BROADBAND ACOUSTIC ABSORBER PANEL

Sid-Ali Meslioui
Aiolos Engineering Corp.
51 Constellation Court, Toronto, Ontario, Canada, M9W 1K4

This paper describes how the absorption bandwidth of a conventional acoustic panel can be expanded to the low frequency domain by coupling it to a reactive panel. The coupling of the two systems is accomplished by a judicious choice of the material properties, an air gap layer, and a proper dimensioning of the Helmholtz resonators (cavity dimensions, plate thickness, hole diameter) with the plate resonators (plate resonator type) [1]. The peaks of resonance are combined in order to widen the absorption bandwidth and thus cover the low frequency range. Different combinations have been tested in impedance tube and a design program has been developed and validated.

VALIDATION

Different samples consisting of single and double layer resonators have been made with different materials and have been tested in an impedance tube by the two microphone technique [2].

The calculation method of the absorption coefficient and the acoustic impedance is based on transfer impedance procedures. The impedance of the overall system is evaluated in stages. The impedance is transferred from one layer to another until the final passive layer which may have a protective skin or a perforated plate.

The "plate resonator" impedance is calculated by solving the equations for the plate motion. The firsts modes of vibrations are then determined and the impedance is calculated [3]. The impedance of the plate resonator is combined with the Helmholtz resonators impedance. The passive layer impedance is calculated using Allard's and Delany & Bazley's models [4,5] in case of a fibrous material. For an elastic porous material, a semi-empirical model is used [6].

The panel's absorption characteristics are dependent on the following:
- two coupled resonance given by the Helmholtz resonance and by the combination of the plate stiffness and volume stiffness of the cavity
- additional coupling of these two resonances by a passive layer of porous or fibrous material
- exact tuning of the system as influenced by the air-gap between the passive layer and the resonators which in turn depend on the material density and its thickness

The coefficients are evaluated from the mass, stiffness and internal damping of the panel, the stiffness of the cavity, the air gap and the characteristic parameters of the passive material.

CONCLUSION

The prediction scheme developed to evaluate the absorption coefficient of a layered passive/reactive absorption panel was validated by conducting impedance tube tests. An example of test results compared to the prediction of the absorption coefficient of a double layer resonator is shown in figure 1. The results show the prediction...
compares well with actual test data. Figure 2 shows an example of
test results of a passive/reactive system absorber. Furthermore, it is
important to mention that the passive system absorber can also be
coupled to a plate resonator system alone. The cavity’s volume of
the plate resonator can be filled with porous or fibrous material to
increase the absorption.

In real applications, the panels will be tuned to different frequencies
to ensure a high absorption over the frequency range of concern.
The proposed broadband absorber acoustic panels would present a
mean absorption coefficient of 0.8 to 1 from 50 Hz to 10 kHz.

REFERENCES

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