The preparation of an insulator material using renewable sources and application of palm oil tree – A Review

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Abstract. Excessive heat will cause discomfort while doing daily life even the use of electrical items such as fans and air conditioner are not entirely helpful. This is because the building does not have a layer to absorb the heat. Then, the best initiative to lessen the heat in building is by adding thermal insulation material into the building material. Past researcher shown most thermal insulators used are fiber glass, mineral wool, polystyrene and polyurethane foam. However, there are some flaws with the thermal insulator that cause new ideas to emerge namely cellulose. Cellulose is an insoluble substance that is a major component of plant cell walls and vegetable fibres such as cotton. Normally cellulose can be found in the plants. By cause to the increasing surplus of oil palm trees then the use of cellulose in oil palm is the best. This paper review discusses about preparation of an insulator material using renewable sources and application of palm oil tree.

1 Introduction

The function of insulting materials is to decrease the passage of heat through the building [1]. The low thermal conductivity and natural character of input fibres are significant advantages of natural fibre insulation [2]. Heat is an example of energy. It raises the temperature of the substance. Heat can only be felt by the hotness that is produced, but it cannot be seen. Essentially, heat is defined as energy in transit. Given that heat is energy in motion, it moves from one location to another due to temperature differences. Heat is the energy transferred from one thing to another as a result of a temperature difference between the two. There are three ways how the heat transfer in different material which is in solids, radiation and lastly in liquid and gas. In solids, heat passes from one point to another through conduction. In Liquids and gases, heat transfer takes place by convection. Heat transfer takes place by the process of radiation when there are no particles of any kind which can move and transfer heat. So, in an empty space or vacuum heat is transferred by radiation. As demonstrated in Equation 1, conduction heat transfer is the transport of heat through matter that is solids, liquids or gases without bulk motion of the substance.

\[ \lambda_{total} = \lambda_{gas} + \lambda_{solid} + \lambda_{rad} \]  

2 Heat Transfer in Solid

The transfer of heat from a hotter region of a material to a cooler part of the material without the particles moving is known as conduction. During the conduction process, there is no net movement of the body's particles. Only conduction transports heat through solids.

2.1 Heat transfer in radiation

Radiation is the direct transmission of heat from one location to another without the use of an intermediary medium. Solar radiation can be received without the use of an intermediary medium. Heat radiations are capable of passing through a vacuum. The electromagnetic radiation released by all surface causes heat transfer by radiation [4].

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3 Heat Transfer in Gas

The physical movement of heated molecules is known as convection. Heat is transmitted from one site to another through the movement of heated particles, which is known as convection. It's especially obvious when it comes to liquids and gases. To attain a lower value, the gas may be replaced with a gas having lower conductivity or the heat may be stopped from being transported. Example of gases including nitrogen, argon and helium that have different thermal conductivity properties at 27°C [5].

4 Thermal insulation

Thermal insulation is a structural element that reduces the heat transfer performance of the material and the structure as a whole. The process of stopping heat transfer between materials in thermal contact is known as thermal insulation. Thermal insulation is generally a process that prevents the thermal energy of equipment structure such as cooling, primary heating and prevents the thermal energy of the building from mixing with external environment. Thermal insulation is a substantial contribution to energy efficiency and an obvious practical and logical initial step, particularly in envelope-load dominated structures in hard climatic conditions. [6]. The thermal conductivity of insulation is used to determine its effectiveness. Heat insulation materials with a low thermal conductivity are employed. The thermal conductivity of a solid is a measurement of the solid's ability to conduct heat through it. The greater a solid's thermal conductivity, the greater its ability to conduct heat through it. The ability of a solid to conduct heat through it is reduced when its heat conductivity is low. The rate of heat conduction through a medium is determined by the geometry of the medium, its thickness, the medium's material, and the temperature difference across the medium. Density and heat capacity, in addition to thermal conductivity, are essential insulating material qualities.

5 Preparation and characterization of insulation material

The researcher creating a new material must complete the entire chain of events, beginning with X-ray analysis and ending with precise measurements of desirable properties. They must also consider the connection between material composition, crystal structure, and required properties. The explanation of the material preparation technique should receive significantly more attention than it has in the past [7]. This is because changes in the data will occur due to trivial matters such as the incorrect conversion of additional materials.

5.1 Fiberglass

Aerogels are cellular solids with a very low density, a high specific surface area, and a coherent open porous network of loosely packed, bonded particles or fibres with gas filled voids [8]. It could be used in place of traditional thermal insulation materials [9]. Fiber-reinforced aerogel blankets are used to create heat and flame-resistant protective clothing for industrial workers, thermal hazards of electrical arc protection and thermal insulation for buildings, protective clothing for workers exposed to molten substances and related hazards, and firefighter protective clothing.

The spatial structure of the samples after the heat treatment was studied using digital 3D X-ray microtomography.[10]. According to the previous researcher, the synthesis and characterization of highly disseminated titania on the surface of fiberglass material. SEM and X-ray digital 3D-microtomography revealed that each support fiber was evenly coated by altering components. The titania layer was composed of 18 nm anatase particles with an average pore size of 3.1 nm. The produced material demonstrated catalytic activity in n-heptane cracking, as well as deep and partial oxidation. The main products of n-heptane conversion in oxygen at 300–400 °were three to four carbon ketones. Deep oxidation rose substantially over 500°C, accompanied by the formation of α-olefins. By subtracting the integral intensities of distinctive absorption bands from the integral coefficients of absorption, which were derived from preparatory calibrations by filling the infrared cell with a known concentration mixture, the reaction product concentrations were estimated [10].

5.2 Mineral wool

Mineral wool is a type of fibre made by spinning or dragging molten mineral or rock materials like slag or ceramics. For external insulation, rockwool is commonly utilized. This material's thermal conductivity and mechanical and physical performance requirements
Have improved considerably during the previous few decades. Based on the early study, each sample of roughly 100 mm original nominal thickness was split into three about 150 mm specimens. Thus, the hardboard should be made up of two layers, one thicker on top and onethicker on the bottom. The examined samples were chilled until they attained a stable mass before being measured. Aside from the samples, the temperature chamber was adjusted to 10°C, and a magnesium nitrate salt solution provided 57 percent relative humidity in the confined area [11,12]. The integral intensities of distinctive absorption bands were used to compute the concentrations of reaction products.

5.3 Cellulose

Cellulose is a structural component of green plants’ main cell walls and many forms of algae and oomycetes. The cellulose content of this fibre was reported to be in the range of 60–75 percent. As a result, it might be a viable cellulosic material for the production of cellulose nanocrystals. [13]. Following a prior study, to determine cellulose’s characterization using TEM analysis for microscopic investigation, samples were analyzed using transmission electron microscopy equipment. A droplet of diluted nano-cellulose sample suspension was placed on a carbon microgrid (400 mesh) and dried before the examination. The sample was then can be examined under the TEM to determine the feature [14].

6 Application of palm tree fibers

Finding a feasible application for oil palm biomass in the fabrication of natural fiber-based composites/hybrid composites would undoubtedly help to alleviate the environmental problems associated with the disposal of oil palm waste. The applications of palm tree fibers can be seen in the products such as plywood, polymer bio-composite, boards, furniture and more [15].

7 Conclusion

Cellulose might be an effective thermal insulation in building material since it contains no oxygen. It’s become a solution to reducing fire damage. Since there is no oxygen in the material, the amountof damage caused by a fire is reduced.

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