Analysis on Multiple Perforated Plate Sound Absorber Made of Coir Fiber

Md. Ayub

Department of Mechanical and Materials Engineering, Universiti Kebangsaan Malaysia, 43600, UKM Bangi, Selangor, Malaysia
Now working with School of Mechanical Engineering, The University of Adelaide, SA 5005, Australia.

Mohammad Hosseini Fouladi

School of Engineering, Taylor's University, 47500, Subang Jaya, Selangor, Malaysia

Masomeh Ghassem

Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600, UKM Bangi, Selangor, Malaysia

Mohd Jailani Mohd Nor

Department of Mechanical and Materials Engineering, Universiti Kebangsaan Malaysia, 43600, UKM Bangi, Selangor, Malaysia

Hamidreza Soheili Najafabadi

School of Industrial Engineering, Iran University of Science and Technology, Narmak, Tehran, Iran

Nowshad Amin

Department of Electrical, Electronic and System Engineering, Faculty of Engineering & Built Environment, Universiti Kebangsaan Malaysia, 43600, UKM Bangi, Selangor, Malaysia
Center of Excellence for Research in Engineering Materials (CEREM), College of Engineering, King Saud University, Riyadh 11421, Saudi Arabia

Rozli Zulkifli

Department of Mechanical and Materials Engineering, Universiti Kebangsaan Malaysia, 43600, UKM Bangi, Selangor, Malaysia

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Current studies are aiming to improve the sound absorption of coir fiber by implementing combinations of Perforated Plates (PPs) and air gaps. The Atalla and Sgrad model along with Johnson-Allard model and Acoustic Transmission Analysis (ATA) approach are used to estimate the absorption coefficient of the combination. Measurements are conducted in impedance tube to validate the analytical results. Outcomes show that the absorption coefficient of the panel is governed by the porosities of the implemented PPs. Reduction in the porosity of the face PP causes the incident sound to reflect back whereas higher porosity encourages the sound to enter and be absorbed gradually in the inner compartments. For the case of multilayer panels with two PPs, the best result is obtained when the inner PP has low porosity and is backed with an air gap. Absorption in high and low frequency bands are enhanced by having highly porous material and a thick layer of air gap in front of and behind the inner PP, respectively. This study shows that the high-frequency absorption is enhanced further in panels that include three PP layers. The study suggests fabricating panels containing two or three PPs with gradual reduction of porosity from the face PP to the inner ones, while the inner most PP has low porosity and is backed with air gap.

1. INTRODUCTION

In previous studies on acoustic characteristics of coir fiber,[1–3] it is shown that the absorption coefficient can be improved by using different techniques such as implementation of air gaps and Perforated Plate (PP). However, the thickness of the panel was found to be too large for limited spaces, and the utilization of PPs and air gaps did not improve the low and medium frequency absorption at the same time. For instance, absorption of coir fiber in different arrangements involving single PP and air gap are illustrated in Fig. 1. For 50 mm coir fiber, the absorption is higher than 75% in the medium and high frequency ranges, while addition of a 35 mm air gap promotes the absorption peak towards low frequencies. Addition of a PP with an air gap enhanced the absorption further in the lower region, but at the same time reduced it at mid and high frequency bands. The best result was observed when PP was placed in between the coir fiber and the air gap, but the thickness of 86 mm for the panel was too large for practical applications. Having the upper face of coir fiber without coverings was not suitable for an absorber composed of fibrous material since it could be a potential health risk factor.

Numerous studies were carried out to improve the sound ab-