WALNUT AND HAZELNUT SHELLS FOR INSULATING PANELS FABRICATION

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INTRODUCTION

Searching new environmentally friendly materials is a goal in the construction area. This sector is one of the most pollutant sectors due to the large number of raw materials and the high amount of energy it requires [1,2], so it is necessary to look for ways to reduce this environmental impact.

In this work, the use of walnut and hazelnut shells as raw material to produce insulating materials, mainly thermal insulation, is proposed. These insulating panels could be used in houses or buildings. In addition, bone glue and beeswax, which are natural binders and have been obtained in an ecological way, will be used as binders. Tests have been carried out combining different ecological materials and changing the ratio used and their thermal conductivity coefficient has been measured.

MATERIALS

Raw Materials
- Walnut shells
- Hazelnut shells

Binder
- Bone glue
- Beeswax

In some samples
- Plaster

SHELLS: Select → Grind → Weight → 100 g or 200 g

BINDER: Soak the binder in cold water for 8 hours → Heat the binder in a water bath → Weight → 100 g

→ Mix

Compact compound in the mould for 24 h

Amalgamated and compact compound

Add 50 g of plaster cast

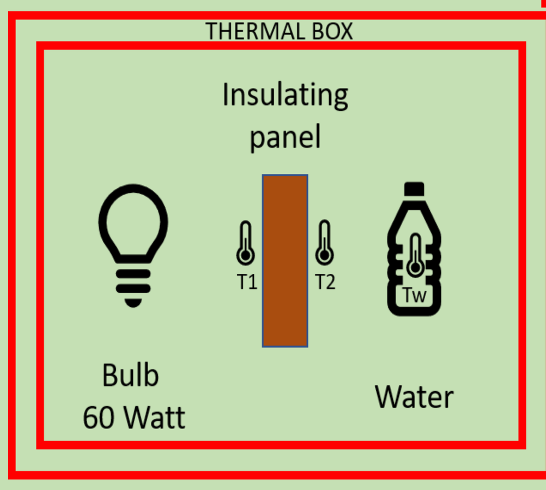
Samples 2, 4 and 6

Fabrication of insulating panel specimen

10 cm x 12 cm x 3 cm

EXPERIMENTAL PROCEDURE

Determination of thermal conductivity coefficient



Fourier's Law

$$q(t) = \frac{k \cdot A \cdot \Delta T}{L}$$

For the water

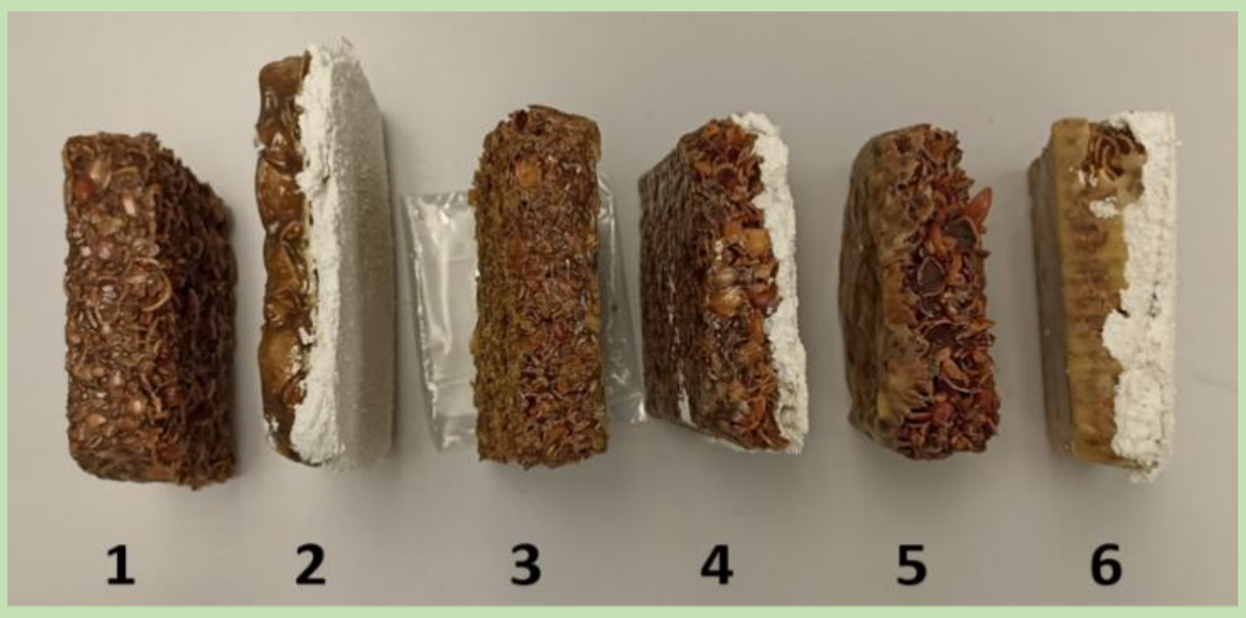
$$q' = \frac{m \cdot c \cdot \Delta T_w}{t}$$

$$k = \frac{m \cdot c \cdot \Delta T_w \cdot L}{t \cdot A \cdot \Delta T}$$

q (Kcal): heat flow
k (Kcal/(h·m·°C): thermal conductivity coefficient
A (m^2): surface of the specimen
ΔT (°C): difference of temperature between the faces of the specimen
L (m): thickness of the specimen
m (g): mass of water
c ($1 \cdot 10^{-3}$ Kcal/g·°C): specific heat of the water
ΔT_w (°C): temperature rise of the water
t (h): time

RESULTS

The thermal conductivity coefficients obtained for different biomaterials are in the range of 0.039 - 0.071 Kcal/h·m·°C. These values are similar to other common materials used as thermal insulators in the construction sector [3-4]. Therefore, walnut or hazelnut shells could be used, giving a use to this natural waste, in the manufacture of insulating panels in construction.



Different samples prepared

Sample	Composition	Ratio (shells/binder)	Thermal conductivity coefficient, k (Kcal/h·m·°C)
1	Hazelnut shells / bone glue	1:1	0.071
2	Walnut shells / plaster / bone glue	2:1	0.039
3	Hazelnut shells / bone glue	2:1	0.048
4	Hazelnut shells / plaster /bone glue	2:1	0.039
5	Hazelnut shells / beeswax	1:1	0.054
6	Hazelnut shells / plaster / beeswax	1:1	0.039

The same procedure used with the cork → Thermal conductivity coefficient obtained is similar to the values reported in the literature → Valid experimental procedure

CONCLUSIONS

- The thermal conductivity coefficients obtained for the biomaterials are in the range of 0.039 - 0.071 Kcal/h·m·°C.
- The raw materials (shells) are a biological waste material and can be used to produce insulating panels.
- These materials can substitute others more polluting materials and reduce the environmental impact in the construction sector.

NEXT STEPS

Life Cycle Assesment: allows to quantify the environmental impact of the production of the panels used and compare it with the materials that are currently used.

Economic viability: economically study the large-scale production of these panels to find out whether their introduction into the market is viable.

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