ALUMINIUM METALLIC FOAMS: A COMPETITIVE CANDIDATE FOR NOISE CONTROL APPLICATIONS IN CONSTRUCCION

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Oral Presentation Prefered

Regardless of porosity, pore size and pore shape, two kinds of metallic foams are existent depending on the fabrication methods: closed pore and open pore foams. “Closed pores” are surrounded by material wall and each pore is isolated, which are usually filled with gas, while “open pores” are pores connected to each other in space. The majority of metal foams in the market are closed-cell aluminium foams manufactured by different process.In the last years, these metallic foams have become an attractive research field both from a scientific viewpoint and from the prospect of applications in several fields. In particular, in lightweight design and construction, steel structures often are replaced with hybrids containing a high proportion of metallic foams. Significant weight reduction potential is achieved, as the pore structure of the material makes it possible to lower density. Other properties, such as the acoustics of the component, play also an important role in developing the finished product.

During the last years we have investigated the acoustical properties of aluminium foams fabricated by means the powder metallurgical technique (closed pores) and aluminium foams fabricated by the infiltration process (open pores). The absorption coefficient at normal incidence of the aluminum foams has been measured in the impedance tube following standard ISO 10534-2:1998. During the measurements, the foam samples were placed either directly against the back plate, with an air gap to the back plate in the impedance tube and also combined with a mineral fiber panel. The sound absorption coefficient at normal incidence was measured as a function of the pore size and of the thickness in the frequency range between 50 Hz and 6500 Hz. The main objective of this work has been to analyze the possibilities of using these aluminum foams for noise control in construction.

The aluminium foams fabricated by means the powder metallurgical technique present a good acoustical behaviour but their inconvenient is a structure very inhomogeneous and a difficult reproducibility during the fabrication process. And the sound absorption coefficient is clearly depending on the cavity morphology of each of the aluminium foam.

The foams fabricated by means the infiltration process present a porosity of around 65 % and different pore sizes. So the acoustical differences observed among the foams are also mainly attributed to the effect of pore size. The aluminium foams with the smallest pore size (0,5 mm) exhibit the best absorption capacities. If the cavities have a small diameter, then this lead to a greater resistance and so greater dissipation of the sound wave, resulting ultimately in a greater absorption of sound. They show a very homogeneous structure combined with a low cost production process that allows an easy fabrication of the aluminium foams with different pore size and so, with different thermal and acoustical properties.

We have chosen these two possibilities because these are usual solutions used in controlling noise and reverberation time in rooms. To perform this kind of experiments with the aluminium foams fabricated by means the powder metallurgical technique we have reduced the thickness of the samples down to values where we are sure that some of the cavities go through the foams. We have mainly worked with 5 and 10 mm thick aluminium foams. The measurements show that the effect of the mineral fiber is raising the maximum absorption peak respect to the value of the foam and a displacement a low frequencies. In this line, the low corrosion of aluminum and easy cleaning could make these foams suited to be used with a mineral fiber in internal spaces to control the reverberation time.

In order to enhance the sound absorption in the low frequency range, an air gap between the face of the material and the rigid surface becomes effective. Introducing an air gap is a usual practice in construction in order to improve acoustical or thermal properties of the constructive system. While the sound dissipation mechanism in the open-cell foams are principally viscous and thermal losses when there is no air-gap backing, it seems predominantly Helmholtz resonant absorption when there is an air-gap backing. In this line, this behavior offers the possibility of using these aluminum foams as selective low-frequency absorptive systems. The resonant frequency of the resonator can be selected combining the foam with an air gap. Another possibility is to combine in the same foam two different pore sizes in a consecutive way. In this last case, the combination of two different pore channels can also be regarded as a Helmholtz resonator, with the small pore size channel as the neck and the high diameter pore channel as the cavity. Only the infiltration technique allows the fabrication of this kind of structure.

The aluminium foams fabricated can be a competitive candidate for noise control applications in different sectors, between them the construction sector. The aluminium foams offer a novel aesthetic that together with their sound absorptive and insulating capacities has drive to use these materials as roofs and walls in different kinds of construction. Also some modern buildings start to décor the façade with different light and rigid panels that are fabricated with aluminium foams. In practical applications, however, other properties as durability and fire resistance of these materials have been also considered. Other advantage of these materials compared to other acoustical materials as polyester, glass fiber is the aluminium foam is eco-friendly and 100 % recyclable while the other two materials have not easy recyclability.

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