Characterization and Thermal Conductivity of Cellulose Based cement Composite

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Objectives

The elaboration of different samples of cellulose based cement composite, derived from orange trees, while incorporating the organic filler in cement block for a potential use in the field of thermal insulation.

- ❑ The creation of an insulating material with developed thermal properties and low thermal conductivity λ.
- ❑ Showing a certain alliance between the fraction of the filler and the thermal conductivity of the sample.

Introduction

In order to achieve progress in the concept of sustainable development for a long-term agreement with our ecology, ecological and bio-sourced alternatives have taken place to restore a new form of significant yield. Very recently, a new strategy has been developed to generate insulating cellulose composite, in order to exploit these energy insulating properties [1]. Cellulose is a renewable material and the most abundant biopolymer on Earth, recognized by an interesting thermal and chemical stability [2].

Methods and results

The stationary method measures the temperature difference through the Seebeck law, thus the thermal flow of the sample while using the conductivity meter:

$$\lambda = {}^{e}/_{\Delta T\, A} \times \Phi$$

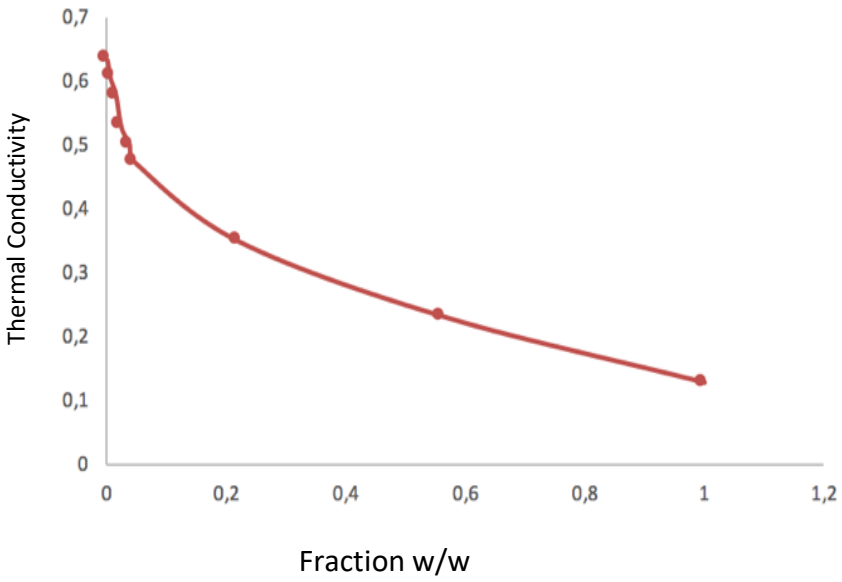

Fig. 1. Thermal conductivity according to the fraction of the load.

The differences in behaviour are explained by the increase in the cellulosic nanoload. It can be said that the cellulose-based composite has a low thermal conductivity as a function of the percentages of charge added. The addition of sawdust gives a composite material with impurities characterized by a lower thermal conductivity (good insulators: λ <0.2), few free electrons and less efficient phonons due to the imperfections of the network of the insulating material.

Characterization

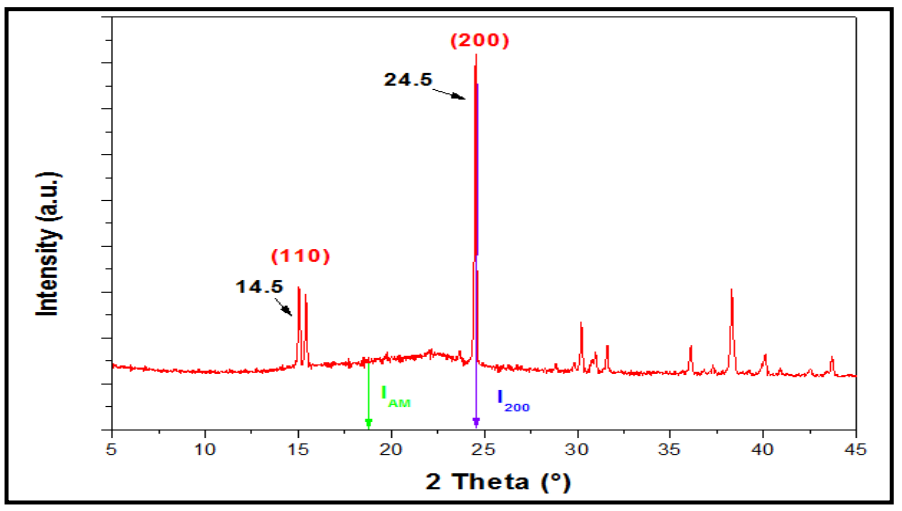

Fig. 2. X-ray diffraction spectrum of the cellulose sample.

The identification of the samples was investigated by an X-ray diffractometer Bruker, using Cu Kα radiation (λ= 1.5406Å). The diffraction patterns were collected in the 2θ range from 5 to 45. XRD involves X-ray diffraction on a sample. According to the XRD patterns, the diffractogram corresponds to that of cellulose Iβ, the diffraction peaks at 2θ were around 14.5, 16.5, and 24.5, corresponding to (1–10) (110) and (200).

Conclusion

Cellulose-based cement composite has been developed while using cellulose derived from orange as raw materials and by reintegrating different fractions of the filler.

It can be said that Cellulose-based composite showed low thermal conductivity (0.2 $W.m^{-1}.K^{-1}$) as a function of the added load.

Future work

This system of course is far from complete, the next steps of research in this area would be:

- Apply our system to a large database, with potentially aerogels.

References

[1]: M. Deng, Q. Zhou, A. Du, J. van Kasteren, and Y. Wang, Preparation of nanoporous cellulose foams from cellulose-ionic liquid solutions, Materials Letters 63 (2009) 1851–1854.

[2]: Paljevac, M., Primožič, M., Habulin, M., Novak, Z. and Knez, Ž., Hydrolysis of carboxymethyl cellulose catalyzed by cellulase immobilized on silica gels at low and high pressures. J. of Supercritical Fluids 43 (2007) 74–80.

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