比翱工程实验室
ProBiot Laboratory

Sorrento SAPEM'23 常熟

Experimental investigation of a simple Meta-Structure's sound absorption installed in different impedance tubes

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Motivation

- The effect of boundary conditions on the test
- Helmholtz resonator (HR) embedded in different shape
- Guide the use and testing precision of Meta-Structure

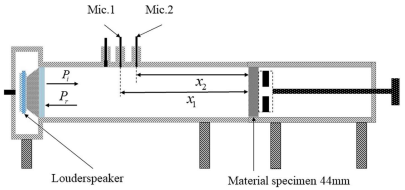
Materials & Methods

1. The Meta-Structure sample was manufactured by 3D printing method
2. Two samples were manufactured from two types resin, which is with different density
3. Sound absorption coefficient test according ISO 10534-2 transfer-function method by using circular(44.44mm) and square(38.1mm) impedance tube

$$P_1 = P_I e^{j(\omega t - kx_1)} + P_R e^{j(\omega t + kx_1)} \qquad P_2 = P_I e^{j(\omega t - kx_2)} + P_R e^{j(\omega t + kx_2)}$$

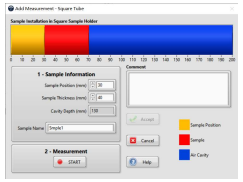
$$H_{12} = \frac{P_2}{P_1} = \frac{e^{-jkx_2} + R\,e^{jkx_2}}{e^{-jkx_1} + R\,e^{jkx_1}} \qquad H_I = \frac{P_{2I}}{P_{1I}} = e^{-jk(x_2 - x_1)} = e^{jks}$$

$$R = \frac{H_I - H_{12}}{H_{12} - H_R} e^{-j2kx_1} \qquad \alpha = 1 - R^2$$



Schematic of the two microphone impedance tube

Square tube sample holder and measurement parameter input interface

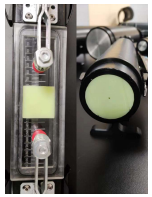


Circular impedance tube with 44.44 diameter

Square impedance tube with 38.1mm side-length

Experiments & Simulation

Samples



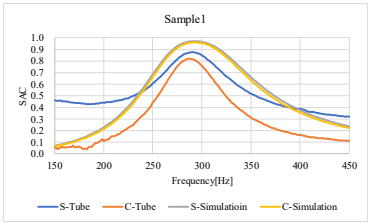
Square

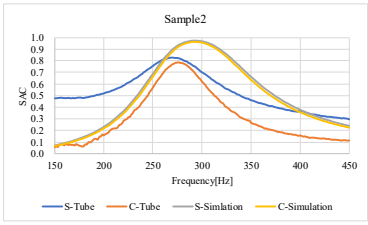
Circular

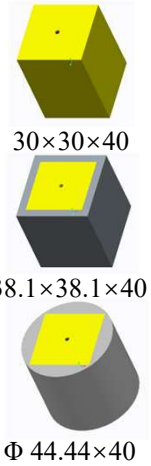
Square

Circular

Results







1. The experimental results were test by two types impedance tubes
2. Experiments according transfer function and simulation according FE method analysis

Conclusion

1. Square and circular samples have no effect on the simulation results and with good agreement
2. The test results of different section ratios differ greatly, and results of the section ratio of 62% are higher than that of 52%
3. The SAC peaks of the simulation and test results are not exactly the same, and the experiments are often smaller than the tests

Acknowledgement

Thanks to Dr. Lu for his support, the experiments for this work were performed at the CAV Acoustic Inspection & Test Center (AIT).