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Experimental study of thermal conductivity of leather and carpentry wastes

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HIGHLIGHTS

- Thermal insulation capacity of leather and carpentry wastes was evaluated.
- Wastes were used as filling and separation materials.
- Effect of weight/volume ratio and moisture content was investigated.
- Waste materials reduce considerably the heat transfer especially in dry state.
- Leather and carpentry wastes can compete with other classical insulating materials.

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ABSTRACT

This research work is focused on analyzing the potential application of two leather wastes (wet-blue chrome shavings (CS) and leather buffing dust (BD)) and two carpentry wastes (wood shavings (WS) and sawdust (SD)) as alternative building thermal insulation materials. These industrial solid wastes are used as filling materials for hollow specimens and as separation material for cement/sand panels and plasterboards. It was experimentally investigated *the effect* of weight/volume ratio and moisture on thermal conductivity of composite specimens and material wastes. It was shown that conductivity increases with the increase of moisture content. Thermal conductivity of dry material wastes deposited between plasterboards and cement boards was then evaluated. The thermal conductivity measurements show clearly that these industrial solid wastes can compete with other insulating materials.

1. Introduction

Buildings are large consumers of energy in all countries. An effective way of saving energy is to improve the thermal insulation of buildings. This is particularly important in hot and cold climates where the energy demand is very high. The thermal insulation is needed in order to reduce the final energy consumption in buildings and to contribute to the use of unconventional regenerative sources of energy for a sustainable development [1]. The use of thermal insulation in buildings helps in extending the periods of thermal comfort without reliance on mechanical air-conditioning especially during interseasons periods [2,3]. One technique for reducing the demand of air conditioning is to apply thermal insulation in walls and roofs [4].

The continuous search for better sustainable and economic processed solutions has been the center of the attention of a broad research community worldwide [5]. Development of new thermal insulation materials requires knowledge of the thermo-physical properties of the material. Many scientific groups have oriented their research to study the thermophysical properties of lightweight construction materials and of various products such as recycled cellulose from waste packaging and paper [6,7], wood [8,9], cork [10], natural pozzolan [11], silica aerogels [12], rubber waste particles [13], mud [14], corn peel [15], sewage sludge ash [16], textile subwaste [5], straw [17], polyethylene (PET) bottle and automobile tire pieces [18], waste polystyrene [19], woven fabric waste and woven fabric subwaste [20], and recycled plastic waste [21]. The thermal conductivities of ordinary heat insulating materials range from 0.034 to 0.173 W/m K [22].

High amount of solid wastes is produced by industries. Increased restrictions on land disposal, recent increases in the costs of land disposal and decreases in the number of disposal sites

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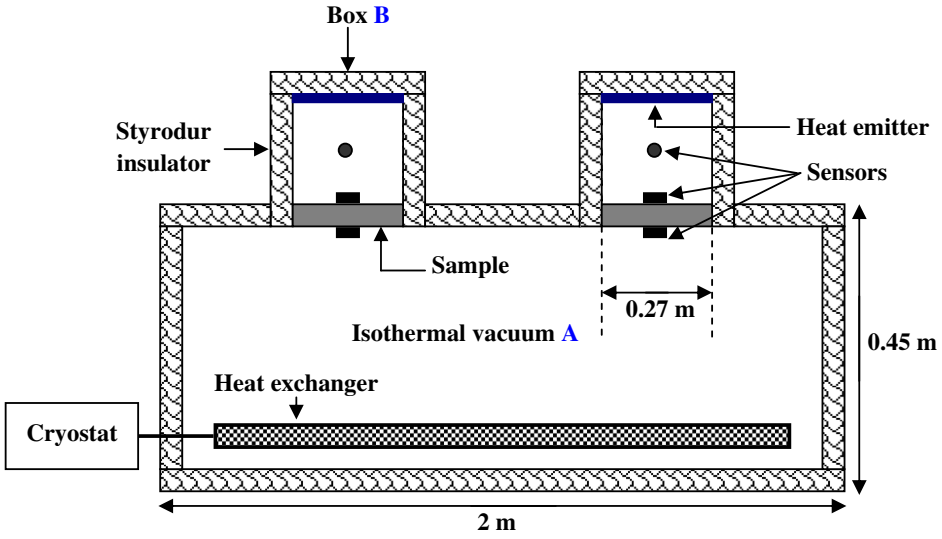

Fig. 1. Schematic presentation of the device for thermal conductivity measurement.

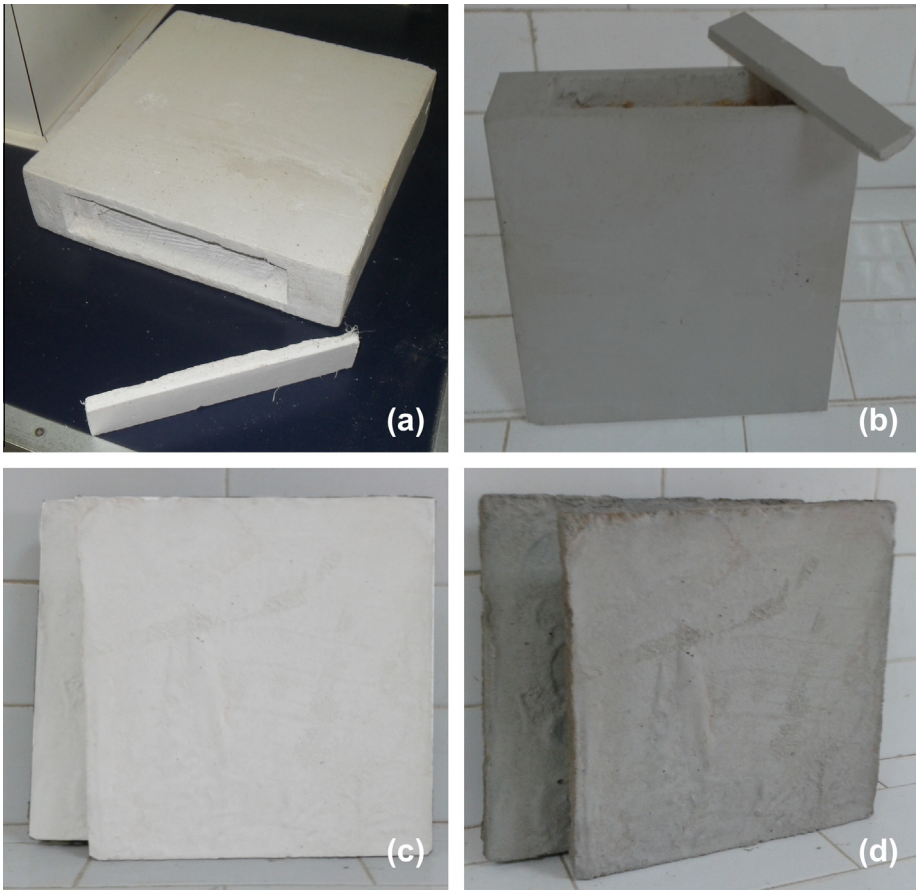

Fig. 2. Photos of hollow specimens and separated panels: (a) HSP: Hollow Specimen of Plaster, (b) HSC: Hollow Specimen of Cement/Sand (25/75), (c) plasterboards, and (d) cement/sand boards.

have combined to spur research into alternative treatments. The reuse of different types of waste can contribute significantly to sustainability. The main objective of this research work is to analyze the potential of using leather wastes (wet-blue chrome shavings and leather buffing dust) and carpentry wastes (wood shavings and sawdust) as an alternative building thermal insulation materials.

2. Materials and methods

2.1. Materials

2.1.1. Tannery solid wastes

Chrome shavings (CS) and buffing dusts (BD) generated by the leather processing industries were used in this study as raw materials. Chrome shavings are small pieces of leather shaved off when the thickness of wet blues is rendered uniform by