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Preliminary Study of Cellulose Insulation Material from Oil Palm Tree Fiber

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Abstract : Cellulose insulation is one of the most environmentally friendly types of insulation. Recent research on cellulose suggests that it might be an effective solution for reducing fire damage. Because of the material's compactness, cellulose contains no oxygen. Since there is no oxygen in the material, the amount of damage caused by a fire is reduced. The objective of this study is to investigate the resistivity properties of cellulose insulators from oil palm tree fiber. The resultant powder was undergo a thermal conductivity process and later characterization using a four-point probe. As a result, shows that cellulose is not only one of the most environmentally friendly kinds of insulation, but it is also one of the most fire-resistant kinds of insulation. Following that, cellulose insulation is somewhat more mold resistant than fiberglass and certain other materials. It is a prevalent misperception that crude borates in cellulose insulation give the product pest control qualities. Therefore, cellulose is a low-cost and effective insulator.

Keywords: Cellulose, Insulator, Palm Oil Tree, Fiber

1. Introduction

There has been an increasing interest in environmentally friendly and energy-efficient systems in the construction sector in recent decades. As climate modifiers, buildings are usually designed to shelter occupants and achieve thermal comfort in the occupied space backed up by mechanical heating and air-conditioning systems as necessary [1]. Several operational phase aspects, such as the efficiency of the air conditioning system, window resistance, door thermal insulation losses of the thermal bridge and thermal performance, have accounted for most of the energy consumption in buildings. Nowadays, thermal insulation performance in the building sector has become a major interest to researchers concerned about energy consumption. Thermal insulation is a significant contributor and a practical measure for achieving energy efficiency, particularly in buildings located in places with harsh climatic conditions. As a result, several alternatives have been proposed to identify sustainable construction materials alternatives for ecologically friendly and energy-efficient structures. The best way to attain this aim is to employ green building materials and eco-products. Forecasting research predicted that in

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2035, roughly 75 percent of total energy would be generated by fossil fuels, while numerous other studies indicated that commercial and residential structures utilize 48 percent of electrical energy. In December 2012, Malaysia owned 5.08 million hectares of oil palm plantations and increased by 11.8% compared to 2008 and accounted for 39% of total world palm oil production and 44% of world exports [2]. An important concept of waste management is limiting and recycling waste while returning as much energy as possible. However, large amounts of oil palm trunk (OPT) production produce large amounts of biomass waste, posing a major disposal problem. The selection of construction materials with an environmental impact is critical to a country's growth. Researchers are now investigating recycled, low-cost and natural materials as building to optimize building performance efficiency. In general, palm oil trees are a material that should be employed to enhance the performance of a structure [3].

Past research has shown most thermal insulators used are fiberglass, but there were some issues with fiberglass that caused new ideas to emerge. Fiberglass insulation contains carcinogenic chemicals that cause cancer. Carcinogens are capable of producing cancer in live tissue and may provide a cancer risk to persons installing the insulation [4]. The majority of fiberglass insulation materials are supplied with a warning that there may be health concerns. Fiberglass inhalation is a major issue. Inhaling tiny fibers can cause them to become lodged in the lungs, causing damage and impairing breathing. Next, the value of fiberglass insulation fluctuates with time. Thus, it severely reduces its efficacy. The effectiveness of the insulation method is measured in R-value. R-value determines the ability of heat to pass through the insulator [5]. If the fiberglass has been installed for a long period of time, the R-value will decrease as the insulation settles or compacts. Finally, while fiberglass insulation may save energy once installed, the production process is not environmentally friendly. Fiberglass insulation consumes three times as much energy as cellulose insulation, which also has the advantage of being made primarily of recycled resources. Cellulose insulation is made of 75 percent recycled newspapers, while fiberglass insulation is made of new materials. As described above, the use of fiberglass has a detrimental effect on humans and the building. The use of thermal insulators from cellulose is preferable.

2. Materials and Methods

2.1 Materials

The material used in the research work was an oil palm tree. Oil palm trees are divided into three divisions which are oil palm fronds (OPF), fresh fruit bunches, which are fresh fruit and empty fruit bunches (EFB) and oil palm trunk (OPT). All parts of the division will be taken to undergo this research work.

The oil palm parts were cut into small pieces and cleaned with distilled water. The purpose of this cleaning was to ensure that the material cleans from all unwanted materials. Afterward, leave it overnight to ensure all the material is dry. Next, grind the material until it becomes bagasse and leave overnight to completely dry the material. It was followed by putting the material in the oven at 70° C for 24 hours. After that, leave it overnight at room temperature. Repeat the previous step by inserting put the material into the oven at a temperature of 70° C for 12 hours. After confirming all the material is completely dry then the actual mass of the material is measured thereafter.

2.2 Preparation for Thermal Conductivity for Oil Palm Tree Fiber

Thermal conductivity was determined by placing the material in a 254 mm × 254 mm x 51 mm wooden container. Because the main goal of the research was to determine the thermal conductivity of oil palm tree fiber, and ensure that all raw materials were thoroughly dried before exposing them to a thermal conductivity test. Thermal conductivity tests were performed at various densities. various density measurements can be measured using different thicknesses and heights After the device's top cover was secured in place, data was captured at various temperature points. The packing density of the insulating material was increased by adding more test material and repeating the prior process.

2.3 Preparation for Characterizations for Oil Palm Tree Fiber.

After the thermal conductivity was measured, leave the sample for 12 hours at room temperature. The purpose of doing this is to ensure the samples are dried entirely. Afterward, put the sample under the SEM to analyze the characterization of all the samples. This part needs to be done to differentiate the sample's differences.

2.4 Preparation for Radiation for Cellulosic Content in Oil Palm Tree Fibre

Next, put the sample in the refrigerator for 24 hours. Coming next was the pretreatment method. The purpose of pretreatment was physically to remove most of the solute to reduce the contamination load and protect all subsequent steps in the treatment plant. Pretreatment was done to get the cellulosic material content in the sample. In this method, it is necessary to add 10 ml of sodium hydroxide solution to the sample. Shake the beaker; therefore, the sample dissolves completely. After that, place the sample in a water bath for 90 minutes. After the sample was removed from the water bath, add 10 ml of hydrogen peroxide (H_2O_2) to the sample. Hydrogen peroxide was used as an oxidizing and bleaching agent. After the sample is mixed, leave it at room temperature until the sample releases a large bubble. After the bubble occurs, place the sample in a water bath for 30 minutes and after that remove the sample and leave it for 5 minutes. Then shake the sample gently and filter it to make sure there is no powder or dust in the sample. After that place the sample in the incubator overnight. Then weigh the sample at room temperature. The sample is ready to be irradiated using the GammaCell 222 exposure chamber in time-varying with the same radiation dose of 25kG.

3. Results and Discussion

Four-point probe device is mounted on the surface of the concrete specimen, a voltage difference is supplied between the two medium probes, the quantity of current between the two exterior probes is measured, and the resistance (R). According to the results, cement with cellulose has the highest resistivity when compared to cement and cement with cellulose on top. After all, the larger the resistance, the greater the barrier to heat transmission [6].

Table 1: Data for four-point probe

Sample	Resistivity, ρ (m)
Cement	29685.755
Cement with cellulose	3116.302
Cement with cellulose on top	29685.755

4. Conclusion

The present study revealed that cement with cellulose yield higher resistivity properties.

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