ABSTRAK

PENGARUH VARIASI KOMPOSISI DAN DURASI PENGGILINGAN BAHAN TERHADAP PEMBENTUKAN *CELLULAR GLASS* BERBASIS *BASALT ROCK* MELALUI METODE *DIRECT FOAMING*

Oleh

Fidhea Pinaring Gusti

Cellular glass merupakan material insulasi ringan berbasis alumina silikat yang memiliki sifat tahan air, api, dan suhu ekstrem. Namun, optimalisasi komposisi bahan baku dan proses pembuatannya masih menjadi tantangan. Penelitian ini penting karena mengusung pendekatan berkelanjutan dengan memanfaatkan sumber daya alam lokal seperti batu basal yang kaya silika, serta limbah industri berupa *fly ash* dan *slag boiler*. Penelitian ini bertujuan mengembangkan *cellular glass* melalui metode *direct foaming*, menggunakan *polyurethane foam* sebagai pembusa dan proses sintering pada suhu 950℃. Variasi komposisi basal (25%, 50%, 75%) dan durasi penggilingan (30, 60, 90, dan 120 menit) diuji untuk mengetahui pengaruhnya terhadap struktur mikro, fasa kristalin, dan sifat fisik-mekanik material. Analisis dilakukan menggunakan XRF, XRD, dan SEM. Hasil menunjukkan bahwa komposisi basal 75% dengan penggilingan 120 menit menghasilkan *cellular glass* terbaik, dengan densitas 0,962 g/cm³ dan kuat tekan 7,603 MPa. Kandungan silika tinggi menghasilkan fasa kristalin dominan seperti cristobalite dan quartz. Sebaliknya, porositas tertinggi (19,15%) ditemukan pada komposisi basal 25% dan penggilingan 30 menit. Penelitian ini berkontribusi pada pengembangan insulasi termal ramah lingkungan berbasis material lokal dan limbah industri.

Kata kunci:
Material ringan, cellular glass, direct foaming, basalt powder, slag boiler

ABSTRACT

THE INFLUENCE OF VARIATIONS IN COMPOSITION AND GRINDING DURATION ON THE FORMATION OF BASALT ROCK-BASED CELLULAR GLASS USING THE DIRECT FOAMING METHOD

by

Fidhea Pinaring Gusti

Cellular glass is a lightweight insulation material based on aluminosilicate that possesses water, fire, and extreme temperature resistance. However, optimizing the raw material composition and manufacturing process remains a challenge. This research is significant as it adopts a sustainable approach by utilizing local natural resources such as silica-rich basal rock, along with industrial waste like fly ash and boiler slag. The study aims to develop cellular glass using the direct foaming method, employing polyurethane foam as the foaming agent and a sintering process at 950℃. Variations in basalt composition (25%, 50%, 75%) and milling duration (30, 60, 90, and 120 minutes) were tested to observe their effects on the material's microstructure, crystalline phases, and physical-mechanical properties. Analyses were conducted using XRF, XRD, and SEM. Results showed that a 75% basal composition with 120 minutes of milling produced the best cellular glass, with a density of 0.962 g/cm³ and compressive strength of 7,603 MPa. The high silica content led to dominant crystalline phases such as cristobalite and quartz. Conversely, the highest porosity (19.15%) was found in the 25% basalt composition with 30 minutes of milling. This research contributes to the development of environmentally friendly thermal insulation based on local materials and industrial waste.

Keywords:
Lightweight material, cellular glass, direct foaming, basalt powder, slag boiler