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MATHEMATICAL MODELING AND SIMULATION OF ACOUSTIC PROPERTIES OF KNITTED FABRICS BACKED BY AN AIR CAVITY

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Noise pollution has become a critical issue in the modern world of ever-increasing industries and machinery. Noise should be controlled due to the physical and psychological health effects associated with noise. Textiles as lightweight and cost-effective porous structures have received increasing interest for acoustic controlling applications. In-room acoustics, knitted fabrics represent a strong source of innovation due to drapability and aesthetic appearance. However, in general, the sound absorption performance of knitted fabrics is relatively low. Therefore, the primary goal of this work is to enhance sound absorption by introducing an air gap between the fabric and a solid wall. The diffuse incident sound absorption coefficient of knitted fabrics was mathematically modeled and simulated using basic equations of fluid dynamics where the fabric is acoustically described by its porosity, thickness, density and airflow resistivity. The air gap varied from 10 to 25 mm in 5 mm increments. Modeling predictions were compared with the experimental data obtained from the literature for sound absorption of knitted fabrics. The modeling predictions were in good agreement with the experimental data for different values of air gap thicknesses. The simulation results indicated that when the air layer thickness increases, the sound absorption coefficient of knitted fabrics increases significantly at low frequencies. The peak value of the sound absorption coefficient moves in the direction of a lower frequency. The sound absorption coefficient reached a maximum value of 0.45 at a resonance frequency equivalent to the quarter wavelength of the air layer thickness.

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