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Measurement of the thermal and acoustic Properties of the concrete alleviated with the cork

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ABSTRACT

This article presents a general survey that approaches the thermal and acoustic aspects of the concrete alleviated with the cork at a time as being material of construction and insulation of buildings. First of all we try to measure experimentally with the help of the method of boxes the conductivity and the thermal resistance of the béto - cork material. To this survey we proceed in the same way by simultaneous measures of the isolation and the acoustic transmission coefficient, of the studied material. Second we examine the influence of the incorporation of the cork within the concrete at the time of its wastage, on the power of thermal and acoustic insulation of this material.

INTRODUCTION

The evaluation of acoustic and thermal parameters of the materials of construction and insulation plays a primordial role in several scientific and industrial domains. Among these materials one finds the alleviated concrete that presents a least density than that of the plain concrete. There exists a huge quantity of alleviated concrete all with a different composition, an example of this is the concrete with natural materials basis. Our choice focuses on the concrete alleviated with the cork because the cork, is a product that is 100% natural and ecological [1], and is counted among the most abundant materials in Morocco.

It comes from a particular species of holly-oak that grows in various regions of the western basin of the Mediterranean, North Africa. Offered by nature and treated by human beings, the cork becomes adapted to the modern processes of construction, maintaining its natural qualities. Its structure is formed of juxtaposition microscopic cells which are isolated from each other and is 95% filled up with immobile air. This process assures a big suppleness and an important power isolating at a time. The cork, the only naturally isolated material with its powerful and mechanical resistance, adds to its thermal isolation a characteristic that contributes to a comfortable setting of life: the phonic insulation.

TECHNIQUES OF PROPERTIES THERMOPHYSICS MEASURE

The method that we used for the measure of the conductivity and the thermal diffusivity is the method of the boxes [1-2]. It is available to the Laboratory of energizing, Thermal Group of solar Energy and Environment (ETEE) of the faculty of the Sciences of Tétouan (Fig.1). It permits the simultaneous measure of the conductivity and the thermal diffusivity of one or two samples.

The thermal conductivity is given by:

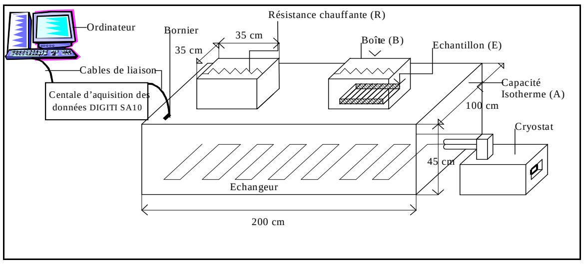
$$\lambda = \frac{e}{S.\Delta T}(q + C.\Delta T') \tag{1}$$

ΔT: Gap of temperature between faces hot and cold of the sample.

$\Delta T'$: Gap of temperature between ambiances outside and interior of the box.

The thermal resistance by unit of surface is defined by the expression:

$$R_{TH} = \frac{e}{\lambda S} \tag{2}$$

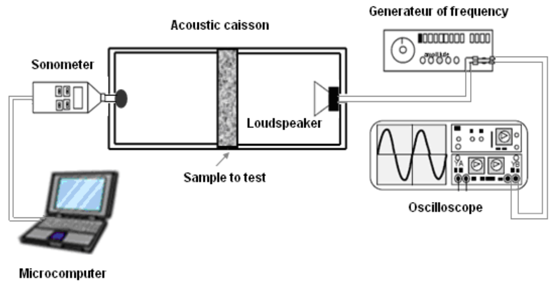


Source: (n.kellati, 2007)

Figure.1: Experimental device of the box method

TECHNIQUES OF MEASURE OF THE ACOUSTIC PROPERTIES

The experimental device used for the measure of the acoustic properties of the materials, is constituted of an acoustic caisson inside which a sonometer is linked to a microcomputer, used to measure the levels of acoustic pressure of the sound waves, created by a high talker HP placed in the caisson and supplied by a generator of frequency (Fig. 2).



Source: (n.kellati, 2007)

Figure. 2-a: Schematic diagram of the experimental device for the acoustic property measure

The figure presents the experimental device used for the acoustic property measure:

Source: (n.kellati, 2007)

Figure. 2-b: Experimental device for the acoustic property measure

In this part, we proceed by measure of the acoustic isolation D of the compact cork, defined as the subtraction between the resonant level signaled by upper speaker, and the one transmitted by sonometer [3-4-5]. In continuation we finish by the identification of the transmission coefficient.

The acoustic isolation defined by:

$$D = L_i - L_t \tag{3}$$

With: $L_i = 10 \log \frac{I_i}{I_0}$ and

$$L_t = 10 \log \frac{I_t}{I_o} \tag{4}$$

The transmission coefficient defined by:

$$\tau = \frac{I_t}{I_i} \tag{5}$$

Of after expression (3) and (4), the expression (5) can write him under this shape:

$$\tau = 10^{-\frac{D}{10}} \tag{6}$$

RESULTS AND INTERPRETATIONS

The samples of acoustic measure have the same measurements as those used for the measure of features thermophysics by the method of the boxes (27*27*e cm^3). The technical features of the samples selected to the experimental tests are regrouped in figure1. For technical reasons, (adopted operative fashion), it is difficult to pass the values of the percentage mass L/B mentioned in the table below.

Table 1: Technical studied material features

L/B	e	ρ	λ	Rth
%	cm	Kg/m3	W/m°C	°C/W
0	2,5	1863,92	0,420	0,82
0,5	2,4	1763,83	0,350	0,94
0,7	2,3	1724,82	0,240	1,31

Source: (n.kellati, 2008)

The results of figures 3 and 4 show a considerable influence, of the fraction of lightening with cork, on the conductivity and on the thermal resistance, the more the concrete is alleviated with the cork the more its thermal conductivity decreases and, therefore, its thermal resistance increases more. It is clear that the factor determining this variation is the porosity of the material that increases as the material is less dense.

One also notices according to figures 3 and 4 that the cork improves the power of thermal isolation of the concrete better, it explains itself by the fact that the cork to a weak thermal conductivity of the order of 0,035 (W/m°C). Besides, it is a material that encourages the existence of the pores better within the material encouraging on their turns the existence of the blades of airs.

According to figures 5 and 6, the acoustic isolation and the transmission coefficient vary in the same way, with the frequency for the different rates of lightening. The isolation can reach some values until 45 dB for the low frequencies (f=250 Hz) through the intermediary of the transmission coefficient, of the peaks of transmissions on average frequency (f=500 Hz) and in high frequency (f=2000 Hz), are notably observable for fractions of lightening equals to 0,7 % (Fig. 6).

According to figures 7 and 8 one notices, for all ranges of frequencies, a considerable influence of the fraction of the cork introduced in the concrete on the acoustic isolation and on the transmission coefficient. Indeed, more the concrete is incorporated with the cork, the transmission power becomes bigger, and consequently, the acoustic isolation power becomes weak.

CONCLUSION

In the light of all these experimental results of the studied material, we can conclude that, the thermal conductivity and the acoustic isolation, contribute to a better knowledge of the thermal and acoustic behavior of a material.

The results of measures show that the fraction of lightening, modify the performances of the studied material considerably, particularly its thermophysics and acoustic characteristics.

This incorporation has both a positive and negative influence respectively on the power of thermal and acoustic insulation of this material.

Based on these different achieved results, one can affirm that the choice of a lightening fraction for which the concrete alleviated with the cork, present the optimal qualities, as materials, both as isolating thermal and acoustic, is necessary. The importance of a complete characterization of the acoustic sizes is going to allow us to consider the versatile side of this material alleviated. This can serve us at a time as thermal and acoustic insulator while keeping correct mechanical properties.

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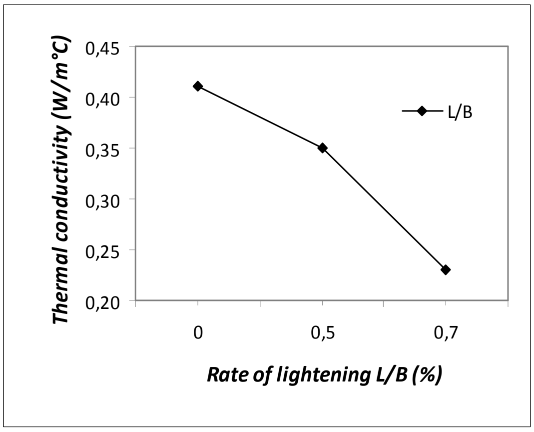

Figure. 3: Thermal conductivity according to the L/B fraction

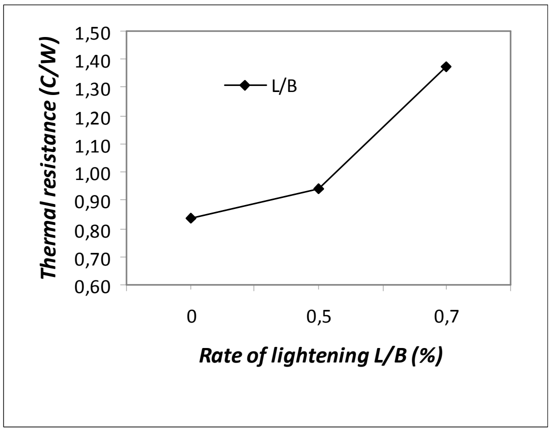

Figure. 4: Thermal resistance according to the L/B fraction

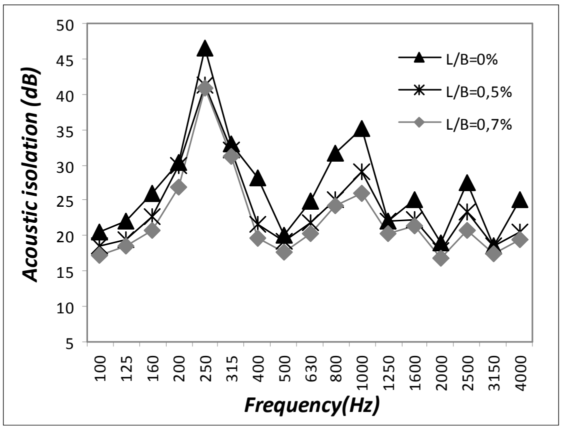

Figure. 5: Acoustic isolation according to the frequency

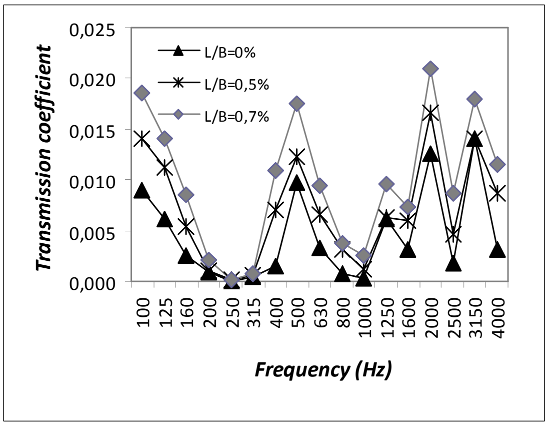

Figure. 6: Transmission coeficient according to the frequency

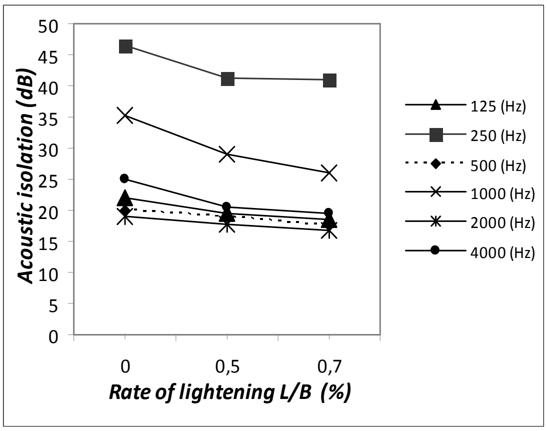

Figure. 7: Acoustic isolation according to the L/B fraction

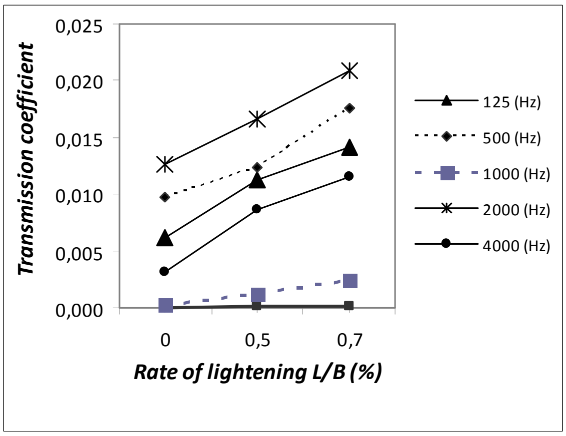

Figure. 8: Transmission coeficient according to the L/B fraction