Potensi Pemanfaatan Limbah Styrofoam Sebagai Material Pereduksi Bising = The Potentiality of Expanded Polystyrene Waste Utilization as a Noise Barrier Material

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Abstrak

Kebisingan yang dihasilkan dari proses industri dan jalan perkotaan mungkin mencapai tingkat yang berlebihan dan menyebabkan dampak negatif pada kesehatan manusia. Pada situasi ini, barrier biasa digunakan untuk mengurangi dampak kebisingan. Penelitian ini bertujuan untuk pengembangan barrier ramah lingkungan untuk mengendalikan kebisingan industri dan jalan raya perkotaan. Penggunaan daur ulang styrofoam sebagai bahan baku batafoam diharapkan dapat menyelesaikan 2 masalah yaitu polusi suara dan limbah.

Batafoam yang terbuat dari daur ulang styrofoam, agregat halus, semen, dan air memiliki beberapa kemampuan yang unik untuk mengurangi kebisingan. Berbagai campuran semen dan agregat halus (1:4, 1:6, 1:8) yang diproduksi dengan mengganti agregat halus dengan styrofoam sebanyak 0%, 20%, 40%, 60%, dan 80% dari volume. Lima belas prototipe batafoam diproduksi rangkap tiga. Densitas, porositas, kuat tekan, koefisien penyerapan suara (?), Noise Reduction Coefficient (NRC), Transmission Loss (TL), dan Sound Transmission Class (STC) diteliti. Pengujian akustik baik absorpsi maupun TL menggunakan Dua Mikrofon dan Empat Mikrofon Impedance Tubes (tipe 2406) dari Bruel dan Kjael sesuai dengan prosedur standar ISO 10534-2. Rentang frekuensi maksimum adalah 6400 Hz.

Studi ini jelas menunjukkan bahwa densitas dan kekuatan tekan batafoam cenderung menurun sejalan dengan peningkatan persentase styrofoam. Komposisi 1: 6 dengan 60-80% styrofoam dan 1: 8 dengan 40-80% styrofoam tidak memenuhi persyaratan aplikasi struktural, tetapi tetap memiliki kemampuan TL yang baik. Karakteristik akustik batafoam menunjukkan bahwa ? berada di kisaran 0,15-0,29, masuk material peredam kelas E. NRC berada di kisaran 0,18-0,33, masuk bahan nonreflektif.

Kemampuan absorpsi batafoam lebih baik dari beton dan dinding bata. Nilainilai STC berada di kisaran 37-40 dB, memenuhi kriteria desain partisi (1) antara kantor dan kantor yang berdekatan, (2) antara kantor dan eksterior bangunan, (3) antara kelas, dan (4) kelas dengan koridor. Batafoam memiliki TL yang baik (> 45 dB), sehingga sangat potensial sebagai bahan penghalang kebisingan. Batafoam efektif mereduksi kebisingan lebih dari 5 dBA. Biaya penerapan barrier adalah 1 dBA /orang/tahun lebih rendah dari biaya penggunaan APT (dengan skenario penggantian APT sekali / bulan atau 1 kali /3bulan).

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The noise resulted from industrial process and urban road might reach excessive level and lead to negative impact on human health. In this situation, sound barrier were commonly used to mitigate the noise impact. This research aimed at the development of environmentally friendly barrier for noise control on industry and urban freeways. The use of recycled expanded polystyrene (EPS) in the form of batafoam was expected to combat the existing problems of both noise and waste pollution.

The batafoam, which has some unique capabilities to mitigate noise, was made from recycled EPS, fine aggregate, cement, and water. Various mixture of cement and fine aggregate (1:4, 1:6, 1:8) were produced by replacing fine aggregate with EPS as much as 0%, 20%, 40%, 60%, and 80% of volume. Fifteen

prototypes of batafoam were produced triplicate. The density, porosity, compressive strength, sound absorption coefficient (?), Noise Reduction Coefficient (NRC), Transmission Loss (TL), and Sound Transmission Class (STC) were investigated. Two-Microphone and Four-Microphone Impedance rubes (type 2406) of Bruel and Kjael were applied to measure the normal incident absorption coefficient and transmission loss according to the ISO 10534-2 standard procedure. The maximum frequency range of measure was 6400 Hz.

This study clearly demonstrated that the density and compressive strenght of the batafoam tended to decrease as increasing of the percentage of content of EPS. Composition 1:6 with 60-80% of EPS and 1:8 with 40-80% of EPS did not meet the requirements of structural application. The acoustic characteristics of batafoam indicated that ? were in range of 0.15 to 0.29 and were classified as class E of absorbing material. NRCs were in range of 0.18 to 0.33 and were classified as non-reflective material. Those were better than concrete and masonry's sound absorption characteristic.

The STC values were in range of 37-40 dB, which mean they met the design criteria partition (1) between office and adjacent office, (2) between office and exterior of building, (3) between classes, and (4) class with corridor. The batafoam had good transmission loss (>45 dB), so it is potential to utilize the EPS waste as a noise barrier materials. It was effective as well to reduce noise more than 5 dBA. the barrier application cost was 1 dBA/person/year lower than the cost of Hearing Protection Devices use (with once/ month and one/ 3months subtitution).