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INTEGRATION OF ACOUSTIC METAMATERIALS MADE OF PLASTIC TO IMPROVE BUILDING ACOUSTICS

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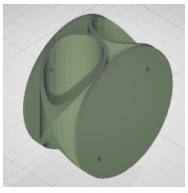
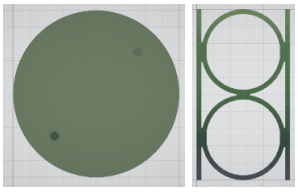
Abstract – According to the Waste Management Policy of the European Union, the recycling and reuse of various wastes is considered the most environmentally friendly and advanced waste disposal technology that has the least impact on the environment. By applying the principles of the Circular Economy, plastic waste will extend its life cycle and will be used as secondary materials to create metamaterial structures with improved sound absorption and insulation properties. Acoustic metamaterial resonators created from plastic were measured in an impedance tube according to standards ISO 10534-2 for their sound absorbing and ASTM E2611 for their insulating properties. Two types of plastic, PLA and recycled PET-G, were used in acoustic metamaterial 3D printing process. Sound absorption of both PLA and PET-G metamaterials was peaking at 1600 Hz with 0.93 and 0.89 sound absorption coefficient, respectively. For sound insulation, combined resonator systems were used to control symmetrical wall sound resonance. The aim of this study was to determine plastic potential for use in acoustic structures. The results showed that combined constructions with plastic metamaterials can be integrated into building structures and used as an alternative for improving building acoustics, reducing indoor noise and reverberation time.

Keywords – Sound absorption coefficient; sound transmission loss; Circular Economy; plastic waste; resonator

Axonometry	Front and side view	Sample code	Description
		O_L1.5_d1.5	O-shaped combined resonator with air gaps. Designed to act as a Helmholtz resonator. It has two holes (necks) on each side, so it can absorb longer waves (lower frequency). The neck length of this resonator is 1.5 mm and the diameter is 1.5 mm

Example of 3D printed acoustic metamaterial resonator.

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