

ABSTRACT**Heat Transfer Mechanisms in Biological Fibrous Materials****Krishpersad Manohar**

In the Caribbean, coconut fibre and sugarcane fibre are readily available as by-products from the copra and sugarcane industries. These potential building thermal insulators are not utilised effectively in the building industry due to the lack of data on thermophysical properties.

Coconut and sugarcane fibre consist of opaque large diameter fibres ($>200\mu\text{m}$). An analytical study of the heat transfer mechanisms across slab-like specimens consisting of large diameter fibres was undertaken. Radiative heat transfer, heat transfer due to conduction in the solid material, and heat conduction in air were considered to be the main contributors to heat transfer.

A model based on physical properties was developed to predict the apparent thermal conductivity of loose-fill large diameter fibrous materials within the temperature range 282 K to 312 K. Theoretical equations for the contribution due to radiative heat transfer and the contribution of the solid material towards the apparent thermal conductivity were developed. The contribution from air conduction towards the apparent thermal conductivity was taken to be directly proportional to the volume of air in the porous system. The interactions between the different modes of heat transfer were considered negligible. This gave the method developed a strong a priori approach for predicting the apparent thermal conductivity of large diameter fibrous materials.

Apparent thermal conductivity measurements were conducted on coconut fibre and sugarcane fibre specimens over the density range of 40 kg/m^3 to 90 kg/m^3

and 70 kg/m^3 to 120 kg/m^3 , respectively. To test the model at different temperatures and for different materials, experiments were conducted at mean test temperatures of 15.6°C , 21.8°C and 18°C , 24°C , 32°C for coconut fiber and sugarcane fibre, respectively.

The apparent thermal conductivity test results for both coconut and sugarcane fibre showed close correlation with the theoretically predicted values. For both materials investigated, the experimental data followed the predicted characteristic hooked shape graph of thermal conductivity with density and showed the optimum density to be within the same range as theoretically predicted. The overall experimental apparent thermal conductivity values were within 7% of the theoretically predicted values.

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