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APPLICATION OF PCM BINDED WITH RESINE ON A COMPOSITE MATERIAL MADE OF A POLYESTER NONWOVEN AND A JUTE FABRIC RESISTIVE LAYER

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Abstract: *Noise is an important concern nowadays. Thermal regulation is also an interesting issue which can be partially solved or improved by textiles. Thermal and acoustic conditioning of rooms can be achieved bymeans of different materials. Fibrous textile materials can be used for both purposes. In this work, PCM micro-capsules are applied by flat printing method on a jute fabric which is used as a resistive layer of a fibrous composite. PCM thermal properties on fabrics have been widely reported. However, The variations on acoustic isolation have not been reported nowadays.The aim of this study is to determine whether there is any alteration due to the preence of PCM on a textile surfece. The sound absorption coefficient of the obtained samples is measured using a standing wave tube. Results show that the application of these micro-capsules boosts the sound absorption coefficient of the composite material, and that the temperature does not affect to this characteristic. In this work we domonstrate that PCM presence improves the acoustic response of the system and it is not anly due to the presence of a binder but also improves whan PCM have been applied. Apparently there is no differennce on the behaviour depending on the temperature what evidences a change in the phase is not latering the acoustic response.*

Key words: *sound absorption, fibrous absorber, acoustic conditioning, thermal.*

1. INTRODUCTION

The interest on natural materials in building and decoration is increasing nowadays. Some vegetal fibres have been studied as fibrous sound absorbers [1,2] and specially jute [3,4]. Textile fibrous materials have been widely used for acoustic purposes, like sound absorbers [5].

Phase change materials (PCM) are used for thermal regulation. When temperature raises over their melting point, they absorb the latent heat and use it to melt, avoiding the temperature in the surrounding to increase. When temperature drops, they act reversely, solidifying and releasing the latent heat [6]. These materials are commonly used in building, but also as functional finishes for textiles [7] Microencapsulation is a method that keeps the PCM isolated from the surrounding materials, and avoids its leaking when the material is melted.

In this work a microencapsulated PCM is applied on a jute fabric by flat textile printing. The resultant fabric is added on a 15 mm polyester nonwoven and the sound absorption coefficient of the resultant composite is measured. Results show that the addition of PCM increases the sound absorption of the composite material, and that the phase change does not affect this absorption.

2. MATERIALS AND METHOD

2.1. Materials

The studied jute fabric characteristics are shown in table 1. The nonwoven employed is made of 100% polyester with 63 mm long, 12,33 dtex, circular cross section fibres, without crimp. The used binder is an acrylic/styrene copolymer, and the PCM micro-spheres were supplie from Color Center Spain. The printing paste composition appears in table 2:

Table 1. *Characteristics of jute fabric*

Material	**Weave**	**Warp Yarn Count (Threads/cm)**	**Filling Yarn Count (Threads/cm)**	**Areal Density (g/cm^2)**
Jute	Plain	6.2	5.2	30

Table 2. *Characteristics of printing paste*

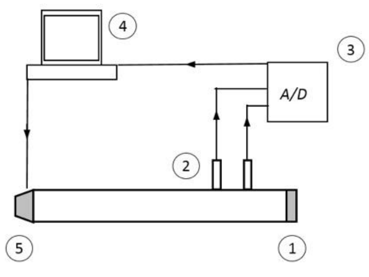
Material	Concentration (g/L)
Binder	15
PCM	50

2.2. Preparation of samples

Two samples are prepared by printing: one of them with all the elements of the printing paste except the PCM micro-capsules, and the other one with all the components. Three test specimens are cut from each sample. Only one specimen of nonwoven is used for all the tests.

2.3 Methods

Sound absorption coefficients of the different samples are measured without air gap at the back of the material. Tests are performed according to ISO Standard 10534-2: Acoustics. Determination of sound absorption coefficient and impedance in impedance tubes. Transfer function method. In this method, the sound wave strikes the material perpendicularly and the measured sound absorption coefficient is known as the normal incidence sound absorption coefficient. The impedance tube consists in is a narrow, rigid and airtight duct which meets certain characteristics described in the above standard. Measurements are performed between 400 and 4000 Hz. These frequencies are chosen due to the diameter of the available tube (around 40 mm).



1. Sample holder
2. Two microphones (microphones G.R.A.S. model 40AO)
3. Data acquisition system (NI-9233)
4. PC with data analysis tool
5. Sound source

Fig. 1. *Scheme of the apparatus employed to measure the sound absorption coefficient.*

To perform the test, the sample is placed at one end of the impedance tube (see point 1 in figure 1). The sample is fit snugly to the sample holder with no air gap. Plane waves are generated, in the tube by the sound source (see point 5 in figure 1). An interferential field decomposition is performed by measuring the sound pressure in two positions, using microphones hanged on the wall (see point 2 in figure 1). Using a Matlab function designed for this purpose, the transfer function of the complex acoustic signals at two microphones is determined.

3. RESULTS AND DISCUSSION

The areal density of the jute fabric before and after printing is shown in table 3.

Table 3. *Jute fabric areal density*

	Areal density (g/m^2)
Jute (untreated)	30,04
Jute + binder	33,94
Jute + binder + PCM	42,36

Sound absorption coefficient of the composite material is measured at a room temperature of 20º C. The combinations that form the composite material areshown in table 4. Results are shown in Fig. 2.

Table 4. *Measured combinations*

1	One layer of 15mm nonwoven and one layer of untreated jute fabric
2	One layer of 15mm nonwoven and one layer of jute fabric, printed only with binder
3	One layer of 15mm nonwoven and one layer of jute fabric, printed with PCM micro-capsules

The results are shown in Fig. 2.

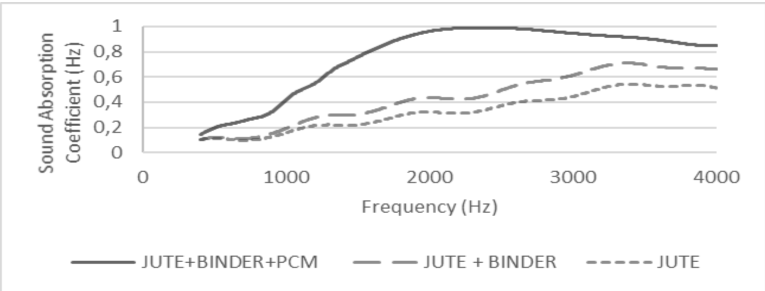


Fig. 2. *Sound absorption coefficient of a composite material made up of a layer of 15mm poliester nonwoven and a layer of untreated jute fabric upstream the sound source, jute printed with only the binder paste, and jute printed with paste containing PCM.*

Samples are heated up inside the sample holder using hot air, up to a temperature over 25ºC to achieve the phase change of the PCM. Then the sound absorption coefficient is measured. Results are shown in Fig. 3. What is clearly demonstrated is that microcpasules modify acoustic behavior. It is not only due to the areal density modification as when the binder is added the response is not as good as when microcapsules are included.

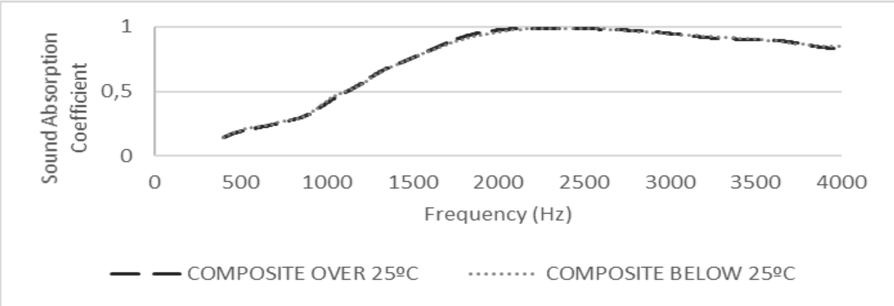


Fig. 3. *Sound absorption coefficient of a composite material made up of a layer of nonwoven and a layer of jute fabric printed with paste containing PCM at two temperatures, below and over the PCM melting point.*

Figure 3 demonstrates that temperature does not show any difference what can dbe understood as there is no modification due to the phase change inside the microcapsule.

4. CONCLUSIONS

The application of PCM microspheres on a jute fabric and nonwove composite improves its sound absorption coefficient in more tan 240% in frequencies from 1500 to 1600 Hz, reaching a maximum of 0,99 at about 2350 Hz. Vlues of sound absorption coefficient above 0,5 are found at frequencies over 1100 Hz The binder affects the absorption of the composite, improving the sound absorption coefficient about 38% between 2800 and 3000 Hz. Values above 0,5 are achieved for frequencies over 2500 Hz. The liquid or solid state of the interior of the micro-capsules does not show any difference in the sound absorption of the composite. In future trends we will study wheather this is similar with microcapsules containing different active core.

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