to improve this report.

Makassar, 16 June 2023

Gilang Prima Tansa Pune'

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SOURCES OF ELECTRICAL ENERGY

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ABSTRACT

Energy currently plays a very important role in the sustainability of human life. Energy can be said to be the main pillar of a country's national economic activities and is used as a tool to achieve social, economic, and environmental goals. The purpose of the Electrical Energy Source practicum is to be able to get to know AC and DC electrical energy sources, understand how the concept of electrical energy and be able to measure the amount of electrical energy from solar panels. The method carried out in the Electrical Energy Source practicum is to measure the voltage of various types of AC and DC electrical energy sources using a multimeter and analyze the means of converting solar and wind energy into electrical energy. The results obtained in the Electrical Energy Source practicum are that electrical energy can be obtained by converting other types of energy into electrical energy itself. One type of energy that is most often converted into electrical energy is solar energy or heat and sunlight which is converted into electrical energy using solar panel systems and mechanical energy from wind which is converted into electrical energy using wind turbines. The conclusion of the Electrical Energy Source practicum is that electrical energy can be said to be one type of energy that is very important in human life because it can function as power for various electronic equipment. Electrical energy itself can come from various sources, even from other jeis energy which is then converted into electrical energy itself.

Keywords: Energy**,** Source, Voltage

INTRODUCTION

Background

Energy currently plays a very important role in the sustainability of human life. Energy can be said to be the main pillar of a country's national economic activities and is used as a tool to achieve social, economic, and environmental goals. However, as the age progresses, the available energy decreases. Therefore, many people are competing to find renewable energy sources that can be utilized.

The energy utilized by mankind today comes from a wide variety of sources. One of these energy sources is solar energy or solar energy whose utilization is done by converting solar energy that was previously in the form of radiation and heat converted into electrical energy using a tool called a solar panel. In addition to solar energy, other energy sources that are also used such as mechanical energy from water and wind flows used to rotate turbines or mills, geothermal that comes out of volcanic mountains, plant energy or commonly called bioenergy and natural gas.

Most energy sources that have been developed by humans today are utilized by converting them first into electrical energy. The system that is tasked with converting various types of energy is known as a power plant. This power plant has the main task of dividing DC electrical energy converted into AC electrical energy which is then distributed to various fields such as home industry.

Based on the description above, a practicum on Electrical Energy Sources is carried out to find out energy sources, how to convert them into electrical energy and their various uses in human life.

Purpose and Uses of Practicum

The purpose of the Electrical Energy Source practicum is to be able to recognize AC and DC electrical energy sources, understand how the concept of electrical energy and be able to measure the amount of electrical energy from solar panels.

The use of the Electrical Energy Source practicum is that it can utilize various kinds of electricity sources, can assemble solar panels and their application in everyday life.

LITERATURE REVIEW

Electrical Energy

Electrical energy in modern times has increased rapidly since it was first discovered. Electrical energy is used not only as a research material but also as a source of electricity for devices used by humans. The use of electrical energy is very helpful for human work because electrical energy can be used as a power source for heating, driving, turning and lighting. Many power plants are built to meet the daily needs of electrical energy. Electrical energy is used by consumers as needed. The use of electrical energy is not limited by the State Electricity Company (PLN) because consumers are responsible for the electricity they use. The large use of electrical energy forces power plants to produce more electrical power. Power plants use natural resources as a source of electricity. Natural resources are divided into two categories, namely renewable natural resources and non-renewable natural resources. Power plants that use non-renewable natural resources such as coal-fired power plants will stop operating if fuel is not available. Saving electricity should be implemented in such a way that electrical energy is easily available and durable. Consumers must use electrical energy wisely so that electrical energy remains easy and cheap to obtain (Anwar et al., 2019).

Electrical energy can be obtained by converting or converting other types of energy into electrical energy itself. One of the energies that is often used into electrical energy is solar energy or solar energy. Solar energy besides being used for direct drying, can also be used by converting it first into electrical energy with the help of solar panels which then the results of the electrical energy formed are channeled to a solar dryer. The advantages of solar dryers are that where drying products are cleaner than ordinary drying, there is no cost for drying energy, saves energy and time, requires less space, improves product quality, makes the process more efficient, and protects the environment (Lestari & Samsuar, 2022).

Solar Panel

Solar panels consist of an array of solar cells. In general, solar cells are made of silicon which has properties as an excellent absorber of solar radiation energy. As long as solar panels work in sunlight, solar radiant energy is converted into electrical energy and the temperature of solar cells increases. Changes in temperature on solar panels can be caused by temperature, cloud conditions and wind speed in the environment around the solar panel placement area. As the temperature drops, the electric current in the solar panels decreases somewhat. Even very fast and extreme temperature changes can disrupt electricity production in a solar power plant (Khwee, 2013).

Solar panels, also known as solar modules or photovoltaics (PV modules), work by using the photovoltaic effect of semiconductor materials in the panels to convert solar

radiation directly into electrical energy. The amount of electrical energy formed from the conversion depends on solar radiation captured by solar panels. Solar panels consist of several sets of solar cells, which form a key component of the system. The battery serves to store the energy emitted by the solar panel when it turns on so that it can be supplied to the load at any time. *The controller* serves to automatically prevent overcharging the battery. Meanwhile, the inverter functions to convert direct DC current into alternating AC current (Xu et al., 2018).

Solar panels can be classified into three generations including Crystalline silicon (monocrystalline or multicrystalline), thin films (amorphous silicon, cadmium telluride, chopper indium gallium selenide-CIGS) and photovoltaic concentrators and new technologies (CPV solar panels, dye-sensitive solar panels, organic solar panels , and hybrid panels). As of 2012, crystalline silicon panels account for about 90% of the global PV market, while third-generation solar panels have not been commercialized on a large scale. Solar panels are the basic power generation unit of a solar energy system, and can be used independently. Typical panels include an aluminum alloy frame (Al), tempered glass, battery parts, EVA (ethylene or vinyl acetate copolymer), and a backboard (TPT, Topotecan Hydrochloride) (Xu et al., 2018).

Wind Turbines

Wind turbines convert speed from wind energy into mechanical energy that can be used by windmills to generate electricity. This wind turbine was originally developed to meet the needs of farmers for rice milling, irrigation, and others. Many early wind turbines were built in Denmark, the Netherlands and other European countries and are better known as windmills. A wind turbine is a tool for conducting studies and research on the interaction between the movement of air and objects in the air stream. Through wind turbines, it is shown how air currents arise due to objects, on the contrary, it is shown the influence of currents on objects, namely in the form of air forces such as pressure, buoyancy and moment. The shape and design of wind turbines are based on different aerodynamic principles and goals to be achieved, such as high efficiency, low noise, or the ability to adapt to various wind conditions (Irfandi, 2020).

One of the uses of wind energy is the use of wind turbines which are widely used for agricultural purposes such as pump drives for irrigation purposes and for energy needs. Various kinds of inventions of wind turbines as alternative energy plants with different forms of construction have been around for a long time. The determination of the size of the windmill based on the power generated cannot be separated from the size of the turbine blades (rotor), such as the size of a windmill for household power plants that need to be able to utilize small amounts of wind. Household-scale turbine design requires a type of blade that can move at low wind speeds, so that turbine blades can use the National Advisory Committee for Aeronautics (NACA) model (Saputra, 2016).

Battery

Batteries as a power source are needed by electrical components in electric vehicles such as starter motors, lighting, horns, and so on. Batteries are very important as energy suppliers for all electrical components in electric vehicles making batteries very important as a source of electrical component power. The battery was invented in 1859 by a French physicist named Gaston Plante. A battery or accumulator is an electrical cell in which reversible electrochemical processes take place with high efficiency. Alternating electrochemical reactions mean that in a battery, the process of converting chemical energy into electrical energy (discharge process) and vice versa from electrical energy to

chemical energy (charging process) occurs through the process of battery regeneration using electrodes, namely by passing an electric current in the direction of the battery with opposite polarity in the cell. Batteries generate electricity through chemical processes (Afif & Pratiwi, 2015).

There are several types of batteries commonly encountered in everyday life, namely primary batteries and secondary batteries. Both types of batteries have the same properties to convert chemical energy into electrical energy. A secondary battery is a rechargeable battery such as a mobile phone battery. Primary batteries are disposable (disposable) batteries. Primary batteries have high commercial value, so this type of battery is often found in large and small stores. A primary battery consists of three important components, namely carbon rod as anode (positive terminal of battery), zinc (Zn) as cathode (negative terminal of battery) and paste as electrolyte (conductor). Batteries have the property to change form from chemical energy to electrical energy (Nasution, 2021).

PRACTICUM METHODOLOGY

Time and Place

The Electrical Energy Source Practicum will be carried out on Thursday, March 11, 2023, at 15.00 WITA until it is completed at the Agricultural Tools and Machinery laboratory, Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University.

Tool

Tools used in the Electrical Energy Source practicum are solar panels, batteries, batteries, wind turbines, tachometers, multimeters and mobile phones.

Material

The material used in the Electrical Energy Source practicum is sunlight.

Practicum Procedure

Prosedur in the practicum of Electrical Energy Sources, namely:

a. Solar Panel

1. Setting up solar panels, DC to AC inverters, batteries and multimeters.
2. Connect all tools.
3. Measure light intensity using a luxmeter and multimeter.
4. Record changes at 1-minute intervals for 5 times.
5. Documenting practicum activities.

b. Wind Turbines

1. Setting up turbines and multimeters.
2. Connecting turbine and multimeter.
3. Measure voltage with 3 attempts (slow, medium and fast) using a multimeter.
4. Mendocument practicum activities.

c. Battery

1. Setting up the battery and multimeter.
2. Connect both ends of the multimeter on both ends of the battery.
3. Calculates and records the voltage results produced by the battery.
4. Document practicum activities.

d. Battery

1. Setting up the battery and multimeter.
2. Combining a multimeter to the battery.

3. Calculate and record the voltage results produced by the battery.
4. Mendocument practicum activities.

RESULTS AND DISCUSSION

Result

a. Table

Table 1. Power Source Component Specifications.

No.	Component Name	Picture	Specifications	Function
1.	ABC Battery		– Dry accu – 0.2 V – 6 AH	The battery has the main function as a source of electrical energy.
2.	9 volt battery		– 9 V – 6LR61	The battery has the main function as a source of electrical energy.
3.	Battery		– Dry accu – 0.2 V – 6 AH	The function of the battery is as a storage of electrical power that will be needed by vehicle components.
4.	Solar Panel		– Type 10-36p – Pmqx 10w – Voc 21.6 v – Isc 0.65 A – Imp 0.59 A – Voltage 10000v – Tolerance is approximately 3% – Size 355 X 255 X 17 mm Power tolerance ± 3%	Solar panels are devices that can convert sunlight energy into electrical energy.

Table 2. The results of observations of components of electrical energy sources.

No.	Component Name	Voltage (V)
1.	ABC Battery	1,63
2.	9 volt battery	8,72
3.	Battery	12,51

Table 3. Test Results of Light Output and Intensity.

No.	Time (Minutes)	Voltage (V)	Light Intensity (Lux)
1.	1	12,73	8326
2.	2	12,74	7907
3.	3	12,73	7412
4.	4	12,72	7053
5.	5	12,71	6780

Table 4. Windmill speed.

No.	Speed	Voltage (V)	Rotation (RPM)
1.	Slow	80,1	0,088
2.	Keep	83,4	3,86
3.	Fast	129,5	6,49

b. Graphs

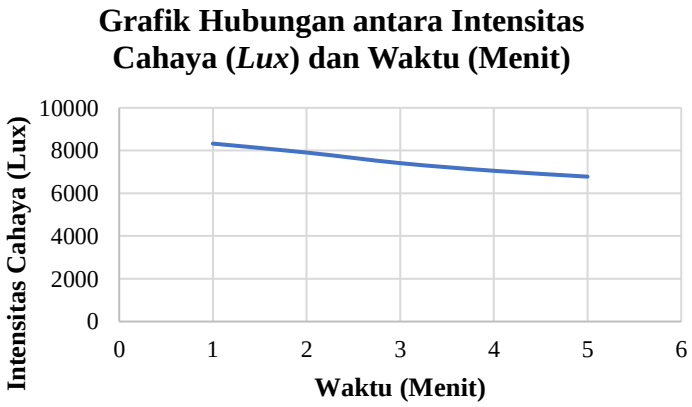

Figure 1. Graph of the Relationship between Light Intensity (Lux) and Time (Minutes).

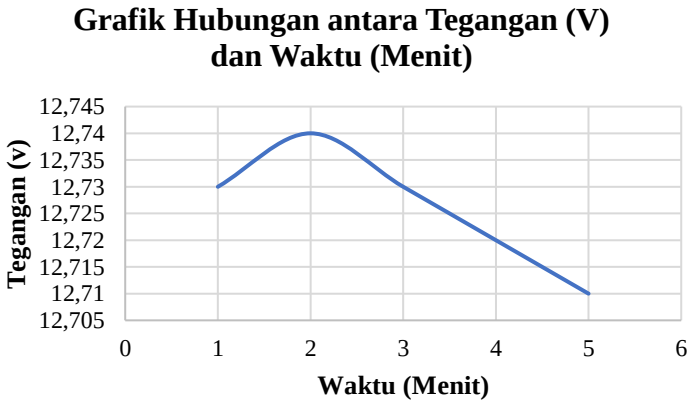

Figure 2. Graph of the Relationship between Voltage (V) and Time (Minutes).

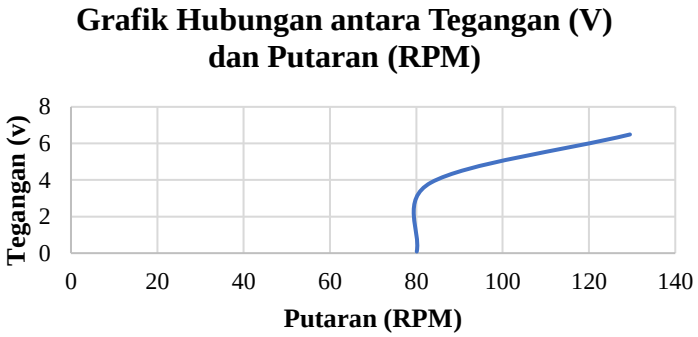

Figure 3. Graph of the Relationship between Voltage (V) and Rotation (RPM).

Discussion

Based on the practicum of Electrical Energy Sources that have been carried out, it can be known that the use of sunlight into electrical energy can be done using tools in the form of solar panels. Solar panels are placed in areas that can be exposed to direct sunlight so that the intensity of absorbed sunlight can be more optimal. In the process of absorbing sunlight, solar cells will experience an increase in temperature along with the length of time solar panels are placed in direct sunlight. This is in accordance with Khwee's statement (2013), which states that solar cells are made of silicon which has properties as an excellent absorber of solar radiant energy. As long as solar panels work in sunlight, solar radiant energy is converted into electrical energy and the temperature of solar cells increases.

The conversion of solar energy in the form of light and solar heat into electrical energy can be proven by the measured electric voltage on the multimeter when connected to a controller connected to a solar panel. Through the graph, it can be seen that over time, the intensity of light received by solar panels will decrease so that the voltage produced is also decreasing. The decrease in light intensity can occur because measurements are made in the afternoon where the sun has begun to set. This is in accordance with the statement of Xu et al. (2018), which states that the amount of electrical energy formed from the results of conversion depends on solar radiation captured by solar panels.

In addition to sunlight, wind is also one of the alternative energy that can be used to produce electrical energy. The experiment was conducted using a small wind turbine. When the mill or rotor of the wind turbine rotates, the multimeter that has previously been connected will show an increase in voltage along with the speed and number of rotations of the windmill from the wind turbine, so that the wind speed is very influential on the rotation of the mill produced. This is in accordance with Irfandi's statement (2020), which states that wind turbines convert speed from wind energy into mechanical energy that can be used by windmills to generate electricity.

CONCLUSION

Based on the practicum of Electrical Energy Sources that has been carried out, it can be concluded that electrical energy is one type of energy that is very important in human life because it can function as power for various electronic equipment. Electrical energy itself can come from various sources, even from other types of energy which are then converted into electrical energy itself.

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ATTACHMENT

Appendix 1. Electrical Energy Source Practicum Documentation

Figure 4. Documentation of Electrical Energy Source Practicum.

ELECTRICAL CIRCUIT

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ABSTRACT

Electrical circuits are in the form of one system that is very important for its use in everyday life, especially for complex electronic devices in carrying out their functions. When installing and repairing electronic equipment, knowledge of electrical circuits is also needed for work safety and security. The purpose of the Electrical Circuit practicum is to be able to understand the concept of a current and voltage amplifier circuit and be able to measure current and voltage in batteries. The method carried out in the Electric Circuit practicum is to measure the voltage in the battery circuit which is arranged in series and parallel with different numbers of batteries. The results obtained in the Electric Circuit practicum are that the battery circuit arranged in series gets a relatively small voltage value but the voltage value will increase every time the addition of batteries in the circuit, while the battery circuit that is arranged in parallel gets a voltage value that is always almost the same in different numbers of batteries. The conclusion of the Electrical Circuit practicum is that the voltage in the series electrical circuit is divided into each component because it is on the same path. Meanwhile, the voltage in a parallel electrical circuit remains the same because the components are arranged on different paths.

Keywords: Current**,** Battery, Voltage

INTRODUCTION

Background

All electronic devices, especially those in the home industry, require electrical energy as a source of power. The existing electrical devices are certainly not used simultaneously, but have their own time when they will be used. For this reason, a system is needed to regulate the flow of electricity distributed in the form of an electrical circuit.

Electrical circuits are in the form of one system that is very important for its use in everyday life, especially for complex electronic devices in carrying out their functions. When installing and repairing electronic equipment, knowledge of electrical circuits is also needed for work safety and security. Therefore, in studying electrical circuits, knowledge is also needed in calculating current, voltage and components in electrical circuits.

The electric circuit itself based on its form of arrangement is divided into series electrical circuits and parallel electrical circuits. Series electrical circuit is in the form of a circuit whose components are arranged sequentially or in a row in one circuit path. Meanwhile, a parallel electrical circuit is in the form of a circuit whose components are arranged in rows on more than one different path in the circuit.

Based on the description above, an Electrical Circuit practicum was carried out to find out the importance of studying electrical circuits and the form of preparation of their components in series electrical circuits and parallel electrical circuits.

Purpose and Uses of Practicum

The purpose of the Electrical Circuit practicum is that practitioners are able to understand the concept of current and voltage amplifier circuits and be able to measure current and voltage in batteries.

The use of the Electrical Circuit practicum is being able to master and apply the basic principles of electrical circuits in everyday life, especially in agriculture.

LITERATURE REVIEW

Electrical Circuit

An electrical circuit is a combination of a number of parts or components plus a circuit or connecting circuit. Current and voltage in an electrical circuit are elements that need to be known. Electric current is the change in charge rate over time with symbols (i) and amperes. As long as the charge moves, current will occur and vice versa. Voltage is often referred to as potential difference (voltage) is an attempt made to move charge on an element or component from one terminal or pole to another terminal or pole, so that voltage is energy per unit charge. Voltage can be written mathematically v=dw/dq with units of volts (Batarius & Samane, 2021).

In general, an electrical circuit consists of three main parts in the form of a current source, conductor or connector and load or electrical component. A power source is a device or system that produces a flow of electrons or an electric current that can be used to meet power requirements. There are different types of electrical power sources used in electrical applications, such as batteries and generators. An electrical conductor or connector is a part of an electrical circuit that functions to transfer or channel electric current from one point to another. Conductors or connectors of electric current that are commonly used are cables consisting of metal or copper fibers as conductors and coatings of insulating materials. An electrical load or component is a device or system that uses electric current to perform its work or function. These electrical loads or components are very numerous and most commonly found such as electronic devices in households (Handoko, 2020).

Series Electrical Circuit

A series electrical circuit is a simple electrical circuit in which two or more electrical components or loads are connected in series so that electric current flows through each component or load alternately where this electrical circuit does not have branching wires. The absence of branching cables in series electrical circuits causes the flow of current to be interrupted if one end of the cable is cut so that no current flows in the circuit. The characteristics of a series electric circuit are such as the electric current flowing in each load is the same, the voltage drop of the series electric circuit at each load of the electric circuit is equal to the total voltage that crosses the source of electric voltage, the electric current flowing in the series electric circuit depends on the amount of load or load resistance in the electrical circuit and when one of the loads or part of the circuit is turned off, the current flow is stopped (Farizki et al., 2016).

According to Rosman et al. (2020), series electrical circuits have common properties such as the following:

1. Through the same resistance, the source voltage is divided by the sum of the series resistances. The sum of the voltage drops in series from each series resistor is equal to the total voltage at the line voltage.

2. If one of the loads or part of the circuit is disconnected or not connected, then the current flow stops.
3. The current flowing at each load is the same.
4. The large number of electrical loads connected in series, the total resistance of the circuit causes an increase from a decrease in the current flowing in the circuit. The current flowing depends on the amount of load resistance on the circuit.

Parallel Electrical Circuit

A parallel electrical circuit is a simple electrical circuit in which two or more electrical components or loads are connected in parallel or parallel to each other, allowing electric current to flow through each load independently. Parallel electrical circuits have branched wires, so that if one end of the cable is cut off, electric current will continue to flow through other cables that are still connected. Parallel electrical circuits are characterized by each load having a potential difference or voltage equal to the source voltage, the strength of the electric current in each branch depends on the resistance of each branch, the total resistance in the circuit is less than the smallest resistance and if one branch of the circuit is broken, the other branch of the circuit will remain lit (Erfan et al., 2020).

According to Rosman et al. (2020), parallel electrical circuits have common properties such as the following:

1. Most resistors are connected in parallel, the total resistance of the circuit is smaller and therefore the total current is greater. (The total resistance of a parallel circuit is smaller than the smallest resistance in the circuit).
2. If one of the parallel resistive branches breaks, the current will be cut off only on that resistive circuit. Other branch circuits continue to operate uninterrupted by isolated branch circuits.
3. Each branch of a parallel circuit is an individual circuit. The current of each branch depends on the resistance of the branch.
4. The voltage on each electrical load is equal to the source voltage.

Kirchoff's Law

Electrical circuits are one application in the field of physics that can be solved by applying Kirchoff's law. Kirchoff's Law is divided into two parts, namely Kirchoff's Law I (KCL) or Kirchoff's Law of Current which states that the total electric current passing through the connection point is zero and Kirchoff's Law II (KVL) or Kirchoff's Law of Voltage which states that the total GGL and potential decrease around a closed path in a circuit must be zero. A parallel circuit with many loads, Kirchoff's Law I is used to ensure that electric current is maintained throughout the circuit, while Kirchhoff's Law II is used to calculate the electrical voltage supplied by a power source and consumed by all loads in the circuit. Meanwhile, in series Kirchhoff's Law I is used to ensure that electric current is maintained throughout the circuit, while Kirchhoff's Law II is used to calculate the electric voltage to be divided among all loads in the circuit (Mutoharoh et al., 2022).

Current and Voltage

Current is the rate of change in the speed of charge or charge flowing in a unit of time with the symbol i (from the French word: intensite), in other words current is a charge in motion. As long as the charge moves there will be current, but when the charge is stationary the current will disappear. The charge moves when external energy acts on it. Charge is the smallest unit of an atom or part of an atom. While modern atomic theory asserts that atoms consist of nuclear particles (protons have a + charge and neutrons have a neutral charge) surrounded by an electron charge (-), atoms are usually neutral. There

are two types of charge, namely positive charge and negative charge. The direction of current is direct to the positive charge (direction of electric current) or opposite to the direction of electron flow. A particle can become positively charged when it loses an electron and negatively charged when it gains an electron from another particle. Coulomb is the International System of Units (SI) base unit for measuring electric charge (Rosman et al., 2020).

Voltage or often referred to as potential difference (voltage), is the work released in moving charge (by one coulomb) on an element or component from one terminal or pole to another terminal or pole, or at both terminals or poles has a charge potential difference when we move a charge of 1 C from one terminal to another. The relationship between the actual work done is the energy released, so the above understanding can be summarized that voltage is energy per unit charge (Rosman et al., 2020).

PRACTICUM METHODOLOGY

Time and Place

The Electrical Circuit Practicum will be carried out on Thursday, May 5, 2023, at 15.00 WITA until it is completed at the Agricultural Tools and Machinery laboratory, Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University.

Tool

The tools used in the Electrical Circuit practicum are multimeters, cables, stationery and mobile phone cameras.

Material

The material used in the Electrical Circuit practicum is a battery.

Practicum Procedure

Prosedur in Electrical Circuit practicum, namely:

1. Preparing the tools and materials used.
2. Assemble batteries with circuits in series and parallel.
3. Measure the voltage produced by the battery using a multimeter.
4. Record the results of measuring voltage values.
5. Document the practicum.

Formula Duses

The formula used in the Electric Circuit practicum, namely:

1. Electric Current Series

$$I_{total} = I_1 = I_2 = ... = I_n$$

2. Parallel Electric Current

$$I_{total} = I_1 + I_2 + ... + I_n$$

3. Voltage Series

$$V_{total} = V_1 + V_2 + ... + V_n$$

4. Parallel mains voltage

$$V_{total} = V_1 = V_2 = ... = V_n$$

Information:

I = Current (A)
V = Voltage (V)

RESULTS AND DISCUSSION

Result

Tabel 5. Test results of battery circuits in series.

Number of Batteries	Battery	Voltage (V)
1	1,5	1,62
2	1,5	3,27
3	1,5	4,90

Table 6. Test results of battery circuits in parallel.

Number of Batteries	Battery	Voltage (V)
1	9	8,85
2	9	8,88
3	9	8,45

Discussion

Based on the practicum of the Electrical Circuit carried out, it can be known that the electrical circuit is an arrangement or combination of various parts or components that function to channel electrons or electricity. Electric circuits are divided into several types such as series electric circuits, parallel electrical circuits and mixed electric circuits. The electrical circuit in practicum consists of three main parts, namely the current source in the form of a battery, the electric current connector in the form of a cable and the load in the form of a lamp. This is in accordance with the statement of Handoko (2020), which states that in general, electrical circuits consist of three main parts in the form of current sources, conductors or connectors and loads or electrical components.

Through the Electrical Circuit practicum, results are obtained in the form of two types of tables. Through the first table, namely testing on the battery circuit in series, it can be seen that the voltage of the circuit is relatively small because in this series the components are arranged in a row which results in the voltage being divided into each component, but each addition of the battery voltage also increases. Series circuits only consist of one path or have no branching, so that if the line breaks, there will be no current flowing in the circuit. This is in accordance with the statement of Farizki et al. (2016), which states that the absence of cable branching in a series electrical circuit causes the current flow to be interrupted if one end of the cable is cut so that no current flows in the circuit.

Furthermore, in the second table, namely testing the battery circuit in parallel, it can be seen that the circuit has a voltage value that is always almost the same even though the number of batteries varies. That can happen because batteries in parallel circuits are on different paths so that each treatment always gets almost the same voltage value. Calculations on sources that supply and load using electric voltage circuits in parallel circuits can be done by applying equations from Kirchoff's Law II or known as Kirchoff's Voltage Law. This is in accordance with the statement of Mutoharoh et al. (2022), which states parallel circuits with many loads, Kirchoff's Law I is used to ensure that electric current is maintained throughout the circuit, while Kirchhoff's Law II is used to calculate the electrical voltage supplied by a power source and consumed by all loads in the circuit.

CONCLUSION

Based on the Electrical Circuit practicum that has been carried out, it can be concluded that an electrical circuit is an arrangement or combination of various components that function to channel electrons or electric current. Electrical circuits can be arranged into

series electrical circuits and parallel electrical circuits. The voltage in the series electrical circuit is divided into each component because it is on the same path. Meanwhile, the voltage in parallel electrical circuits remains the same because the components are arranged on different paths.

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ATTACHMENT

Appendix 2. Manual Calculation of Electrical Circuit

1. Battery circuit in series

   V_{total} $= V_1 + V_2 + V_3$
   $= 1.62 + 3.27 + 4.90$
   $= 9.79$ V

2. Battery circuits in parallel

   V_{total} $= V_1 = V_2 = V_3$
   $= 8.85$ V

Appendix 3. Electrical Circuit Practicum Documentation

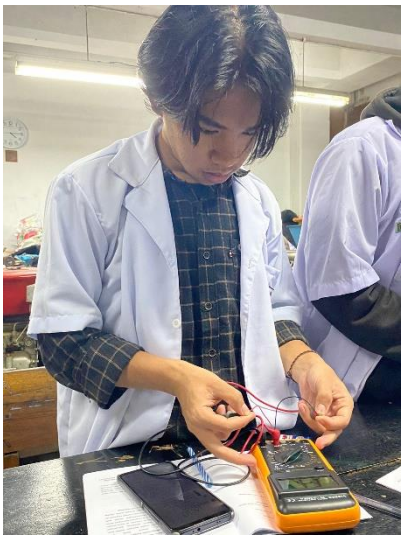

Figure 5. Electrical Circuit Practicum Documentation.

POWER SUPPLY

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ABSTRACT

In general, the principle of the power supply circuit consists of the main components, namely transformers, diodes and capacitors. When making a power supply circuit, in addition to using the main components, supporting components are also needed so that the circuit can function properly. These supporting components include switches, fuses, sockets and plugs, printed circuit boards (PCBs), and cables. The purpose of the Power Supply practicum is to know how to make a plain PCB board electronic circuit path and know the application of PCB boards in electronic circuits (power supply). The method carried out in the Power Supply practicum is to make a design of the power supply circuit in Proteus software which is then continued by making the original circuit. The result obtained in the Power Supply practicum is that the electrical components for the power supply circuit are arranged on a plain PCB board. However, the circuit that has been made does not show success because the LED light that functions as an indicator does not light up. This is because it is possible that the components used are damaged. The conclusion of the Power Supply practicum is that the power supply circuit made consists of several types of electrical components, where these components are assembled on a plain PCB board that has previously been cleaned of copper layers and made circuit paths.

Keywords: Component**,** Pcb, Circuit.

INTRODUCTION

Background

Along with the times, the use of existing electronic devices is also increasing. The increasing load of electronic devices certainly causes the use of power supply to also increase. The power supply itself can be said to be a device that functions to generate and channel voltage to the load or electronic devices used.

In general, the principle of the power supply circuit consists of the main components, namely transformers, diodes and capacitors. When making a power supply circuit, in addition to using the main components, supporting components are also needed so that the circuit can function properly. These supporting components include switches, fuses, sockets and plugs, printed circuit boards (PCBs), and cables. Both the main components and supporting components play an important role in the power supply circuit.

Printed Circuit Board (PCB) has a function as a place to connect various electrical components into a circuit, Before being assembled on the original PCB board, usually a design or circuit model is made first using software such as Proteus. Making models in Proteus software is useful to minimize errors that occur when making the original circuit because the compatibility between components can be known in advance

Based on the description above, a power supply practicum is carried out to find out the principles and workings of the power supply system in everyday life, as well as how to make circuit models on the Printed Circuit Board (PCB) board, both on Proteus software and the original circuit.

Purpose and Uses of Practicum

The purpose of the Power Supply practicum is to know how to make a plain PCB board electronic circuit path and know the application of PCB boards in electronic circuits (power supply).

The use of Power Supply practicum is being able to design or design power supply components in Proteus software and make power supply circuits on plain PCB boards to be applied to agriculture.

LITERATURE REVIEW

Power Supply

A power supply is a device that supplies electrical energy to one or more consumers or electrical loads. Power supply is an important part in electronics that acts as a source of electrical energy, for example in batteries or accumulators. The power supply has almost the same circuit structure, which consists of a transformer, rectifier and voltage smoother. The term is most commonly used for devices that convert one form of electrical energy into another, although the term can also refer to devices that convert other forms of energy (e.g. mechanical, chemical, solar) into electrical energy. In general, the principle of the power supply circuit consists of the main components, namely transformers, diodes and capacitors. Making a power supply circuit in addition to using the main components, supporting components are also needed so that the circuit can work properly. There are two sources of power supply, namely AC power source and DC power source. The AC source is an alternating voltage source, while the DC voltage source is a direct voltage source (Sihotang et al., 2018).

Transformer

A transformer is an electrical device that can transfer and convert electrical energy from one or more circuits to another by magnetic coupling and on the principle of electromagnetic induction without changing its frequency. Generally, transformers consist of a core made of layered iron, and two windings, namely the primary winding and the secondary winding. Usually the winding consists of copper wire wound around the legs of the transformer core. In general, transformers can be divided into two types according to their construction, namely the core type and the shell type. Core type, there are two legs and each leg is wrapped around a scroll. While the shell type has three legs and only the middle leg is wrapped around the two rolls (Siburian, 2019).

Diode

Diode, etymologically the meaning of diode comes from the two words DI (two) and ODA (electrode), which means two electrodes. The term diode is literally an electronic component that has two electrodes, a positive polarity electrode called an anode and a negative polarity electrode being a cathode. The function of the diode is closely related to the regulation of voltage current, in this case directing the AC voltage signal into a DC voltage signal. If you want to use it for a half-wave rectifier, you can use only 1 diode. However, if you want to be a full-wave rectifier, you need to use 4 diodes arranged like a bridge or use 2 diodes with transformers that have a center tap (CT). Diodes are active components that have two channels, but specifically for thermionic diodes can have a third channel that functions as a heater. However, in general diodes have two active electrodes through which electrical signals can flow. Most of these components are used

for one-way characteristics, while varicap diodes (variable capacitors) are used as voltage-controlled capacitors (Saukani, 2019).

Capacitor

Understanding capacitors are electronic components that can store and release electric charge. The capacitor structure consists of 2 metal plates separated by a dielectric material. Commonly known dielectric materials such as air vacuum, ceramics, glass, electrolytes and others. When an electric voltage is applied to both ends of the metal plate, a positive charge builds up at one of the metal legs (electrode) and a negative charge builds up at the other end of the metal. Positive charges cannot flow to the negative pole and vice versa negative charges cannot flow to the positive pole because they are separated by a non-conductive dielectric material. This electric charge is stored as long as there is no conduction at the toe. The ability to store electric charge on a capacitor is called its capacitance or capacity (Sihotang et al., 2018).

Integrated Circuits (ICs)

Integrated circuits (ICs) are the backbone of modern computing systems. IC itself is an active electronic component consisting of a combination of hundreds or even millions of transistors, resistors and other components integrated into an electronic circuit in a small package. The shape of Integrated Circuits (IC) also varies, ranging from three feet to hundreds of feet (terminals). IC functions also vary, ranging from amplifiers, switches, controllers to storage media. In general, IC is an electronic component used as a brain in an electronic device. IC is a semiconductor component that is very sensitive to electro static discharge (ESD) (Shamsi et al., 2017).

Resistor

A resistor is an electronic component that acts as a barrier to current flowing in a circuit and is a two-terminal electronic component that generates a voltage across the terminals proportional to the current according to Ohm's law (V = IR). A resistor does not have positive and negative poles, but rather has the main characteristics, namely resistance, tolerance, maximum operating voltage and power rating. Other characteristics include temperature coefficient, noise and inductance. Ohm, denoted by the symbol Ω (Omega) is the unit of resistance of a resistive resistor. The function of resistors is as a regulator to regulate, limit, decrease and divide the amount of current flowing in a circuit. The existence of obstacles causes electric current to be distributed as needed (Suryani, 2020).

LED Light

LED or short for Light Emitting Diode which means light-emitting diode is one of the most famous electronic components in modern life today. LED lights are widely used in various fields such as lighting, traffic signs, as well as indicator lights for electronic devices in industry. In addition, LED lights can function as a marker that an electronic device is running or working. This LED is widely used because the power consumption required is not too large. LED lights can also produce various colors and light intensities that can be adjusted such as dimmed and automatically recolored (Faridha et al., 2016).

PCB Board

Printed Circuit Board also known as PCB is a printed circuit board full of metal circuits that connect different types of electronic components simultaneously without wires. Usually these circuit boards are made of ebonite or fiberglass coated with a layer of copper on one or both sides. A circuit board that has only a copper layer on one side of its surface is referred to as a singlelayer circuit board. While circuit boards that have

copper layers on both sides of the surface are referred to as double-sided circuit boards (multilayer). Printed Circuit Board (PCB) functions as a place to assemble various electronic components to install more neatly, orderly and safely, and can replace cables to connect different components, namely to connect the legs of one component to another, both active component legs and passive component legs (Darmawan, 2020).

$FeCl_3$ Solution

The process of making a Printed Circuit Board (PCB), one of the processes that must be passed is the etching process. Etching is a process that uses a chemical solution with a specific composition and type of solution to remove a specific part of a material such as a copper coating on a PCB board. The most important thing about the etching process is that it is fast, environmentally friendly, and production costs are kept to a minimum during the PCB manufacturing process. The chemical solution commonly used in the etching process is ferrite chloride ($FeCl_3$). Ferrite chloride solution (FeCl 3) is widely used as etching in printed circuit board (PCB) materials because of its high chemical reaction speed and low regeneration rate compared to other chemical materials or solutions such as ammonium persulfate, chromic acid, copper chloride and alkaline ammonia which have opposite properties to $FeCl_3$ solution (Riafinola et al., 2019).

Proteus Software

Making an electrical circuit usually begins with making its design first in order to minimize errors that occur when making the original circuit. One software that is often used to design electrical circuit schemes is Proteus. Proteus is very easy to understand for beginners who want to learn about electronic components. Proteus consists of a combination of the Intelligent Schematic Input System (ISIS) and the ARES program. Through the merging of these two programs, schematic electronic circuits can be designed and simulated and transformed into PCB layouts. In addition, Proteus' function is to design circuit boards, simulate circuits, and also provide nearly 800 variations of microcontrollers that can be used directly for simulation. Some of Proteus' features are VSM simulation, PCB design creation, and visual design (Pangaribowo et al., 2022).

PRACTICUM METHODOLOGY

Time and Place

The Power Supply Practicum will be carried out on Thursday, March 16, 2023, at 15.00 WITA until it is completed at the Agricultural Tools and Machinery laboratory, Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University.

Tool

The tools used in the Power Supply lab are coins, containers, gloves, permanent markers and laptops.

Material

The materials used in this lab are plain PCB board, liquid $FeCl_3$, PCB transfer paper, power supply components namely transformers, diodes, capacitors, ICs, plain PCBs, lotions, tin, plastics, single cables, photocopies of PCB lines, water, resistors and LEDs.

Practicum Procedure

Prosedur in Power Supply practicum, namely:

a. Proteus software circuit

1. Displays the start page of Proteus software.
2. Create a new project on the main page of the Proteus software.
3. Selecting electronic components that will be assembled through the Pick Device feature.
4. Add electronic components to the component mode feature.
5. Arrange or assemble components that have been selected.
6. Perform simulations on electronic circuits.
7. Document the results of electronic circuits before and after simulation.

b. Power supply circuit

1. Preparing the tools and materials used.
2. Sanding plain PCB boards.
3. Cut the PCB board according to the scheme to be used.
4. Transform layout designs into PCB boards by using lotions and coins.
5. Design a plain PCB board by using permanent markers.
6. Mixing ferricloride solution ($FeCl_3$) using water.
7. Make holes on the PCB board by using a mini drill PCB drill.

c. Stringing the power supply

1. Removing the layout design results on the PCB board using sandpaper
2. Attach the transformer to the PCB board.
3. Stringing diodes on the PCB board.
4. Stringing capacitors on a PCB board.
5. Stringing ICs on a PCB board.
6. Stringing transistors on the PCB board.
7. Stringing resistors on the PCB board.
8. Stringing LEDs on the PCB board.
9. Connect transformer PCB boards and circuit PCB boards.

RESULTS AND DISCUSSION

Result

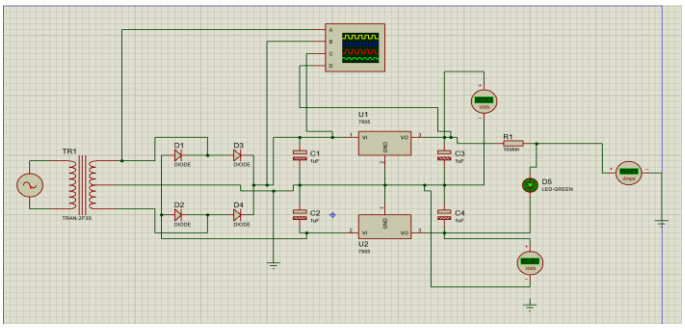

Figure 6. Series Results in Proteus Software.

Figure 7. PCB Board Circuit Path.

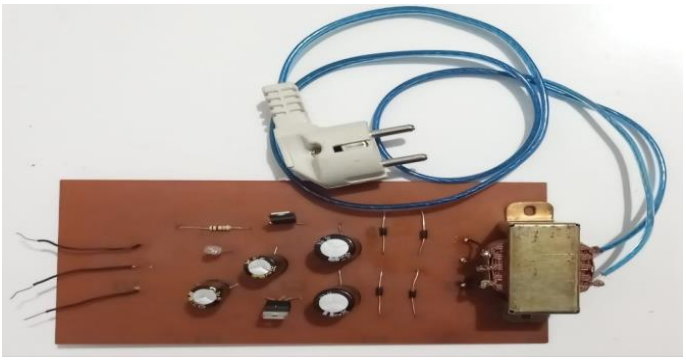

Figure 8. Power supply circuit.

Discussion

Based on the Power Supply practicum that has been carried out, it can be concluded that the power supply circuit process is carried out in several stages. The first stage begins with making a design or scheme of the circuit that will be created in Proteus software. The circuit scheme created in the Proteus software is then simulated to find out whether the circuit is running well or not. Through making the design or scheme carried out, it can further minimize errors that occur when making the original circuit. This is in accordance with the statement of Pangaribowo et al. (2022), which states that the manufacture of an electrical circuit usually begins with making the design first in order to minimize errors that occur when making the original circuit.

The power supply circuit made consists of several types of electrical components, such as transformers or transformers, diodes, capacitors, ICs and resistors. These components are assembled on a plain PCB board that has previously been cleaned of copper layer with tools such as sandpaper and $FeCl_3$ solution which is then made circuit path with carbon from printing ink attached with the help of lotion. The circuit indicator in the form of LED lights that have been made does not light up which indicates that the circuit fails because there may be damaged components. Therefore, the main and supporting components in the circuit must be considered feasibility so that the power supply circuit made can run properly. This is in accordance with the statement of Sihotang et al. (2018), which states that in addition to using the main components, supporting components are also needed so that the circuit can work properly.

CONCLUSION

Based on the Power Supply practicum that has been carried out, it can be concluded that the power supply circuit consists of several components such as transformers or transformers, diodes, capacitors, ICs and resistors. The components are assembled on a plain PCB board that has previously been cleaned of copper layer and made a circuit path. The feasibility of the components used must also be considered so that the circuit can run well.

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ATTACHMENT

Appendix 4. Power Supply Practicum Documentation

Figure 9. Power Supply Practicum Documentation.

HEATER (Heating Element)

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ABSTRACT

Tools used in drying a material have a component called a heater. This heater is in the form of an electronic component that can produce heat energy from conversion which was previously in the form of electrical energy through a process called Joule Heating. The purpose of the Heater practicum (Heating Element) is to be able to understand the concept of a 1-phase and 3-phase heater circuit. The method carried out in the Heater practicum (Heating Element) is to measure the temperature of the heater heat blown by the wind at several types of distance and time intervals. The results obtained in the Heater practicum (Heating Element) are that the heater is an electronic component that is able to produce a heat source from an electrical energy source through the joule heating process. Treatment carried out on the heat generated by the heater with varying or varying wind speeds results in the result that the temperature height read by the thermometer is inversely proportional to the distance interval measured. The conclusion of the Heater practicum (Heating Element) is that the heater is a heating element consisting of several types such as finned heaters equipped with fins. The heater series consists of a 1-phase heater and a 3-phase heater.

Keywords: Energy, Components, Heat

INTRODUCTION

Background

Thermal energy is energy derived from heat produced by an object or material, where the energy moves from a place with high temperature to a place with a lower temperature. Thermal energy can come from a variety of sources such as sunlight, geothermal, nuclear reactions or the result of burning fossil fuels. Thermal energy can be used for various human needs such as in heating water, cooking, generating electricity, and also for purposes in industrial fields such as power plants or industrial heating.

Thermal energy is also often used in drying agricultural products, especially grains. This heat energy serves to reduce the water content in agricultural products because with the reduction in water content, agricultural materials will be more difficult to rot by various decomposing microorganisms so that in storing stranded materials can last longer. This drying process itself can be done conventionally with the help of direct sun or modernly with the help of heat generating devices.

Tools used in drying a material have a component called a heater. This heater is in the form of an electronic component that can produce heat energy from conversion which was previously in the form of electrical energy through a process called joule heating. Heaters consist of various types depending on the type of material to be given or channeled heat energy, where the types of heaters have their own advantages and disadvantages.

Based on the description above, a Heater practicum is carried out to determine the use of heat energy, especially from electronic components in the form of heaters (heat elements), especially in agriculture such as the drying process of agricultural products.

Purpose and Uses of Practicum

The purpose of the Heater practicum is to be able to understand the concept of a 1-phase and 3-phase heater circuit.

The use of the Heater practicum (Heating Element) is able to apply the manufacture of a series of heaters used in agricultural drying machines.

LITERATURE REVIEW

Thermal Energy

Thermal energy is the energy contained in an object or substance due to the movement of the particles it contains. Thermal energy can be obtained from the sun or through the process of converting other energy into thermal energy itself. Thermal energy can move from one medium to another because of the temperature difference between the two media. The phenomenon of heat transfer is called heat transfer. Heat transfer can occur through several means such as conduction, convection and radiation. Conduction occurs when heat is transferred through direct contact between objects, convection occurs when heat is transferred through a fluid stream and radiation occurs when heat is transferred by electromagnetic waves (Li et al., 2021).

Heat transfer by convection can be divided into two planes, namely natural convection and forced convection. Natural convection (free convection) occurs because liquid or gaseous fluids move naturally, where the displacement of fluid substances is caused by differences in fluid density due to variations in fluid temperature between two different media or places. Forced convection occurs due to fluid movement that is not due to natural factors but due to external forces such as from pumps or fans, so that the flow of fluid that conducts heat is higher and increases the efficiency of the heat transfer process. Forced convection also consists of laminar and turbulent forced convection. Laminar forced convection occurs when fluid flow is slow and regular, whereas turbulent forced convection occurs when fluid flow is fast and irregular. The use of forced convection can be seen in various processes such as radiator or cooling systems on machines and tools or drying machines for agricultural products (Wijiati & Widodo, 2019).

Heater

Heater is a technology that is widely developed because this heater does not use fire to heat objects. The heater converts electrical energy into heat energy through the joule heating process, electricity derived from alternating electric current undergoes induction and then flows through copper coils. The resulting alternating electric current causes electromagnetic fields of varying strength. The working principle of the heater is that the electric current flowing through the element meets its resistance, causing heat to the element. Heaters based or based on power electronics have a close relationship with operating frequency which can be in the form of voltage values and input currents, as well as the shape of the object to be heated. Each of these factors has an impact on the characteristics of the heat generated (Dirja, 2019).

Heaters or heating elements generally have three types that are often used such as metallic, silicon carbide (SiC) and molybdenum disilicide (MoSi2). Most metallic grade heaters or heating elements use nichrome 80/20 (80% nickel, 20% chromium) in the

form of wire, tape, or strips. Nichrome 80/20 is a good material because it has a relatively high resistivity and forms a chromium oxide layer when first heated, so that the material under the wire does not oxidize and prevents the wire from breaking or burning (Lubis, 2016).

One type of heater is a finned heater, where this type of heater is in the form of a pipe equipped with fins. The finned heater finned fins are made of stainless steel with a fin width of 7-10 mm and a tube diameter of 11 mm. Finned heaters can be used in a variety of applications such as automotive radiators, space heaters, air conditioners, and other electronic devices. The fins on the finned heater are designed to improve heat efficiency by increasing the surface area available for heat transfer, thereby accelerating heat transfer to the environment. Finned heaters usually use electric heating elements to generate heat (Panorama, 2019).

1 Phase Electricity

1 phase electricity is one of the most common types of power sources used in homes, offices, and industries. This current is also known as single-phase electricity because only one wire is used to carry electric current from the source to the consumer. The 1-phase electrical system, the electric current moves back and forth alternately in one conductor called phase, while the other conductor called neutral serves as a link to the earth. The 1 phase electrical system has several advantages such as easy installation, more efficient for low power needs and relatively cheaper installation costs. However, 1 phase electrical systems also have some disadvantages such as limited and unstable performance when used for heavy loads such as industrial machines or large cooling systems. The 1 phase electrical system in the house is usually used for daily needs such as lighting systems, charging devices, and the use of electronic devices such as washing machines, televisions and refrigerators (Faturrahmah, 2016).

3 Phase Electricity

3 phase electricity is a type of electrical system used in many industrial and commercial applications. The system consists of a three-phase cable that produces alternating current with the same frequency but different phases. 3 phase electricity has different properties from 1 phase electricity. Electric 3 phase electric current flows alternately between three separate phase wires arranged in such a way that the electric current in a certain phase is always reversed with the current of other phases, where each phase is separated from each other by 120 degrees and the resulting current has the same amplitude. 3 phase electricity has advantages such as better efficiency and the ability to start larger electric motors. This is due to a more stable and continuous electric current in each phase, allowing electrical devices to work more effectively. In addition, 3-phase electricity also has the advantage of being able to power many electrical devices at the same time because of its large power (Wakole, 2022).

3 phase electricity is used in a wide range of large industrial and commercial applications such as metal cutting machines, grinding machines, printing machines, manufacturing machinery, processed food dryers and large refrigeration systems. In addition, 3-phase electricity is also used in electrical distribution systems to power many houses and buildings in a settlement. 3 phase electrical installations require several special equipment, including 3-phase transformers, switchboards and phase cables. This appliance must be installed correctly and in accordance with safety standards to avoid fire and electrical short circuits.

Thermometer

A thermometer is a device used to measure temperature or temperature. It usually consists of a glass or plastic tube with a bulb at one end that contains a liquid, usually mercury or alcohol. As the temperature changes, the liquid expands or contracts, causing it to move up or down the tube, indicating the temperature on a scale marked on the outside of the tube. There are many types of thermometers including digital thermometers, infrared thermometers and bimetallic thermometers that use different methods of measuring temperature. Thermometers are commonly used in a wide variety of places including homes, hospitals, laboratories, agricultural land and industrial environments (Supu et al., 2017).

PRACTICUM METHODOLOGY

Time and Place

The Heater Practicum (Heating Element) will be carried out on Thursday, April 6, 2023, at 15.00 WITA until it is completed at the Agricultural Tools and Machinery laboratory, Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University.

Tool

The tools used in the Heater practicum (Heating Element) are heating elements in the form of finned pipes, markers, fans, bars, stopwatches, thermometers, multimeters and mobile phone cameras..

Practicum Procedure

Prosedur in the Heater practicum (Heating Element), namely:

a. Temperature measurement using time

1. Preparing tools and materials.
2. Turn thefan on at speed 1, speed 2 and speed 3.
3. Put the heater in front of the fan.
4. Turn on the heater.
5. Stick themanual thermometer near the heater.
6. Turn on the stopwatch and observe the temperature rise on the thermometer at 2-minute intervals for 18 minutes.
7. Record the results of measurements that have been observed.
8. Document the practicum.

b. Measuring temperature using distance

1. Preparing tools and materials.
2. Turn on the fan at speed 1, speed 2 and speed 3.
3. Put the heater in front of the fan.
4. Measure distances of 5 cm, 10 cm and 15 cm using a bar.
5. Turn on the heater.
6. Stickthe manual thermometer with a distance of 5 cm, 10 cm and 15 cm.
7. Observe the temperature increase on the thermometer when it is at a distance of 5 cm, 10 cm and 15 cm.
8. Record the results of measurements that have been observed.
9. Document the practicum.

Formula Duses

The formula used in the Heater practicum (Heating Element), namely:

$$P = \frac{v^2}{R}$$

Information:
P = Power (W)
V = mains voltage (v)
R = Resistance (Ω)

RESULTS AND DISCUSSION

Result

Figure 10. Graph of the Relationship between Distance and Temperature at Speed 1.

Figure 11. Graph of the Relationship between Distance and Temperature at Speed 2.

Figure 12. Graph of the Relationship between Distance and Temperature at Speed 3.

Discussion

Based on the Heater practicum that has been carried out, it can be known that the heater or heating element is an electronic component that can convert a source of electrical energy into thermal energy. The process of converting electrical energy into heat energy is called the joule heating process. The heater used in the lab is a finned heater, where this heating element is equipped with fins that function to extend the range of the heat transfer process to the surrounding environment. This is in accordance with the statement of Panorama (2019), which states that the fins on the finned heater are designed to increase heat efficiency by increasing the surface area available for heat transfer, thereby accelerating heat transfer to the environment.

The heater series itself can be divided into 1-phase heaters and 3-phase heaters . The 1 phase heater circuit only consists of one phase which causes the electric current to move back and forth alternately, so that the power produced is smaller. The 3-phase heater circuit itself consists of three phases that cause the electric current to flow alternately and between one phase and another phase the flow is always reversed, so that the power produced is also greater. This is in accordance with Wakole's statement (2022), which states that 3-phase electricity has different properties from 1-phase electricity. 3 phase electricity, the electric current flows alternately between three separate phase wires arranged in such a way that the electric current in a certain phase is always reversed with the current of another phase.

Through the three graphs formed, it can be seen that the influence of wind variations blown on the heater or heating element results in the temperature read on the thermometer does not have a significant difference. Through the three graphs it can also be seen, that the influence of distance on the temperature read on the thermometer gets the result that the farther the distance, the smaller the temperature read. The process of transferring heat energy from the heater blown by the wind from the fan is called forced convection. This is in accordance with the statement of Wijiati & Widodo (2019), which states that forced convection occurs due to fluid movement that is not due to natural factors but due to external forces such as from pumps or fans, so that the flow of fluid that conducts heat is higher and increases the efficiency of the heat transfer process.

CONCLUSION

Based on the Heater practicum that has been carried out, it can be seen that the heater is a component that functions to convert electrical energy into heat energy. Heaters consist of several types such as finned heaters equipped with fins, so that the wide range of heat transfer is also larger. Heaters can be divided into a series of 1-phase heaters and 3-phase heaters, where the power produced by both types of circuits has different magnitudes.

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ATTACHMENT

Appendix 5. Table of Heater Measurement Results (Heating Element)

Table 7. Results of Distance and Temperature Measurements Against Wind Speed.

No.	Distance (cm)	Temperature ()°C	Time (minutes)	Speed
1.	5	52	2	
2.	10	48	4	1
3.	15	35	6	
4.	5	39	8	
5.	10	34	10	2
6.	15	34	12	
7.	5	41	14	
8.	10	36	16	3
9.	15	25	18	

Appendix 6. Manual Calculation of Heater (Heating Element)

$$P = \frac{v^2}{R}$$

$$P = \frac{220^2}{352}$$

$$P = \frac{48.400}{352}$$

$$P = 137.5 \text{ W}$$

Appendix 7. Heater Practicum Documentation (Heating Element)

Figure 13. Heater Practicum Documentation (Heating Element).

AC AND DC ELECTRIC MOTORS

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ABSTRACT

Along with the development of the times, existing technology is increasingly advanced, especially in electronic devices so that dependence on electrical energy is also increasing. This electrical energy functions as the main source of energy or power from existing electronic devices, for example, in the use of electric motors. The purpose of AC and DC Electric Motor practicum is to be able to understand AC and DC motor circuits and be able to know the types of AC and DC motor circuits. The method carried out in the AC and DC Electric Motor practicum is to see how the AC and DC electric motors work and measure the voltage and rotational speed of AC electric motors at different dimmer angles. The results obtained in the AC and DC Electric Motor practicum are that the magnitude of the angle by the dimmer is directly proportional to the rotational speed (RPM) of the electric motor. Likewise, the voltage channeled to the electric motor is also directly proportional to the magnitude of the angle regulated by the dimmer. The conclusion of the AC and DC Electric Motor practicum is that based on the source of electric current, electric motors can be divided into DC electric motors such as dynamos and AC electric motors for example such as 1 phase electric motors and 3 phase electric motors.

Keywords: Dimmer, Electric, Motor.

INTRODUCTION

Background

Along with the development of the times, existing technology is increasingly advanced, especially in electronic devices so that dependence on electrical energy is also increasing. This electrical energy functions as the main source of energy or power from existing electronic devices, for example, in the use of electric motors. The electric motor itself is a component that functions as a drive on a tool or machine.

Electric motors are widely used in various industries. This type of motor is susceptible to overcurrent caused by overcurrent and overcurrent. Overcurrent interference causes the motor winding to heat up, which in the long run reduces the insulating ability of the motor. The potential for interference due to reduced motor insulation strength increases and can cause fire, so it is necessary to counteract the power of the electric motor itself.

Electric motors consist of various types, for example, from the source of energy, electric motors can be divided into AC electric motors and DC electric motors. AC electric motors are usually used in home industries or jobs that require electrical power that is not too large because the energy source comes from AC electricity or back and forth. Meanwhile, DC electric motors are more often used in jobs that require large electrical power such as industrial factories because the energy source comes from DC or unidirectional electricity.

Based on the description above, AC and DC Electric Motor practicum is carried out to find out the working principle of the electric motor and the types of electric motors based on the type of electrical energy source.

Purpose and Uses of Practicum

The purpose of AC and DC Electric Motor practicum is to be able to understand AC and DC motor circuits and be able to know the types of AC and DC motor circuits.

The use of AC and DC Electric Motor practicum is to be able to find out the application of AC and DC motors in everyday life, especially in agriculture and know the working principle of the AC and DC motors.

LITERATURE REVIEW

Electric Motor

Electric motor is a type of driving power source from electronic tools or machines. The working principle of the electric motor itself is to convert electrical energy which is the source of power into mechanical energy in the form of rotation or rotation through the process of interaction in magnetic fields and electric currents called electromagnets. The interaction of the magnetic field and electric current works when energy flows through the main components of the electric motor in the form of a stator and rotor. The use of this electric motor is usually used as a drive in shredding machines, pumps or vehicles such as electric cars (Priono et al., 2019).

Based on the type of electrical energy source, electric motors can be divided into two types, namely DC electric motors and AC electric motors. DC electric motor is a type of electric motor that uses a DC (unidirectional) electric energy source as its power source. DC motors have historically been the most widely used motors in the past. This is due to ease of adjustment and separate flow of flux and torque. However, DC motors have shortcomings on the maintenance side which is quite difficult. DC electric motors are commonly used in various applications and industrial jobs such as in printing machines, blower drives or fans and so on (Aditya et al., 2019).

Another type of electric motor is in the form of an AC electric motor. AC electric motor is a type of electric motor that uses an AC electric energy source (alternating back) as its power source. Such AC electric motors can then be further divided into induction motors and synchronous motors. Induction motors are the most suitable type of electric motor for use in various applications or jobs. This is because electric motors have reliability, resistance to interference, do not require intensive maintenance and the ability to work in extreme environments. Meanwhile, synchronous motors are a type of electric motor that requires a stator that generates a magnetic field so that it can keep the rotor rotating synchronously. Synchronous motors have advantages such as their relatively high efficiency, especially at a constant level of speed. Therefore, synchronous AC electric motors need a sophisticated and complex control system to generate the right rotating magnetic field, so that the production and maintenance costs are higher than induction motors or other types of AC electric motors (Aditya et al., 2019).

Stator

Electric motors consist of several types of components and one of them is a component called a stator. The stator is a static or immovable component in an electric motor in the form of a collection of wire windings or coils that produce a magnetic field from the process of converting electrical energy into mechanical energy and serves to wrap the rotor. The magnetic field generated by the stator is what will later make the rotor rotate.

The number of wire coils in an electric motor depends on the design of the electric motor. The stator on the electric motor is very important in engine performance and good stator manufacturing quality can increase the possibility of the machine to run with a high level of efficiency and consistency (Pramono et al., 2016).

Rotor

In addition to the stator, the electric motor also requires a rotor as a driving component. The rotor is a dynamic part of an electric motor engine that rotates and is inside the stator. The rotor is connected to the shaft located in the center of the stator and rotates in it. When an electric current is passed through the stator, the resulting magnetic field pulls the rotor into rotation. The speed of the rotor is determined by the angular frequency and voltage applied to the engine. Stators are generally made of conductive materials such as copper or aluminum because of their good conductivity (Pramono et al., 2016).

Dimmers

Energy conservation is an effort to rationalize the use of electrical energy for a need. Energy saving is done to consume less energy without reducing the benefits obtained and reducing excessive energy consumption. This situation can be overcome by saving energy to reduce excessive energy consumption in a more environmentally friendly way. One option is to use an electronic dimmer.A dimmer is an electronic circuit that converts the shape of a pure AC signal into a modulated signal so that the output voltage can be regulated. The dimmer is used to regulate the voltage of electric current flowing to the electric motor so that the electric motor can provide faster or slower rotational power according to the desired needs. More complex dimmers use PWM as the controller. This PWM dimmer is able to produce a small level of power, so that control becomes easier and more precise (Prasetia & Liya, 2021).

Battery

Battery or accumulator is a source of direct electric current that can convert chemical energy into electrical energy that serves to store the electrical energy produced and will later be channeled to the electrical system connected to the battery. Batteries contain electrochemical elements that can affect their reactants or reagents, therefore they are called secondary elements. The battery was first discovered by a French physicist named Gaston Plante in 1859. The battery consists of three main parts, including the positive pole (anode) made of lead oxide (PbO_2), the negative pole (cathode) made of pure lead (Pb) and an electrolyte solution made of sulfuric acid (H2SO4) with a concentration of 30%. The working principle of the battery is on the basis of charging and discharging the electrical energy it contains. When the battery is used, a discharge occurs that converts both electrodes into lead sulphate. This is because both electrodes react to sulfuric acid solution, where the lead electrode releases many electrons and creates an electric current from lead dioxide. The battery is one of the components that has a limited service life, so when it reaches the service age limit the battery needs to be replaced with a new one (Setiono, 2015).

According to Setiono (2015), batteries can be classified into the following types:

1. Wet Battery, which is a type of battery that is widely used in motorized vehicles and contains sulfuric acid which can be added through the hole in the battery box. This fluid can be reduced because during the use of the battery, a chemical reaction occurs in it with the battery cell.
2. Hybrid battery, which is a type of battery whose structure is the same as a wet battery, only the difference lies in the material of the cell components. Hybrid batteries use

low-antimonial materials on the positive electrode and calcium on the negative electrode.

3. Calcium battery, which is a type of battery that uses calcium material both on the anode and also on the cathode.
4. Dry battery, which is a type of battery that uses calcium on the anode and cathode, with insulators or insulators in the form of nets that can hold electrolyte fluid. Electrolyte liquid is in the form of a gel with hermetically sealed packaging. When evaporation occurs, natural gas is absorbed by the mesh so that the amount of electrolyte does not decrease.

PRACTICUM METHODOLOGY

Time and Place

The AC and DC Electric Motor Practicum will be carried out on Thursday, April 13, 2023, at 14.30 WITA until it is completed at the Agricultural Tools and Machinery laboratory, Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University.

Tool

Tools used in AC and DC Electric Motor practicum are multimeters, tachometers, AC and DC motors, screwdrivers, single cables, stopwatches, dimmers, stationery and mobile phone cameras.

Material

The materials used in AC and DC Electric Motor practicum are batteries.

Practicum Procedure

Prosedur in AC and DC Electric Motor practicum, namely:

1. Preparing tools and materials.
2. Connect the AC dimmer to a power outlet via the dimmer input.
3. Connect the dimmer to the AC motor via the dimmer output.
4. Measure the voltage of the AC dimmer based on the magnitude of the angle using a multimeter.
5. Measure the rotational or rotational speed on the AC motor using a tachometer.
6. Record the results of rotation and voltage readings on the tachometer and multimeter.
7. Document the practicum process.

Formula Duses

The formula used in AC Electric Motor practicum and, namely:

$$P = k.V.I. \cos \theta$$

Information:

P = power (W)
V = voltage (V)
I = current (A)
K = 1 (1 phase AC motor)
√3(3 phase AC motor)
Cos θ = power factor

RESULTS AND DISCUSSION

Result

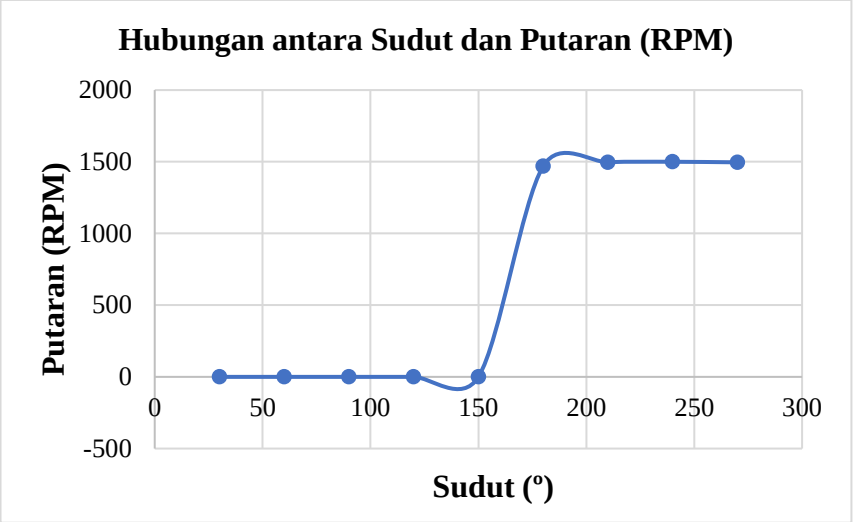

Figure 14. Graph of the Relationship between Angle and Rotation (RPM).

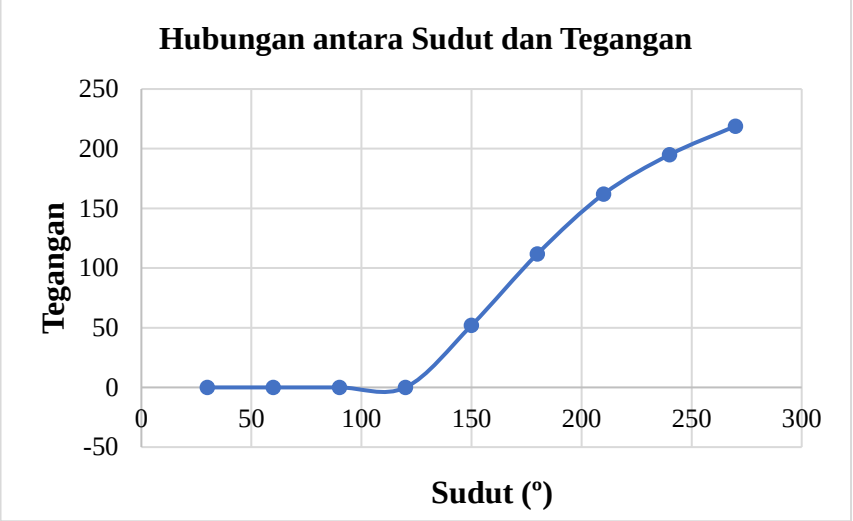

Figure 15. Graph of the Relationship between Angle And Voltage.

Discussion

Based on the AC and DC Electric Motor practicum carried out, it can be seen that electric motors can be divided into several types based on the type of electric current source. The division based on the type of electric current source includes DC electric motors whose power sources are in the form of DC current or direct current, for example such as dynamos and DC electric motors whose power sources are in the form of AC current or alternating current, for example such as 1-phase electric motors and 3-phase electric motors. This electric motor itself functions as a driving force in electronic tools or machines by converting the source of electrical energy into mechanical energy in the form of rotation or rotation through the process of interaction between the magnetic field and electric current that occurs in the stator and rotor. This is in accordance with the statement of Priono et al. (2019), which states that the working principle of the electric motor itself is to convert electrical energy which is the source of power into mechanical energy in the

form of rotation or rotation through the process of interaction in magnetic fields and electric currents called electromagnets.

Through practicum, results were also obtained in the form of two types of graphs. The first graph explains the effect of angular magnitude on rotation (RPM) produced by an electric motor. Based on the graph, it can be seen that the magnitude of the angle is directly proportional to the rotation, where the greater the angle, the greater and faster the rotation (RPM) produced. The observed rotation occurs in the electric motor component in the form of a rotor whose rotation speed is influenced by the angular frequency given to the electric motor. This is in accordance with the statement of Pramono et al. (2016), which states that the speed of the rotor is determined by the angular frequency and voltage applied to the engine.

The second graph explains the effect of the magnitude of the angle on the electric voltage channeled to the electric motor. Based on the graph, it can be seen that the magnitude of the angle is also directly proportional to the voltage, where the greater the angle, the greater the voltage channeled to the electric motor. Setting the amount of voltage channeled to the electric motor can be done using a dimmer through a large angle setting so that the rotation or rotation speed of the electric motor is also as desired. This is in accordance with the statement of Prasetia & Liya (2021), which states that the dimmer is used to regulate the voltage of electric current flowing to the electric motor so that the electric motor can provide faster or slower rotational power according to the desired needs.

CONCLUSION

Based on the AC and DC Electric Motor practicum that has been carried out, it can be concluded that an electric motor is a tool that functions as a driving force in a tool or machine by converting its source of electrical energy into mechanical energy with rotation or rotation. Based on the source of electric current, electric motors can be divided into DC electric motors such as dynamos and AC electric motors such as 1 phase electric motors and 3 phase electric motors. Regulation of the voltage entering the electric motor can be done using a dimmer.

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ATTACHMENT

Appendix 8. Manual Calculation of AC and DC Electric Motors

$$P = k.V.I. \cos \theta$$

Dik:
V = 220 V
I = 3.61 A
K = 1 (1 *phase* electric motor)
cos θ = 0.99°
Dit:
P =.....?
Settlement:
P = 1 220 3.61 cos 0.99 ×××
= 794.2 0.999850726×
= 794.181432 W

Appendix 9. AC and DC Electric Motor Measurement Results Table

Table 8. AC Electric Motor Power Measurement Results.

No.	Angle ()°	Voltage (V)	Speed (RPM)
1.	30	0	0
2.	60	0	0
3.	90	0	0
4.	120	0	0
5.	150	52	0
6.	180	112	1469
7.	210	162	1497
8.	240	195	1500
9.	270	219	1496

Appendix 10. AC and DC Electric Motor Practicum Documentation

Figure 16. AC and DC Electric Motor Practicum Documentation.

CABLE

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ABSTRACT

The cable is an electrical component composed of conductors that function to conduct electricity and insulator parts that function to limit the flow of electricity so that it does not come out of the cable. Cables consist of various types depending on the function and place of use. The purpose of the Cable practicum is to get to know the shape and types of cables, be able to understand the use of cables according to the type of cable. The method carried out in the Cable practicum is to distinguish the types of cables by paying attention to the constituent materials. The results obtained in the Cable Practicum are that the types of cables are such as NYA cables, NYAF cables, NYM cables and NYMHY cables, where these cables have their respective places of use. The conclusion of the cable practicum is that the cable is a material that functions to channel electrical energy produced by the power source to the electrical load. Cables consist of various types with main differences such as the conductor material is single and some are fiber, but the insulators are mostly derived from PVC.

Keywords: Insulator, Conductor, Electrical

INTRODUCTION

Background

All activities in today's digital era cannot be separated from the use and utilization of electrical energy. The use and utilization of electrical energy has covered all fields, both in the field of goods production, marketing and even agriculture. Electrical energy is useful as a source of power in the works carried out in the field.

The electrical energy used comes from energy produced or converted from other forms of energy by electrical sources such as generators. The use of electrical energy is carried out by electronic equipment or what is often referred to as an electrical load in carrying out its duties. The electrical energy is channeled from the power source to the electrical load using components known as cables.

The cable is an electrical component composed of conductors that function to conduct electricity and insulator parts that function to limit the flow of electricity so that it does not come out of the cable. Cables consist of various types depending on the function and place of use. Examples of cables that are often used are NYA, NYY and NYM cables.

Based on the description above, a cable practicum is carried out to determine the function of cables in distributing electrical energy and the types of cables used in everyday life.

Purpose and Uses of Practicum

The purpose of the Cable practicum is to get to know the shape and types of cables, be able to understand the use of cables according to the type of cable.

The use of the Cable practicum is to provide an understanding of the types of cables that exist in everyday life and be able to distinguish the use of cables to apply them in agriculture.

LITERATURE REVIEW

Cable

Cable is one of the main materials needed in making a panel or electrical circuit. Today's rapid technological developments in the industrial world demand the use of devices that can operate automatically to increase productivity, shorten production time and reduce production costs. Human needs for devices that can work automatically are increasing, so that the number of automatic devices is getting more and more and replacing manual devices. Automatic devices can do their own work in a relatively shorter time compared to devices in general (Efendi, 2019).

Electrical equipment that often receives special attention in industry is the electrical wiring that connects the source of electrical energy with the load. A cable is a length of one or more conductor strands, either solid or fibrous, each of which is equipped with its own insulation or insulator and forms a single whole. The union or combination of one or more nuclei is usually done with a protective sleeve or protective casing (Kaspuddin et al., 2021).

Power cables are a medium for the transmission of electrical energy. The electrical wiring consists of insulators and conductors. Insulators are cable sheaths and are usually made of thermoplastic or thermoset materials, while conductors are made of copper or aluminum. The conductivity of electrical cables is determined by the Conductive Current Ability (KHA) because the electrical conductivity parameters are given in units of amperes. The carrying capacity of the current is determined by the cross-sectional area of the conductors on the electrical cable. The provisions of the power cable CRC are regulated in the SPLN specification (Ali &; Sultoni, 2019).

Cable Construction

Most cable construction consists of three parts. These parts of the cable include conductive parts that must have a cross-section suitable for the load being flowed, insulator parts with color or code numbers for identification and outermost parts that may contain something for protection against mechanical damage. Each type of material that makes up the cable usually consists of various types depending on the type of cable (Kaspuddin et al., 2021).

According to Kaspuddin et al. (2021), the parts of the cable constituent construction are as follows:

1. A conductor is a material (usually a metal) that allows heat and electricity to flow. There are two main types of conductors, namely aluminum and copper, each with certain advantages and disadvantages. Copper conductors have advantages such as having high conductivity per unit area and are easy to connect and solder mechanically, corrosion resistant, stronger than aluminum, but this type of conductor is relatively expensive. Meanwhile, aluminum conductors have advantages such as having high conductivity per unit weight, must be equipped with connections with glue, adhesive or welding aluminum an insulator and cheaper than copper, but the expansion coefficient must be taken into account when connecting because this type of conductor is not corrosion resistant and weaker than copper.

2. Insulators are materials (usually nonmetals) that heat and electricity cannot easily pass through. The insulator material used for grounding cables must meet the following requirements such as high insulation value, high dielectric strength, good mechanical properties such as elasticity and should not be hygroscopic because the dielectric strength of any material decreases sharply when wet and humid. Insulating materials that are often used in electrical construction are such as polyvinyl chloride (PVC) which is a form of polymer obtained from acetylene and cross-linked polyethylene (XLPE) which is an improvement of synthetic insulation materials.
3. Protective layer, which is a layer that serves to protect cables from mechanical damage, the influence of chemicals, electrolysis and fire or external influences that can damage cables. Types of protection that are widely used in electrical cables include PVC plastic sheaths, polyamide and polyurethane sheaths, rubber sheaths, metal sheaths and armour.

NYA Cable

NYA cable is a type of single-core cable with a layer of insulator PVC material used for outdoor installation or aerial wiring. The insulator color code includes red, yellow, blue and black according to PUIL regulations. The insulator layer is only one layer which causes the cable to be easily damaged, not watertight (NYA is a type of aerial cable) and easily bitten by mice. Security assurance when using this type of cable can be done by having to be attached to PVC pipes or other closed channels so as not to be bitten by rats and when removed the insulator cannot be touched directly (Emidiana &; Widodo, 2018).

NYM Cable

NYM cable is a type of cable that has a white or gray PVC insulator. NYM cables have two-layer insulators, so they are relatively safer than NYA cables and also more expensive. NYM cables are designed for wall mounting, ductwork or indoor wiring conduits. This cable is not suitable for outdoor use or in environments that can be directly exposed to water or high humidity. NYM cables can be used in both dry and wet environments, but should not be buried or buried into the ground (Emidiana &; Widodo, 2018).

NYY Cable

NYY cable is a type of cable with an insulator layer made of PVC (usually black), the number of cores is 2, 3 or 4. NYY cables are used in underground cable installations, have a thicker insulation layer and are made of materials that rodents such as rats do not like. When compared to NYM cable, the price is much more expensive (Emidiana &; Widodo, 2018).

NYAF Cable

NYAF cable is a type of flexible cable with PVC insulated fiber copper conductor. This PVC insulator layer serves to protect conductors from direct contact with other materials and provide good insulation between conductors and the environment. In addition, NYAF cables are made with an outer protective layer of PVC to provide additional physical protection. NYAF cables are used to install panels that require high flexibility (Vahlevi, 2019).

NYMHY Cable

This type of cable has more than one filamentous copper core with an outer insulator material in the form of PVC. This cable is also commonly used for household electrical installations under 900 watts. NYMHY cable consists of three parts, namely the conductor, the inner insulator and the outer protector which is also made of insulator material. Each conductor core is given a different color to indicate the function of each core. For example, black for phase, blue for neutral, and yellow-green for ground (Rinaldi, 2021).

PRACTICUM METHODOLOGY

Time and Place

The Cable Practicum will be carried out on Thursday, May 11, 2023, at 15.00 WITA until it is completed at the Agricultural Tools and Machinery laboratory, Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University.

Tool

The tools used in the Cable practicum are stationery and mobile phone cameras.

Material

The materials used in the cable practicum are NYA, NYAF, NYM and NYMHY cables.

Practicum Procedure

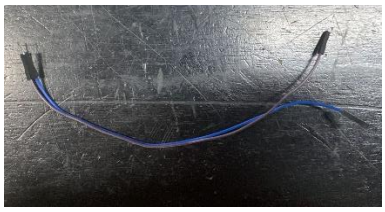
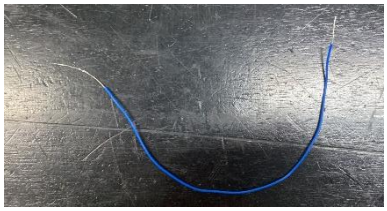
Prosedur in Cable practicum, namely:

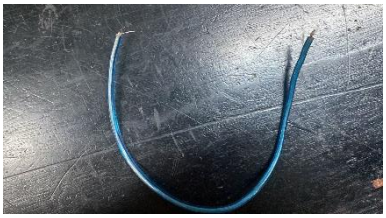
1. Preparing the tools and materials used.
2. Identify the types of cables that exist.
3. Record the results of identification that has been done.
4. Document the practicum.

RESULTS AND DISCUSSION

Result

Tabel 9. Types of Cables.

No.	Name	Picture	Uses
1.	HIS		Used in residential installations, for example lighting and switch installations.
2.	NYAF		Used for panel installations that require high flexibility, such as areas that have a lot of buy.

		 	
3.	NYM		Used for wiring electrical installations of homes or buildings and power systems.
4.	NYMHY		Used for household-scale electrical installations below 900 watts.

Discussion

Based on the cable practicum carried out, it can be known that the cable is a material or component that functions to channel electrical energy produced by a power source to an electrical load or a device that utilizes electrical energy in an electrical circuit. The cable consists of two main components, namely conductors that function as conductors of electricity and are usually made of copper or aluminum and insulators that function as conductor wrappers and are generally made of polyvinyl chloride (PVC) or other insulators. The conductivity strength of the conductor on the cable itself is determined by KHA or Current Conduction Ability with the unit of conductivity parameter in the form of Amperes. This is in accordance with the statement of Ali & Sultoni (2019), which states that the conductivity of electrical cables is determined by the Conducting Current Ability (KHA) because the electrical conductivity parameters are given in units of amperes.

The results obtained in this practicum are in the form of a table that explains the types of cables and the place of use of each. The types of cables themselves such as NYA cables used in residential installations, NYAF cables used for panel installations that require high flexibility, NYM cables used for home or building electrical installation cables and power systems and NYMHY cables used for household-scale electrical installations below 900 watts. Each type of cable is composed of different conductors and insulators based on their respective uses. This is in accordance with the statement of Kaspuddin et al. (2021), which states that each type of material that makes up the cable usually consists of various types depending on the type of cable.

CONCLUSION

Based on the cable practicum that has been carried out, it can be concluded that the cable is a material that functions to channel electrical energy produced by the power source to the electrical load. Cables consist of various types with main differences such as the conductor material is single and some are fiber, but the insulators are mostly derived from PVC. Each type of cable is used in different places depending on the constituent material.

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Appendix 11. Cable Practicum Documentation

Figure 17. Cable Practicum Documentation.

LAMP

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ABSTRACT

Human activities in order to keep running well at night, a device known as a lamp was made. The lamp itself is a device that functions to produce light with one of its energy sources in the form of electrical energy. The purpose of the Lamp practicum is to recognize the shape, types of lamps and their use and be able to understand the use of lamps in accordance with the type of lamp. The method carried out in the lamp practicum is to analyze several types of lamps based on their constituents and the light produced. The results obtained in the Lamp practicum are that lamps consist of several types such as incandescent lamps, fluorescent lamps and LED lamps, where each type of lamp has its own advantages and disadvantages. The conclusion of the lamp practicum is that each type of lamp has its own characteristics and shapes, as well as the location of the use of each lamp also varies.

Keywords: Light**,** Electricity, Lighting

INTRODUCTION

Background

One element that is very important in supporting all human activities and activities in the form of light. The light that serves to illuminate this, one of its main sources comes from the sun. The light produced by the sun itself has a limited time, which is only available from morning to evening, so human activities at night are very limited.

Human activities in order to keep running well at night, a device known as a lamp was made. The lamp itself is a device that functions to produce light with one of its energy sources in the form of electrical energy. The installation of this lamp is very flexible as long as it is still close to the source of electrical energy.

Lamps in their development from time to time led to the birth of various types of lamps that have their own advantages and disadvantages. These types of lamps consist of different characteristics that can be seen from the shape and color produced. These common types of lamps such as incandescent lamps, fluorescent lamps and LED lamps.

Based on the description above, a lamp practicum is carried out to find out the lamps and their working principles, as well as the types of lamps along with the advantages and disadvantages of each lamp.

Purpose and Uses of Practicum

The purpose of the Lamp practicum is to recognize the shape, types of lamps and their use and be able to understand the use of lamps in accordance with the type of lamp.

The use of the Lamp practicum is to provide an understanding of the types of lamps that exist in everyday life and be able to distinguish the use of lamps to apply in agriculture.

LITERATURE REVIEW

Light

Humans know various types of light in everyday life, such as sunlight and lamplight. Light is important in life, because without light there is no life. If the earth did not get light from the sun, it would be pitch black and cold making life impossible. Experts have studied light to find out its properties and characteristics. There are two opinions about light: light is considered as a wave and light as a particle. Each of these opinions has its reasons and both have been proven experimentally. Based on further research, light is an electromagnetic wave that can behave like a particle under certain conditions. Electromagnetic waves are waves that do not require a medium to propagate, so light can propagate without a medium. Therefore, sunlight can reach the earth and breathe life into it. Light propagates very quickly at a speed of 3 × 108 m / s, which means light can travel a distance of 300,000,000 m or 300,000 km in one second (Haryadi et al., 2017).

According to Isniaini et al. (2017), light can be produced by objects by treatment:

1. Incandescent light is produced when solids and liquids are heated to 1000 K to emit radiation in the form of light. The higher the heating temperature, the whiter the light produced. This process creates thermal energy as a negative effect.
2. The electric charge in which light is created by passing a high-voltage electric current through a gas, causing the atoms and molecules in the gas to emit radiation.
3. Electroluminescence where light is produced by passing an electric current through semiconductor materials and phosphorous-containing materials.
4. Photoluminescence where light radiation from other objects is absorbed by certain substances and then re-emitted in the form of light of different wavelengths. This phenomenon is also referred to as fluorescence and phosphorescence.

Lamp

One electronic device that consumes electrical power is a lamp. A lamp is a device that can produce light to illuminate the room or environment where the lamp is placed. People really need a source of lighting, especially at night or when they are in a dark room. However, when people consume electrical power, it generally happens that the electrical power needed to turn on the lights is often wasted due to the carelessness of users who forget to turn off the lights, so that the lights remain on even though they are not in use (Mulyanto et al., 2017).

The lamp was first invented in 1650 by Otto von Guericke who was a German scientist. This was followed in 1879 by the invention of the first incandescent lamp by Thomas Alfa Edison using a charcoal filament as an incandescent wire whose temperature reached 20,000 °C and the light emitted was reddish with a light flux of 3 lm/W. In 1910 Coolidge of America invented the tungsten wire vacuum lamp. The gas cylinder lamp was first invented by Langmuir, its specific light flux was 12 lm/W. In 1933, a man named Phillips then developed a double spiral filament whose light flux increased to 14 lm/W with a slight degree of glare. In the following years, electric lights developed according to the desired lighting needs, both in terms of the shape of the lamp tube, the material used, the type of filling gas, color, construction and function of the lamp. The latest development of electric lamps itself is divided into three categories, namely incandescent lamps, gas cylinder lamps (discharge lamps) and electroluminescent lamps (Haryadi et al., 2017).

Incandescent

According to Ohm's law, in an incandescent lamp current flows through a thin wire called a filament. The electric current flowing through the filament is converted into heat and light. Electric current is the movement of free electrons with the generation of heat, electrons that are far from their bonds and occupy other, larger orbits. When this electron returns to its original orbit, it emits light or heat. If an incandescent lamp can emit as much visible light as possible, the temperature of the filament should be raised and should not exceed 3.655 K which is the melting point of the filament. This can be achieved by adjusting the amount of electric current flowing through the filament. Incandescent lamps that have been used for a long time, the emitted light flux decreases due to evaporation, the cross-sectional size of the wire becomes smaller, the resistance increases and the current decreases. In addition, the tube turns black due to the voltage on the light bulb. The effect of incandescent lamps does not depend on the type of lamp. Incandescent lamps are usually yellowish-white and give a warm impression to the surroundings. Incandescent bulbs are very inefficient at detecting color and can also generate heat up to 60°C. This leads to a lack of comfort at work. Another drawback is less durable, quickly worn out because the vacuum of the tube is not optimal so that it supports oxidation of the tube. The advantage of incandescent lamps is that they are cheap and voltage stability is not too affected (Hendrawan, 2018).

Fluorescent Lights

Fluorescent lamps are a category of lamps commonly used in residential construction. Fluorescent lamps can last ten thousand hours, ten times the life of incandescent lamps. Depending on the spectral lines of fluorescent lamps, spectral diagrams show different wavelengths. Each spectral line has a maximum wavelength peak. The wavelengths of the fluorescent light spectrum are 379.2 nm, 461.8 nm, 588.4 nm, 598.1 nm, 613.3 nm, 617.7 nm, 635.1 nm and 640.9 nm. Fluorescent lamps consist of glass tubes filled with fluorescent gas at low pressure. When an electric current flows through the glass tube, the fluorescent gas becomes ionized, which means that electrons in the gas gain energy and jump to higher energy levels. When electrons return to their basic energy level, the energy released in the form of photons will later create visible light (Shamsiah et al., 2022).

LED Light

LED lamps are lamps produced from the monochromatic emission of light from a semiconductor when powered by electrons or electric current. At the time of its discovery, researchers called LEDs as magic objects. This is because LEDs have high durability, are cheap, do not produce heat energy, are lightweight and can produce many colors of light. LEDs are diodes with pn junctions. When p-type and n-type semiconductors are connected, there is a transition region between them. In this area, the electron charge is transferred from the n-type semiconductor to the p-type semiconductor. Therefore, in n-type semiconductors the atom loses electrons and this region becomes positively charged, whereas in p-type semiconductors there is an excess of electrons and a negative charge is created. Then this process forms an equilibrium and a depletion area is formed in the joint area. When electrons enter the p-type semiconductor region, they join holes. This combination of holes produces a spontaneous beam of photons (light) emitted by the diode. This process is also known as photoluminescence injection (Isniaini et al., 2017).

PRACTICUM METHODOLOGY

Time and Place

The Light Practicum will be carried out on Thursday, May 18, 2023, at 15.00 WITA until it is completed at the Agricultural Tools and Machinery laboratory, Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University.

Tool

Tools used in lamp practicum are plugs, lamp holders (fittings), incandescent lamps, LED lights, fluorescent lamps, stationery and mobile phone cameras.

Material

The material used in the lamp practicum is electrical energy.

Practicum Procedure

Prosedur in the Lamp practicum, namely:

1. Preparing the tools and materials used.
2. Identify the types of lights that exist.
3. Record the results of identification that has been done.
4. Document the practicum.

RESULTS AND DISCUSSION

Result

Tabel 10. Types of Lamps.

No.	Types of Lamps	Information
1.	Incandescent	The advantages of incandescent lamps are economical prices and easy use. The disadvantages of incandescent lamps are not durable and the lighting is less than optimal.
2.	Neon	The advantages of fluorescent lamps are long-lasting use, safe for eye health and economical prices. The disadvantage of fluorescent lamps is that they are prone to break if used for too long.
3.	LED	The advantages of LED lamps are more energy efficient, environmentally friendly and good lighting levels for eye health. In addition, LED lights have several color options. The disadvantage of LED lamps is that the price is relatively expensive compared to other types of lamps.

Table 11. Types of Lighting on Lamps.

No.	Lamp Picture	Information
1.		Incandescent
2.		Fluorescent Lights
3.		LED Light

Discussion

Based on the lamp practicum carried out, it can be seen that lamps are one type of lighting source used by humans in carrying out their activities, especially at night. The working principle of the lamp itself is to produce photons or light by changing the source of electrical energy through reactions that occur in the lamp. Light itself is a form of electromagnetic waves that do not require a medium to propagate from one place to another. This is in accordance with the statement of Haryadi et al. (2017), which states that electromagnetic waves are waves that do not require a medium to propagate, so light can propagate without a medium.

Based on the practicum carried out, results were obtained in the form of two types of tables. The first table explains the types of lamps along with their advantages and disadvantages, such as the type of LED lamp has advantages in the form of more energy-efficient, environmentally friendly, good lighting levels for eye health and has several color choices, while the disadvantages are such as relatively expensive prices compared to other types of lamps. The second table then explains the types of lighting in lamps, such as incandescent lamps whose lighting is yellow-orange, fluorescent lamps whose lighting is white and LED lamps whose lighting is purplish. All types of lamps generally have the same main function in the form of a source of lighting where the lamp is installed. This is in accordance with the statement of Mulyanto et al. (2017), which states that a lamp is a device that can produce light to illuminate the room or environment where the lamp is placed.

CONCLUSION

Based on the lamp practicum that has been carried out, it can be concluded that each type of lamp has its own characteristics and shapes, such as incandescent lamps that are round or pear-like, fluorescent lamps that are uniquely shaped with curves and LED lamps that are usually single or with many LEDs. The location of the use of each lamp also varies, such as incandescent lamps that are generally used in egg incubators, fluorescent lamps for lighting at home and LED lamps are usually used as decorations because of their various colors.

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Appendix 12. Lamp Practicum Documentation

Figure 18. Lamp Practicum Documentation.