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Effect of Installation Method and Thickness on the Sound Absorption Performance of Melamine Foam

Youngjae Chun[1] **Sunjoong Kim**[1] **Sungchan Lee**[2*]

[1] Department of Architectural Engineering, Kangnam University, Republic of Korea
[2] Division of Real Estate and Construction Engineering, Kangnam University, Republic of Korea

ABSTRACT

This study investigates the sound absorption performance of melamine foam, a common porous acoustic material. The objective was to evaluate the effect of specimen thickness and installation conditions. Tests were conducted in a 325.0 m³ reverberation room using specimens with a surface area of 10.50 m² and thicknesses ranging from 10 mm to 100 mm in 10 mm increments. To assess the influence of edge effects, three different mounting configurations were applied: untreated edge, profiled edge, and flush-mounted. The absorption coefficients were calculated based on reverberation time measurements with and without the specimens, using both the projected area alone and with the edge surface included. Results showed that absorption increased with specimen thickness, with a linear trend at 250 Hz and a logarithmic trend at higher frequencies. For untreated edges, coefficients exceeding 1.0 were observed in specimens thicker than 50 mm, attributed to additional absorption from the exposed edges. In contrast, the profiled edge yielded results comparable to the flush-mounted configuration, indicating reduced edge effects. These findings emphasize the importance of considering both material thickness and mounting method when evaluating sound absorption performance under ISO 354 conditions.

Keywords: *Porous absorber, Sound absorption, Edge effect.*

[*]***Corresponding author***: *sclee@kangnam.ac.kr*

1. INTRODUCTION

Evaluating the sound absorption performance of building materials is essential for controlling the acoustic environment of indoor spaces and ensuring acoustic comfort [1]. According to ISO standards, the sound absorption properties of building materials can be assessed using either the reverberation room method or the impedance tube method, each offering distinct advantages depending on the testing conditions [2-3]. The ISO 354:2003 standard specifies a method for measuring the sound absorption of materials in a reverberation room under diffuse field conditions. This method enables the evaluation of absorption coefficients by comparing the reverberation time of the room with and without the test specimen installed. However, the ISO 354 method can be influenced by edge exposure due to the thickness of the material, which may affect the measured sound absorption [4]. Therefore, in this study, the sound absorption performance of melamine foam was measured with increasing thickness according to the ISO 354 method. Additionally, three different installation configurations were applied to investigate the effect of mounting conditions on the absorption coefficient.

2. METHOLOGY

In this study, the sound absorption characteristics of melamine foam, a widely used porous sound-absorbing material, were evaluated in a reverberation room with a volume of 325.0 m³, in accordance with the ISO 354:2003 standard. Test specimens with a surface area of 10.50 m² (width 3.0 m × length 3.5 m) were assessed at thicknesses ranging from 10 mm to 100 mm, in 10 mm increments. To examine the potential influence of edge effects on the measured absorption coefficients, the specimens were installed in three distinct configurations within the reverberation room, as shown in Figure 1.

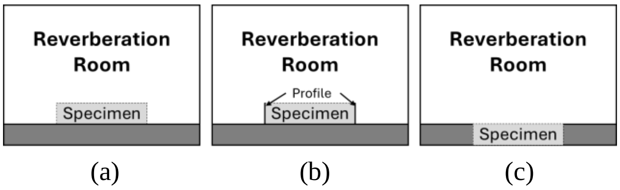

Figure 1. Installation types of specimens: (a) untreated edge, (b) profiled edge, (c) flush mounted.

3. RESULTS

The sound absorption coefficients were calculated, as shown in Figure 2, by measuring the reverberation time in the room with and without the specimen installed, in accordance with ISO 354:2003. The projected area of the specimen was primarily used for the calculations. For the untreated edge condition, two cases were considered: one using only the projected area and the other including the exposed edge surface area.

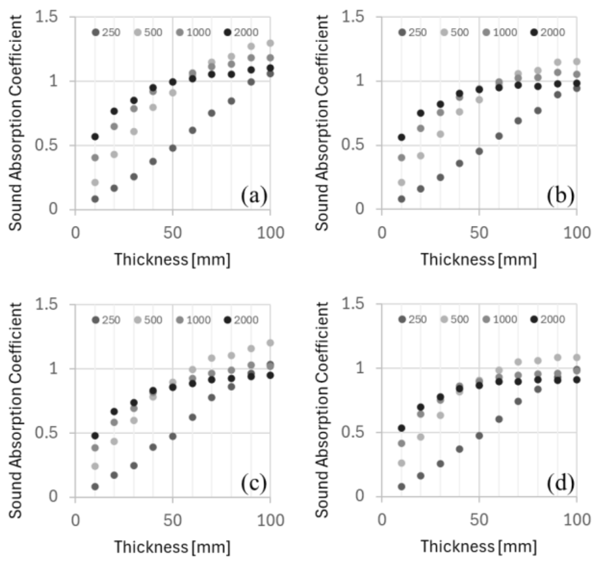

Figure 2. Sound absorption coefficient results: (a) projected area, untreated edge; (b) projected area + edge surface, untreated edge; (c) projected area, profiled edge; (d) projected area, flush-mounted.

Across all frequency bands, an increase in specimen thickness resulted in higher absorption coefficients. At 250 Hz, a linear increase was observed, while at higher frequencies, the trend followed a logarithmic pattern. In the untreated edge condition, absorption coefficients exceeding 1.0 were observed for specimens thicker than 50 mm, except at 250 Hz, likely due to the additional absorption caused by the exposed edges. The profiled edge configuration showed a similar trend to the flush-mounted condition.

4. CONCLUSION

This study evaluated the sound absorption performance of melamine foam with varying thicknesses and installation conditions. The results showed that absorption increased with thickness, following a linear trend at 250 Hz and a logarithmic trend at higher frequencies. The untreated edge condition led to absorption coefficients exceeding 1.0 for thicker specimens, indicating a notable edge effect. The profiled edge showed similar results to the flush-mounted case, suggesting that edge treatment can reduce this effect. These findings emphasize the importance of both thickness and mounting method in absorption measurements.

5. ACKNOWLEDGMENTS

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6. REFERENCES

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