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The effect of microwave interference on electromagnetic microwave length in determining telecommunications transmission systems

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***Abstract*---**Electromagnetic waves, like mechanical waves, can interact with each other. We can see that light, as a wave, shows the phenomenon of interference of waves that have a fixed phase difference. When light passes from a source through a slit in a screen, and the light emerging from that slit is used to illuminate two adjacent slits on a second screen. If light is transmitted from these two slits and falls on the third screen, a series of parallel interference bands will form. This is an interference phenomenon. The development of electromagnetic theory in the early 19th century by Oersted, Ampere, and others was not really made in the context of electric and magnetic fields. The idea of fields was put forward later by Faraday, and was not used generally until Maxwell showed that electric and magnetic phenomena could be described using four equations involving electric and magnetic fields. These equations, called Maxwell's equations, are the basic equations for electromagnetism. Basically, this equation has the same position as Newton's three laws of motion and the law of universal gravitation in mechanics. On the other hand, Maxwell's equations are even more fundamental, because they are consistent with the theory of relativity. Because all electromagnetic characteristics are contained in these four equations, Maxwell's equations are considered a great victory for human thought. Interference is also mentioned as an event where two or more waves combine to produce a new wave. To obtain light interference, a

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coherent light source is needed, namely a light source that has a fixed phase difference. A microwave oven is a kitchen appliance that uses microwave radiation to cook or heat food. Microwaves or microwaves themselves are one of the electromagnetic waves in the electromagnetic wave spectrum. Transmission or broadcasting (English: transmission) is a telecommunications transmitter which aims to transmit Radio Frequency (RF) signals which carry information signals in the form of images (Video) and sound (Audio), so that they can be received by TV receivers in the area covered by the TV transmitter. In radio frequency engineering, a transmission line is a special cable or other structure designed to carry radio frequency alternating current, that is, current with a frequency high enough that its wave properties must be taken into account. Transmission lines are used for purposes such as connecting radio transmitters and receivers with their antennas (feed or feeders), distributing cable television signals, routing trunklines calls between telephone switching centers, computer network connections and high-speed computer data buses.

Keywords**---**Interference, Microwaves, Electromagnetic Waves and Transmission.

Introduction

Electromagnetic waves, like mechanical waves, can interact with each other. We can see that light, as a wave, shows the phenomenon of interference of waves that have a fixed phase difference. When light passes from a source through a slit in a screen, and the light emerging from that slit is used to illuminate two adjacent slits on a second screen. If light is transmitted from these two slits and falls on the third screen, a series of parallel interference bands will form. This is an interference phenomenon. Interference or disruption is the interaction between waves in an area. Interference can be constructive and destructive. It is constructive if the phase difference between the two waves is equal to zero, so that the new wave that is formed is the sum of the two waves. Interference is also mentioned as an event where two or more waves combine to produce a new wave.

Microwave ovens work by passing microwaves with a certain frequency, namely between 915 MHz or 2450 MHz (with a wavelength of 12.24 cm) to food or samples in the cooking chamber. Microwave electromagnetic waves carry electric and magnetic fields. The ingredients or nutrients contained in the sample will absorb microwaves through a process called dielectric heating. Materials consisting of molecules that are bipolar, have a positive charge and vice versa have a negative charge at the end of the molecule. Electricity is a series of physical phenomena related to the presence and flow of electric charge (Griffith, 1991). Electricity causes various well-known effects such as lightning, static electricity, electromagnetic induction and electric current Edminister, 1989). The presence of electricity can also generate and receive electromagnetic radiation, such as radio waves. Electric current flowing from the voltage source through the wires to the light switch (Giancoli, 2001). Wires that carry electric current can be made of various electrically conductive materials (Halliday & Resnick 1991; Jensen 2019). Examples of electrical conductor materials are aluminum, gold, silver, copper, and so on. Basically, electricity is the flow of electric charge from one point to another. This flow is caused by an imbalance of charges between two points. When there is a difference in electric potential between two points.

According to the general understanding of electricity, electricity is the transfer of electrons from atom to atom, a conductor or energy that has a very large influence in human daily life. This electrical energy is used to power various electronic devices that facilitate human work. Electricity is divided into two types, namely static electricity and dynamic electricity. Static electricity is the energy found in electrically charged objects. The charge contained in an object can be positive or negative. If we take a closer look, all these substances are formed due to the presence of many atoms. Each atom has a nucleus, which is made up of electrons and protons orbiting around it. Protons have a positive electric charge, while electrons have a negative electric charge. When two substances or objects, such as our hands and a balloon, rubbed together, the electrons are attracted to the material with a weaker attraction, the hand, and stick to the object with a stronger attraction, the balloon. Both of these substances have an electric charge where the electron material loses so that it is positively charged and when the material gains electrons the charge is negative (opposite). Dynamic electricity is electricity that can move. How to measure dynamic electric current strength by dividing electric charge by time with units of electric charge in coulombs and units of time in seconds. The strong current of the branch circuit equals the strong input current and strong output current. Furthermore, in a series circuit, the electric current strength at both ends of the resistor remains the same. Conversely, if the voltage is different for a series circuit resistance, it also depends on the voltage resistance. However, the voltage in the branch circuit does not affect the resistance. All of this is written in Kirchoff's law, which states that "the sum of the electric currents entering is equal to the sum of the electric currents leaving".

The relationship between electricity, resistance, and current is explained by Ohm's Law, which is one of the basic laws in electricity. Ohm's Law states that the electric current (I) flowing through a conductor is directly proportional to the voltage (V) applied to it and inversely proportional to the resistance (R) of the conductor. Ohm's Law formula is as follows:

$$I = V / R$$

Where:

I is the electric current in amperes (A).
V is the mains voltage in volts (V).
R is the electrical resistance in ohms (Ω).

That is, the greater the voltage applied to a conductor, the greater the electric current flowing through it, provided the resistance remains constant. Conversely, if the voltage remains constant, the greater the resistance of a conductor, the smaller the electric current flowing through it. In other words, resistance (resistance) causes a restriction on the flow of electric current in the conductor. Materials with low resistance (for example, copper metal) allow electric current to flow easily, while materials with high resistance (for example, plastics) impede the flow of electric current.

Based on the background and main issues presented above, the purpose of this study is: To make it easier for the public to know the effect between the value of the type resistance and the factors that occur on the wire as a result of Appropriate Technology (TTG) which will make it easier for consumers/communities to live their lives more efficient and practical in the development of increasingly advanced technology.

Method

Electrical resistance is the property of an object or material to resist or restrain the flow of electric current (Nayfeh & Brussel, 1986; Rademakers 2011). According to the principle of Ohm's law, the magnitude of the resistance of an electric circuit determines the amount of electric current flowing in the circuit for every voltage applied to the circuit. The amount of resistance of the conductor is determined by the length of the wire, the cross-sectional area and the type of resistance.

The value of resistance or resistance in an electric circuit is measured in units of Ohm which is symbolized by the symbol Omega (Ω). Although the international standards used to denote resistance multipliers are kiloohm, megaohm and gigaohm. Electric current is the amount of electric current that flows in an electric circuit per unit time due to the movement of electrons in a conductor. And conductors also have resistance, or what is called electrical resistance.

Electrical resistance is affected by several factors, including the type of material, the length of the wire or material, and its cross-sectional area. Ohm's law states that the relationship between electrical resistance (R), voltage (V), and electric current (I) is:

$$R=V/I$$

Where R is the resistance in ohms, V is the voltage in volts, and I is the current in amperes. Some materials have low resistance and are called conductors, while others have high resistance and are called insulators. Conductors, such as copper and aluminum, allow electric current to flow easily, whereas insulators, such as plastic or rubber, impede the flow of electric current. Apart from conductors and insulators, there are also materials which have a higher resistance than conductors but lower than insulators, and these materials are known as semiconductors. Semiconductors have an important role in the electronics industry because of their resistance properties which can be changed by controlling the temperature or adding doping agents.

Electrical resistance also plays a role in many practical applications, such as the use of resistors in electronic circuits to control current and voltage, and in components such as incandescent lamps, heaters, and so on. Understanding electrical resistance is important for designing and understanding how various electrical and electronic devices operate. Electrical resistance refers to the resistance or resistance of a material to an electric current flowing through it.

Electrical resistance is measured in ohms (Ω) and is an inherent property of a material. Electrical resistance is affected by several factors, including length, cross-sectional area, and type of conducting material. These factors affect the amount of resistance that a material has to the flow of electric current. In general, the longer the conducting wire, the higher the electrical resistance. Likewise, the larger the cross-sectional area of the conducting wire, the lower the electrical resistance. The type of conducting material also affects the electrical resistance. Materials that have a high level of conductivity, such as copper metal, have a low electrical resistance. Conversely, materials that have a low level of conductivity, such as plastic or wood, have a high electrical resistance.

The basic law that describes the relationship between electrical resistance, electric current, and voltage is Ohm's Law. Ohm's Law states that the electric current (I) flowing through a conductor is directly proportional to the voltage (V) applied to it and inversely proportional to the resistance (R) of the conductor, with the formula $I = V/R$. In some materials, such as resistors, electrical resistance may be intentionally added to control the flow of electric current. Meanwhile, in electrical circuits, components such as resistors are used to regulate the current and voltage in a circuit by relying on the electrical resistance they have. An understanding of electrical resistance is important in fields such as physics, electrical engineering, and electronics, as it aids in the analysis and design of electrical circuits,

Electric current, or dynamic electricity, is the flow that occurs due to a large electric charge (Sugiyono, 2008; Difficulty 2003). Electric charges move from one point to another and these events occur successively per unit time. The international unit for electric current is the A or ampere. When writing the formula, the meaning of electric current is illustrated by the symbol I (current). We can use a tool called Basicmeter to determine the amount of electric current. If you want to know the amount of voltage, you can use a voltmeter. The ammeter (ammeter) measures the strength of the electric current. Understanding the electric current has the properties that cause energy in an electric circuit. These features include the production of heat energy, magnetic energy, light energy, and chemical reactions. Although the type of electric current is divided into two types, namely direct current and alternating current. Both electric currents affect daily needs equally well. This is direct current. Current flows from high voltage points to low voltage points (positive to negative). Such electric currents are found in batteries or accumulators. The electric shock from contact with direct current (Sale, 2012) does not seem to be too great. In general, the use of direct current in electronic devices is beneficial. The manufacturer installs a converter that acts as a detector, so the type of amperage may be required. The definition of alternating current is current that flows inconsistently (changes with respect to the time axis). We often encounter this type of current in electricity generated by generators originating from induction. The advantage of alternating current is that the voltage efficiency is relatively high. In addition, alternating current tends to be stable and not easily disturbed by distortion. But once it reaches the home's electrical network, the voltage and current must be reduced. For example, in a computer, a power supply directs electric current to supporting devices.

Place and Research Object. This research was conducted at the Electrical Circuits Laboratory, Physics and Workshop, Warmadewa University Vocational School.

Results and Discussion

Figures and Tables

The results of observing the effect of electrical resistance took place in the Physics Lab at the Warmadewa University Vocational School. This sampling was carried out on May 1, 2023. Then the samples were taken to the Physics Laboratory of the Warmadewa University Vocational School for analysis through electrical circuit boards, power supplies, voltmeters and ammeters to determine electric current, voltage and resistance.

Table 1. Constant Wire Data Observations

Sample	Wire Length (l)	Voltage)	Electric Current (I)	Cross-sectional Area Percentage Value (%)
Constant Wire	L	0.40	0.28	9.62%
	2L	0.45	0.16	
	3L	0.47	0.11	

The results of this constant wire analysis have been processed and identified with Voltage and Current using a Power Supply and a Voltmeter.

Table 2. Relationship of Voltage, Current and Resistance

Sample	Wire Length (l)	Voltage)	Electric Current (I)	Resistance Value (R)	Type Resistance Value	Relative Error (KR)
Constant Wire	L (28.00x10-2)	$(0,40 \pm 0,05)$	$(0,28 \pm 0,05)$	1.4 ohms	$\bar{\rho} = 4,8x10^{-7}$	46%
	2L (56.00x10-2)	$(0,45 \pm 0,05)$	$(0,16 \pm 0,05)$	2.8 ohms	$\bar{\rho} = 4,8x10^{-7}$	50%
	3L (84.00x10-2)	$(0,47 \pm 0,05)$	$(0,11 \pm 0,05)$	4.3 ohms	$\bar{\rho} = 4,9x10^{-7}$	60%

Based on the analysis and graph above, the resistivity values for wire length l are obtained, ranging from 2.6x10-7 Ω.m to 7.0x10-7 Ω.m. For the length of the wire (2L) with a relative error of 46%, the true value of the resistivity of the wire for a length of 2l ranges from 2.4x10-7 Ω.m to 7.2x10-7 Ω.m with a relative error of 50%, and for the true value of the resistance of the wire type for a length of 3l ranges from 2.0x10-7 Ω.m to 7.8x10-7 Ω.m. The relative error of the experiment is 60%. Based on the results obtained from the experimental results, namely the magnitude of the specific resistance for wire lengths l, 2l, and 3l is almost the same. Although there are still slight differences. This is due to the occurrence of several errors in conducting experiments.

Conclusions and recommendations

Based on the experimental results and discussion that has been described above, it can be concluded:

1) The true value of the resistivity of the wire for length l ranges from 2.6x10-7 Ω.m to 7.0x10-7 Ω.m. With a relative error of 46%.
2) The true value of the resistivity of the wire for a length of 2l ranges from 2.4x10-7 Ω.m to 7.2x10-7 Ω.m. With a relative error of 50%.
3) The true value of the resistivity of the wire for a length of 3l ranges from 2.0x10-7 Ω.m to 7.8x10-7 Ω.m. With a relative error of 60%.
4) The resistance value of the constant wire type from the experimental results is 4,8x10-7 Ω.m. The relative error value of the experimental results is more than 10%, it can be concluded that the experimental results are unacceptable.

References

Difficulty. (2003). Educational research methodology. Jakarta: Earth Script.

DJ Griffiths. (1991). Introduction to Electrodynamics, second edition. Printice Hall.

Edminister, Josepha, (1989). Electric Circuits, Mc. Grow Will, New York

Giancoli, Douglas C. 2001. Physics/Fifth Edition, Volume 2. Jakarta: Erlangga.

Halliday, D and Resnick, R. (1991). Physics vol 1 (Translation by: pantur silaban and Erwin Sucipto). Jakarta: Erlangga.

Jensen, L., Report of the United Nations' Secretary General on SDG Progress. (2019). United Nation Publication. Johnston, PC, JF Gomez, B. Laplante, Climate risk and adaptation in the electric power sector. 2012, Asian Development Bank publication.

Nayfeh, H, M., & Brussel, M, K. (1986). Electricity & Magnetism. John Wiley and Sons Inc: Toronto Singapore

Rademaekers, K., et al., (2011). Investment needs for future adaptation measures in EU nuclear power plants and other electricity generation technologies due to the effects of climate change. Directorate-General for Energy-European Commission: Brussels.

Sale, MJ, et al., (2012). Assessment of the effects of climate change on federal hydropower (No. ORNL/TM-2011/251). EERE Publication and Product Library, Washington, DC (United States).

Sathaye, J., et al., (2012). Estimating risk to California energy infrastructure from projected climate change. Lawrence Berkeley National Laboratory.

Sugiyono. (2008). Educational research methods (Quantitative, Qualitative, and R&D Approaches). Bandung: Alphabet.