Percentage of reducing heat of coco fiber material as a potential isolation of building walls

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Abstract. This paper was purposed to determine the percentage of coco fibers ability in reducing heat as a potential for insulation building walls with different coco fiber thickness. For the fulfillment of thermal comfort in buildings requires engineering, knowledge and skills and innovation. One way to reduce hot air in the room can be done through walls, thereby reducing the use of air conditioning. The walls need protection and solar heat absorbers which can make the room inside the building have thermal comfort. Based on this, research needs to be done on natural ingredients that can function to reduce heat. Tests carried out on coconut fiber and fiber-free materials. Material without fiber and coco fiber thickness are 1 centimeter, 2 centimeter and 3 centimeter. This coco fiber material is coated with a mixture of cement which also functions as a fiber adhesive. In this case testing by applying heat of 35 Celsius degree to one side of the fiber and measuring the temperature that occurs on the other side of the fiber. The test results found that there was a significant difference between the heat temperature supplied and the heat temperature measured on coco fiber. The thicker the coco fiber material, the greater the percentage of heat that can be reduced. This shows that the coco fiber material has the potential to reduce heat as a wall covering against solar radiation.

Key words: coco fiber, insulation, building wall, percentage, reducing heat

1. Introduction
Sunlight is the main source of heat in the building, the heat of sunlight will mainly enter the room through the media of roof and wall. About 83% of the sun's heat in the form of infrared rays on the roof and building walls are absorbed and emitted into the room by radiation, conduction and convection. In humid tropical climates, the building coating is a building element that must be able to protect the occupants from the sun's heat, also reducing the radiant heat forwarded into the building. Therefore one of the functions of the building coating is to control or reduce the heat load from solar radiation into the building (transmission). The entry of solar radiation into the building can be through a vertical cover that is a wall or a horizontal or sloping cover that is roof (S Heru) 2008. Cooling the space in this way is classified as passive cooling system that relies heavily on air movement as a hot carrier medium in the morning to late afternoon to reduce room’s temperature (Cook) 1985 & (Giovani) 1994 ²(Santoso).

Global warming causes the warming of the earth's temperature so that the use of air conditioner in the room is also increasing as the need for comfortable room condition is also higher. This will increase the energy use of the earth and increase the contribution of rising earth temperatures and greenhouse effect. From the research of Bourdeau 1999 ³(Hari Agung Yuniarto) 2016 also revealed
the fact that 50% of the energy absorbed in a building is only consumed by refrigerators only, therefore 30% of the total energy required by a country is usually used in housing. This figure is from conditions in developed countries that are more manageable, for in developing countries this figure will not be smaller even believed otherwise. If this fact not handled strategically, will be a terrible impact on sustainable nation development. Based on these factors, it is need to be balanced with the existence of building innovations that can save energy and environmentally friendly, as has been developed in several countries.

The heat on the wall will propagate into the room so the room becomes hot. Walls need protection and dampening from the sun's heat so that indoor space will not heat up. Therefore one way to inhibit heat from outside the room can be done through the wall. Non-heated rooms can reduce the use of air conditioning. By reducing the use of air conditioning means to save energy and also save the earth and the environment.

Environmental awareness can be realized with the use of materials derived from nature as a form of energy conservation and environmental protection. For example coconut coir (coco fiber), is one of the waste that has not been fully utilized in Indonesia. The amount of coco fiber capacity produced from coconut harvest annually in Indonesia is quite large where coconut fiber is a large part of coconut fruit, which is 35% of the total weight of coconut.

Coconut fruit composed of fibers called fiber that serves to protect the hard part called the shell, serves to protect the seeds that are only protected by the membrane attached to the inner side of the shell, there is a liquid containing many enzymes called coconut water, and solid phase settles on the wall of the shell along with the growing old fruit called coconut meat. It can be concluded that the coco fiber is part of the coconut that protects the inside of the coconut from the outside including from the heat of the sun. Based on this coco fiber is estimated to have the potential for heat insulation. Based on this matter, it is necessary to do research on natural materials that can reduce heat. The problem that arises in this study is how is the potential of coco fiber material based on the character of thick fiber as insulation to reduce heat. This research was conducted with the aim to know the potential of coco fiber which later can serve as a wall covering the building to reduce heat from outside.

2. Review Of Related Literature

Research on innovations related to environmentally friendly buildings to answer the phenomenon of global warming has been done by some researchers in research on building materials for walls that can reduce heat among them is Fadhl Md Din Mohd, et. al. about Investigation of Heat Impact Behavior on Exterior Wall Surface of Building Material at Urban City Area; Yao Jian, Y. C. about Effects of Solar Absorption Coefficient of External Wall on Building Energy Consumption. Ayu Yuswita Sari et al, who conducted research on lightweight concrete panels focus on the pearlite as a mixture of concrete panels that can serve as a heat insulator. Likewise Agus Santos et al, who conducted research on mortal mix materials with a focuson the utilization of pumice breksia as the main ingredient of instant mortar as a heat reducer. While Hary Wibowo conducts a hot conductivity study between styrofoam and rice coir and focuses on measuring the comparison between styrofoam particle board composition with rice coir particle board composition as a good material for heat insulators.

Similarly, several studies conducted on building materials for a wall capable of muffling the heat among them by Xi Meng et al, who conducted a study of the wall of the building that focused on the addition of retroreflective material on the wall, which can improve the temperature of the building by reflecting solar radiation back in the opposite direction. Furthermore, V.B Omubo-Peppe et al, which conducted a study on building walls with a focus on determining the thermal conductivity of cement reinforced by periwinkle shells (sea shells) used as construction materials. Meanwhile, Dubois Samuel et al, Conducted a study of building walls with a focus on hygrothermal behavior of plant-based insulation products to assess their impact on energy performance in buildings, predict indoor climatic conditions, and prevent unexpected degradation risks.

Several studies were also conducted on the potential of coconut fiber by Irwan, et al, about the effect of addition of coconut fiber to concrete mixtures as sound absorbers; Yusril, I. (n.d.), about
development of coconut coir fiber for making boards with different types of matrices: cement, gypsum and clay.

3. Material and Methods

Kemala J 2019 about the research elaborations in this study are as follows.

3.1 Material

The material in this study consisted of character for coco fiber material, namely 1 centimeter, 2 centimeter, dan 3 centimeter coated with a cement mixture. The other material are mixtures of cement and sand commonly used as wall plaster material. The process of making the material can be shown in Figure 1 below.

![Figure 1. Process of making coco fiber material](image)

3.2 Methods

The research approach tests related to coco fiber in reducing heat was following the framework in Figure 2.

![Figure 2. Flowchart of the Research Process](image)

The approach of this research is based on the experiment to know the potential thickness character of coco fiber in reducing heat. In this case testing is done by comparing the two test materials. After the fiber and cement is good enough to bind and harden then tested. In this case the test by providing heat on one side of the fiber part and measuring the temperature occurs on the other side of the fiber. The same heat test and treatment is also carried out on the material without a fiber. The heat given is 35 °C for 140 minutes. The instrument for measuring the temperature that occurs in the material is by using sensors connected to the computer and can be read on the monitor screen.
In testing, the material is placed in a box. Testing on this material is done by using 3 thermal sensors and one heater as a heater. The first sensor is placed on one side of the material connected to the heater as T1 which is the temperature given to the material. The second sensor is T2, which is ambient temperature in the test environment that is placed outside of the box. The third sensor, T3, is placed on the other side of the material which will detect the yield temperature that has been absorbed by the material. This heater is connected to a power source and a Ts controller which is a device to control the amount of temperature given.

4. Results and Discussion
Research on innovations related to building materials that can reduce heat has been carried out by many researchers but not many have conducted research on the natural material of coco fiber. Coconut fruit composed of fibers that serve to protect the hard part called the shell, serves to protect the seeds that are only protected by the membrane attached to the inner side of the shell, there is a liquid containing many enzymes called coconut water, and solid phase settles on the wall of the shell along with the growing old fruit called coconut meat. It can be concluded that the coconut coir is part of the coconut that protects the outside of the coconut from the outside including from the heat of the sun. Based on this, coconut coir is estimated to have the potential for heat insulation so, it is necessary to research the character of coco fiber as building wall coating to reduce heat.

This study compared the potential character of thick coco fiber material to non-fiber material, and measures the percentage of heat that can be reduced by coco fiber material. The results test can be shown in the graph in the following figure. The figure shows that there are 3 graph lines: the top line shows the temperature given; the line in the middle shows the measured temperature after the material has been absorbed; the line below shows the temperature around the test. The graph is as follows.

![Graph](image)

**Figure 3.** The results of material without fiber

The graph in figure 3 shows the results of the test material without fiber. The Y-axis of the line 1 shows the amount of heat applied and measured on one side of the material expressed in Celsius, while line 2 shows the amount of heat absorbed by the material measured on the other side of the material, next the line 3 shows the measured temperature in the environment around the test. The X-axis shows the length of time during the test expressed in minutes. The results obtained from the graph show that when given the heat of 35 Celsius for 140 minutes that the temperature measured on the other side of the material without fiber ranges from 34.2°C. There is a decrease in temperature by a percentage of 1.4%.
Figure 4. Test results of coco fiber material

The graph in figure 4 shows the test results of the fiber material 1 cm, 2 cm, and 3 cm. The graph shows that when given the heat of 35 °C for 140 minutes, the results obtained from that the temperature measured on the other side of the material of fiber 1 cm ranges from 33°C. There is a decrease in temperature by a percentage of 5.71%. The results obtained from that the temperature measured on the other side of the material of fiber 2 cm ranges from 32°C. There is a decrease in temperature by a
The results obtained from that the temperature measured on the other side of the material of fiber 3 cm ranges from 31.5°C. There is a decrease in temperature by a percentage of 10%.

The ratio of the percentage of heat that can be reduced based on the thickness of the coco fiber material can be shown in the following table.

**Tabel 1.** The ratio of the percentage of heat that can be reduced

| Thickness of the coco fiber | The greater percentage of heat that can be reduced |
|-----------------------------|---------------------------------------------------|
| 1 cm                        | 5.71%                                              |
| 2 cm                        | 8.5%                                               |
| 3 cm                        | 10%                                                |

From the results of experiments conducted in this study showed differences in temperature measured between coco fiber and without fiber. A significant difference also occurs between the measured temperature of the coco fiber material when compared to the different thickness of coco fiber. The results of this study may still be far from perfect.

5. Conclusion
From the ratio of temperature received and measured on coco fiber material, it can be concluded that coco fiber material has the ability to reduce heat temperature so that it can be used as a wall covering solution to solar heat radiation from outside. Based on the experimental results, the thicker the coco fiber, the greater percentage of heat temperature that can be reduced.

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