19th INTERNATIONAL CONGRESS ON ACOUSTICS
MADRID, 2-7 SEPTEMBER 2007

STUDY OF ACOUSTIC PROPERTIES OF CORK COMPACT

PACS: 43.55.Ti

Kellati, Nor-edine [1]; El Bouardi, Abdelmajid [1]; Ajzoul, Taïb [1]; Ezbakhe, Hassan [1]
[1]Laboratory of Energetic, Equips with Thermal Solar energy and Environment, Faculty of Science, University Abdelmalek Essaâdi, Tetouan – Morocco; n_kellati@hotmail.com

ABSTRACT
The research of comfort conditions in the habitat passes by a better knowledge of the acoustic behavior of the porous materials used in the construction and the insulation of buildings. This article presents a survey that approaches the acoustic aspect of the material cork under compact shape, as being porous material. We proceed by simultaneous measures of the acoustic attenuation index and the transmission coefficient of the studied material, with the help of an experimental device.

INTRODUCTION
Among the porous materials used in the acoustic insulation of buildings, the cork, a product 100% natural and ecological. 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 the nature, worked by the man, the cork adjusted to the modern processes, of construction, all in maintaining theirs natural's qualities. Its structure is formed of isolated microscopic cell juxtaposition the some to the other and full to 95% by the immobile air. This one assures him at a time a big suppleness and an important power isolating.

The cork, only propertied naturally insulating material at a time such a power and such a mechanical resistance, add to theirs qualities of thermal insulator a characteristic that contributes to the comfort of the setting of life: Phonic Insulation.

TECHNIQUE OF ACOUSTIC PROPERTY MEASURE
The experimental device used for the measure of the acoustic properties of materials (Figure 1), is constituted inside of an acoustic caisson of which is positioned, a high talker nourished by a low-frequency generator, and a sonometer coupled to a microcomputer, used to measure levels of acoustic intensity in the caisson.

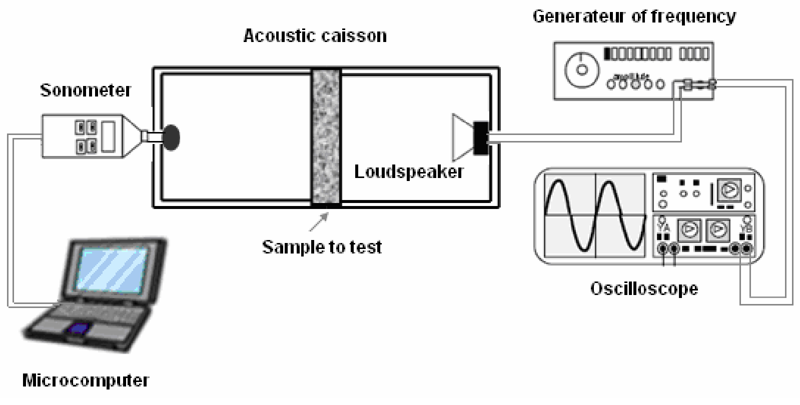

Figure 1.-Schematic diagram of the experimental device for the acoustic property measure

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

Figure 2.-Experimental device for the acoustic property measure

We proceed in this part by measure of the acoustic attenuation index D of the compact cork, defines as being the subtraction between the resonant level given out of the side loudspeaker, and the one transmitted side sonometer [1-6]. In continuation we finish by the identification of the acoustic transmission coefficient.

The acoustic attenuation index defined by: $$D = L_i - L_t \qquad \text{(Eq. 1)}$$

With: $$L_i = 10\log\frac{I_i}{I_0} \text{ and } L_t = 10\log\frac{I_t}{I_o} \qquad \text{(Eq. 2)}$$

The transmission coefficient defined by: $$\tau = \frac{I_t}{I_i} \qquad \text{(Eq. 3)}$$

Of after (Eq. 1) and (Eq. 2), the expression (Eq. 3) can write him under this shape:

$$\tau = 10^{-\frac{D}{10}} \qquad \text{(Eq. 4)}$$

RESULTS AND INTERPRETATIONS

Samples of measure have the same measurements that those used at the time of measures of features thermophysiques (27x27 cm^2), the table 1 gives the technical features of samples selected to the experimental tests.

Table 1.-Technical studied material features

material cork	L1	L2	L3	L4
m (g)	157,00	211,00	286,00	757,00
e (cm)	0,8	0,8	3,5	5
μ (kg/m^2)	2,15	2,89	3,92	10,38

Results of the figure 3 show, that the acoustic attenuation index varies with the frequency, it can reach values until 30 dB, for the low frequencies (f=250 Hz), and vary also with features of the sample, as the thickness and surface mass.

According to figures 4 and 6 one notices, for all ranges of frequencies, a considerable influence of surface mass on the acoustic attenuation index and the transmission coefficient, therefore on the acoustic insulation power. Through the intermediary of the transmission coefficient, more the material is dense in surface more the transmission coefficient is weak; therefore the acoustic insulation power is raised. Indeed, of picks of transmissions in low-frequency (f=125 Hz) and average frequency (f=500 Hz), are notably observable for surface densities relatively weak (figure 5).

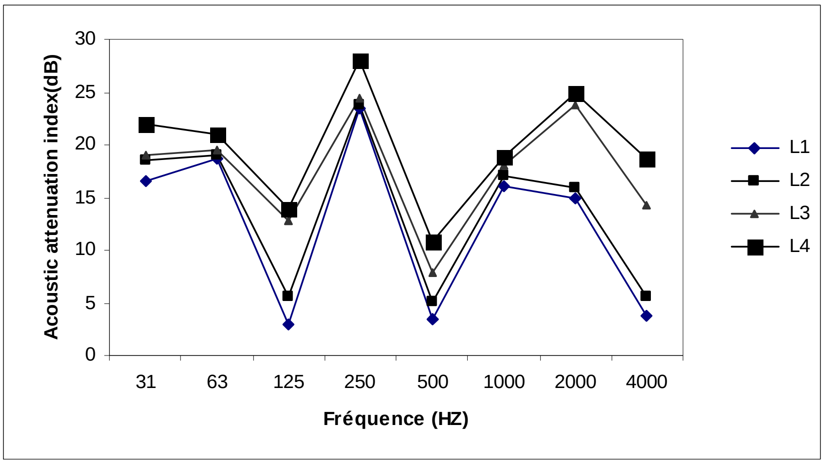

Figure 3.- Acoustic isolation of the cork according to the frequency by strip of octave

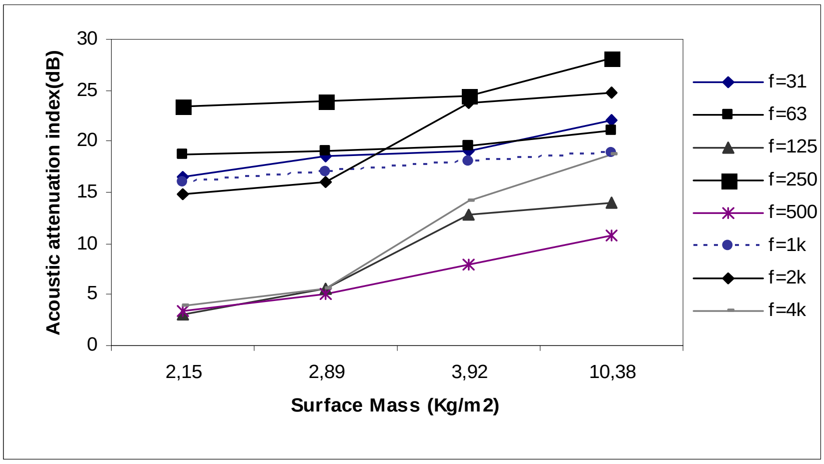

Figure 4.-Acoustic isolation according to surface mass of the cork

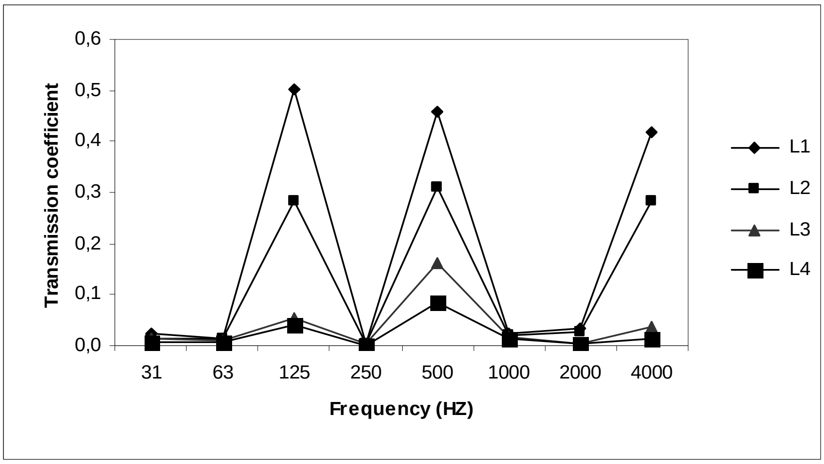

Figure 5.-Acoustic coefficient of transmission of the cork according to the frequency by strip of octave

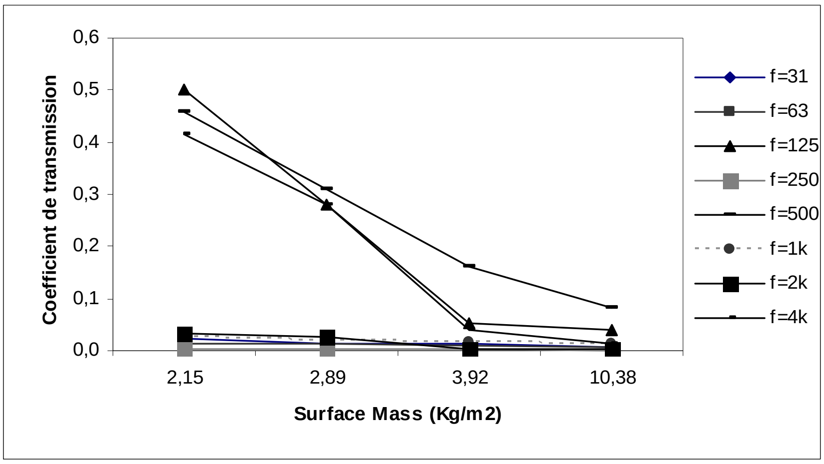

Figure 6.-Acoustic coefficient of transmission of the cork according to surface mass

CONCLUSION

The acoustic attenuation index, contribute to a better knowledge of the acoustic behavior of a material. Results of measure show that the degrees of compaction modify their performances considerably, in particular their acoustic features.

The density influences a lot on the acoustic performances of materials of construction and insulation. So the least porous materials (dense and absorbing) have a high acoustic insulation power. Of or the necessity of a complete characterization of the acoustic sizes, that is going to permit us to consider the versatile side of this material (cork), that can serve the thermal and acoustic insulator at a time while preserving some correct mechanical properties.

References

[1] B. Grehant, Acoustique et Bâtiment, technique et documentation Lavoisier, paris (1994).
[2] J.V.PARTICIO: Acustica de edificios : indices de isolamento a sons de percussão utilizados no espaço europeu. Revista de Acustica. Vol. 36. N°1y 2.
[3] CEN: Comité Européen de Normalisation-Acoustics: Measurement of sound insulation in buildings and of building elements. Part 6: Laboratory measurements of impact sound insulation of floors. En ISO Standard 140-6,(1998).
[4] J.V.PARTICIO: Isolamento sonoro a sons aéreos e de percussao.Metodologias de caraterização. Lisboa, LNEC, (1999).
[5] J.S. Bradley, K. Lay et S.G. Norcross: Mesures de l'isolation acoustique d'une habitation à ossature de bois soumise au bruit d'aéronefs, Rapport interne de l'IRC, IRC IR-831F, (2002).
[6] V. CEREZO: Propriétés mécaniques, thermiques et acoustiques d'un matériau à base de particules végétales : approche expérimentale et modélisation théorique, Thèse de Doctorat, Lyon (2005).

Nomenclature

D: Acoustic attenuation index.
L_i: Acoustic level of emitted intensity, dB;
L_t: Acoustic level of transmitted intensity, dB;
I_i: Emitted acoustic intensity, W/m^2;
I_t: Transmitted acoustic intensity, W/m^2;
I_0: Acoustic intensity of reference, 10^{-12} W/m^2.
τ: Acoustic transmission coefficient.