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COMPARISON BETWEEN THE THERMAL PROPERTIES OF CEMENT COMPOSITES USING INFRARED THERMAL IMAGES

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Introduction

The use of lignocellulose fibers is increasingly being studied, due to its abundance and availability, which can directly lead to energy savings, conservation of scarce resources and reduction of environmental pollution. (Sudin & Swamy, 2006).

The current work aimed to investigate the thermal performance of three cement-based composites properly reinforced with lignocellulosic materials (Eucalyptus, sugar cane and coconut fibre) and commercial gypsum board to be used as in internal partitions of the building using infrared thermal images

Material and Methods

Lignocellulosic cement panels were produced using the Eucalyptus, sugar cane and coconut. Three repetitions for each kind of lignocellulosic material were made.

For the calculations of the components of each panel (lignocellulosic material, cement, water, and $CaCl_2$), the methodology suggested by Souza (1994) was used to determine the equivalent mass of components. In the production of panels, the following parameters were applied: material and cement ratio, 1:2.75; water and cement ratio, 1:2.5; hydration water rate of 0.25; additive, 4% (based on cement mass); the percentage of losses, 6%. The calculations were performed for a nominal panel density of 1200 kg m^{-3}.

In order to produce each panel, components were weighed and then mixed in a concrete mixer for eight minutes. After mixing, the mass of each panel was separated, weighed, and randomly distributed in aluminum moulds of 480 x 480 x 150 mm. The moulding and stapling were carried out in a cold process for 24 hours, and then panels were kept in a climatic room at a temperature of 20 ± 2° C and 65 ± 3% relative humidity to ensure uniform drying for 21 days.

Results and Discussion

Table1 shows the thermal performance results of the evaluated panels

Table 1. Thermal properties of the evaluated panels..

Material	Thickness (mm)	Density (Kg m^{-3})	Thermal conductivity (W $m^{-1}K^{-1}$)	Thermal Resistivity (K W^{-1})	Thermal Resistance (m^2 K W^{-1})	Thermal Transmittance (W $m^{-2}K^{-1}$)
Eucalyptus	17 b (0.667)	1,182.1c (68.471)	0.050 a (0.002)	20.103 b (0.624)	0.344 b (0.003)	2.903 a (0.024)
Sugar cane	17 b (0.845)	1,172.1c (82.297)	0.058 b (0.003)	17.295 a (0.899)	0.345 b (0.003)	2.900 a (0.027)
Coconut	16 ab (0.269)	984.3 b (82.010)	0.047 a (0.001)	20.028 bc (1.672)	0.333 a (0.000)	3.007 b (0.002)
Commercial gypsum board	15 a (0.030)	1,608.0 a (30.000)	0.045 a (0.000)	21.991 c (0.096)	0.330 a (0.001)	3.032 b (0.013)

Fig. 1 shows the surface temperature distribution of the cement composites with lignocellulosic materials from external size measured by infrared thermography. Also, it shows the temperature distribution from the internal side (in contact with the heat resource). The colour scale is based on the variation of the surface temperature.

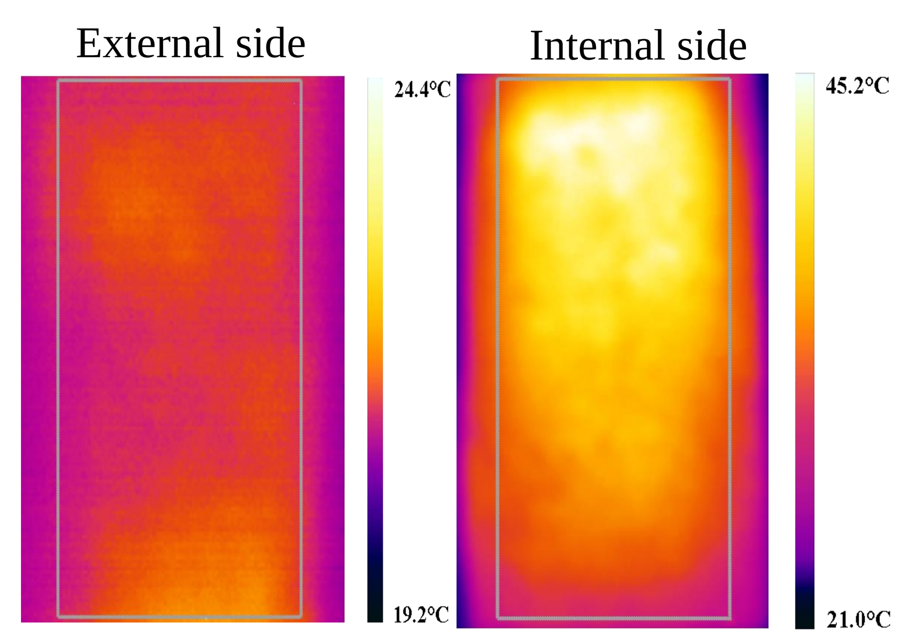

Figure 1a. Infrared thermal images form external and internal sides of the eucalyptus panels

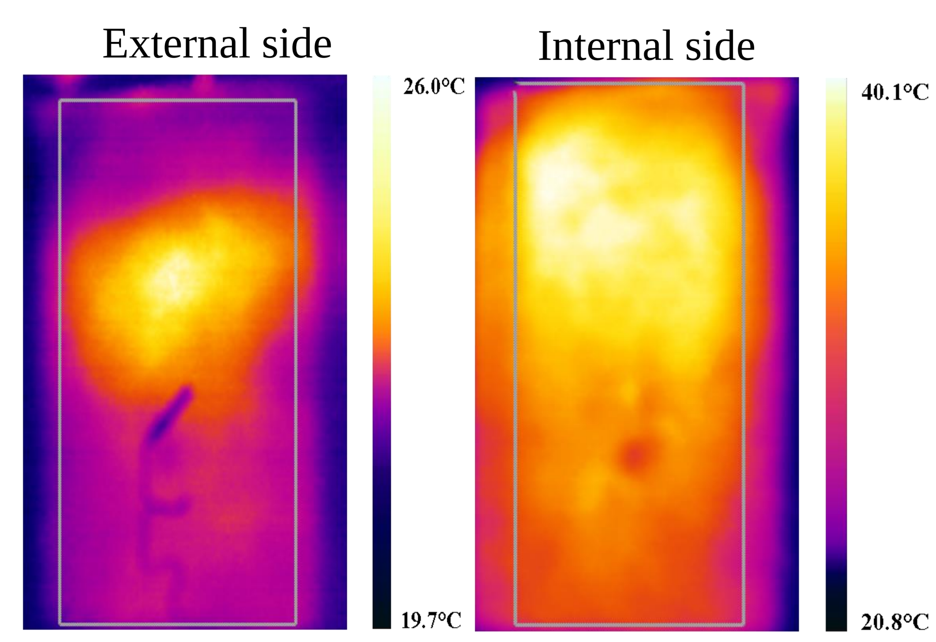

Figure 1b. Infrared thermal images form external and internal sides of the sugar cane panels

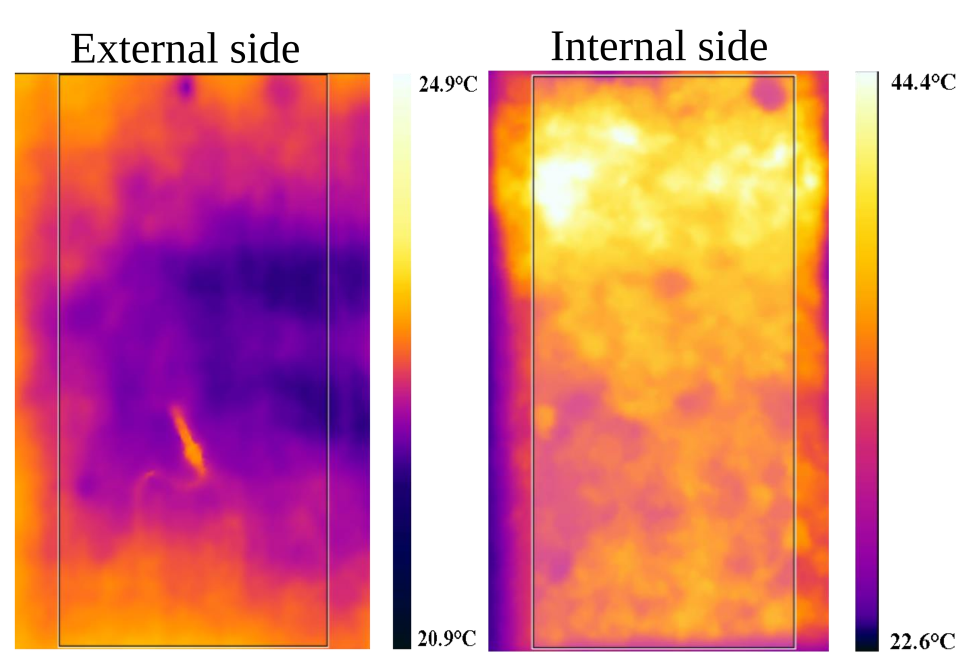

Figure 1c. Infrared thermal images form external and internal sides of the coconut panels

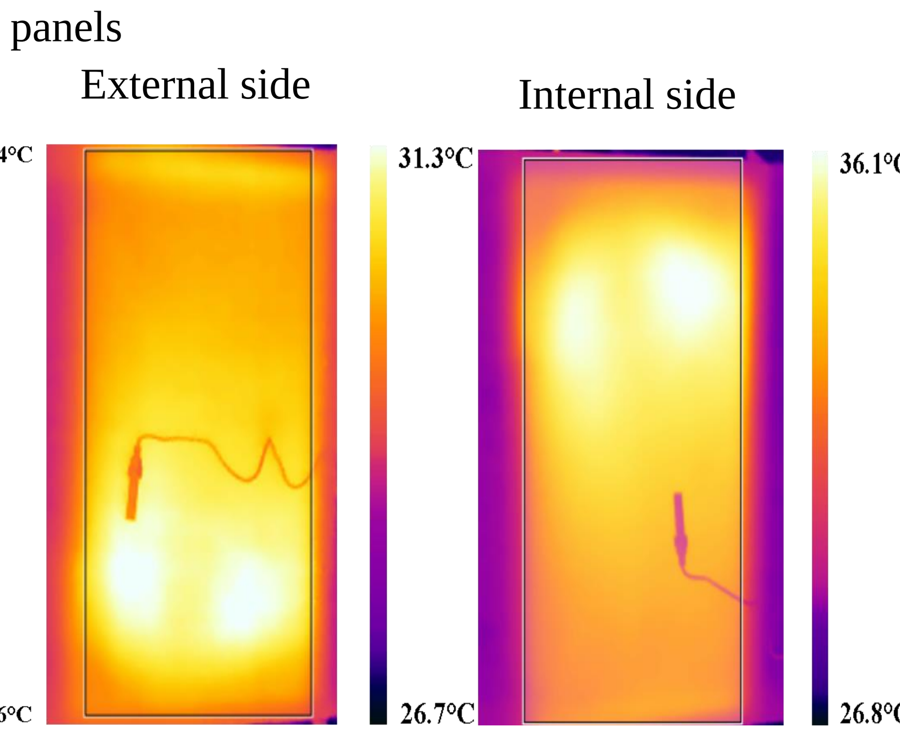

Figure 1d. Infrared thermal images form external and internal sides of the commercial gypsum board

The commercial gypsum board, coconut, and Eucalyptus cement composite had similar thermal conductivity. Nevertheless, related to thermal resistivity, thermal resistance, and thermal transmittance, only the coconut panel presented the same behaviour to the commercial gypsum board. Higher thermal resistance values are obtained with lower thermal conductivity values

Conclusions

The commercial gypsum board, coconut, and Eucalyptus cement composite had similar thermal conductivity. Nevertheless, related to thermal resistivity, thermal resistance, and thermal transmittance, only the coconut panel presented the same behaviour to the commercial gypsum board. Higher thermal resistance values are obtained with lower thermal conductivity values

Acknowledgements

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