ABSTRAK

PERAN VARIASI TEMPERATUR PEMBAKARAN SERTA KOMPOSISI BASAL DAN SILIKA GEOTHERMAL SEBAGAI *RAW MATERIAL CELLULAR GLASS CERAMIC* MENGGUNAKAN METODE *DIRECT FOAMING*

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Telah dilakukan sintesis komposit *cellular glass ceramic* menggunakan bahan baku basal dan silika geotermal dengan variasi temperatur pembakaran linear dan non-linear dan komposisi untuk mengkaji pengaruhnya terhadap pembentukan fasa kristalin, morfologi pori, serta sifat mekanis dan sifat fisis. Komposisi yang digunakan adalah rasio basal dan silika geotermal (30%:70%, 50%:50%, dan 70%:30%) dengan temperatur linear (400°C, 700°C, dan 880°C) dan non-linear (400°C, 880°C, 700°C).

Karakterisasi dilakukan menggunakan STA, XRD, XRF, dan SEM, serta pengujian kuat tekan, densitas, dan porositas. Hasil penelitian menunjukkan bahwa temperatur pembakaran linear menghasilkan distribusi pori yang lebih merata, sedangkan non-linear menghasilkan fasa kristalin yang lebih teratur pada temperatur tinggi. Secara keseluruhan, komposisi CG30/70-L dan CG50/50-L memberikan kombinasi terbaik antara isolasi termal, kuat tekan, densitas, porositas, dan struktur kristalin yang stabil.

CG30/70-L didominasi oleh SiO_2 (40,96%), Fe_2O_3 (26,86%), dan CaO (13,78%), dengan fasa utama *halite*, *anorthite*, dan *albite*. Material ini memiliki kuat tekan 35,98 MPa, densitas 1,12 g/cm³, dan porositas 75%. Ukuran pori berkisar 50-100 μm, mendukung isolasi termal yang baik. CG50/50-L didominasi oleh SiO_2 (54,66%), ZnO (3,431%), dan Cl (22,80%), dengan fasa utama *halite, augite*, dan *albite*. Kuat tekan 12,25 MPa, densitas 1,22 g/cm³, dan porositas 68%. Ukuran pori 80-150 μm. CG30/70-L lebih cocok untuk aplikasi isolasi termal dan ketahanan tekanan tinggi, sementara CG50/50-L lebih baik untuk aplikasi pada temperatur tinggi.

Kata Kunci: komposit, *cellular glass ceramic,* basal, silika geothermal.

ABSTRACT

THE EFFECT OF FIRING TEMPERATURE VARIATION, BASALT COMPOSITION, AND GEOTHERMAL SILICA AS RAW MATERIALS FOR CELLULAR GLASS CERAMICS USING THE DIRECT FOAMING METHOD

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The synthesis of cellular glass ceramic composites was carried out using basalt and geothermal silica as raw materials with variations in firing temperatures (linear and non-linear) and compositions to examine their effects on crystalline phase formation, pore morphology, and mechanical and physical properties. The compositions used were basalt and geothermal silica ratios of (30%:70%, 50%:50%, and 70%:30%) with linear temperatures (400°C, 700°C, and 880°C) and non-linear temperatures (400°C, 880°C, 700°C).

Material characterization was performed using STA, XRD, XRF, and SEM, along with mechanical testing for compressive strength, density, and porosity. The results showed that linear firing temperatures produced more uniform pore distribution, while non-linear firing resulted in more regular crystalline phases at higher temperatures. Overall, the compositions CG30/70-L and CG50/50-L provided the best combination of thermal insulation, compressive strength, density, porosity, and stable crystalline structure.

CG30/70-L was dominated by SiO_2 (40.96%), Fe_2O_3 (26.86%), and CaO (13.78%), with the main phases being halite, anorthite, and albite. This material had a compressive strength of 35.98 MPa, density of 1.12 g/cm³, and porosity of 75%. The pore size ranged from 50-100 μm, supporting good thermal insulation. CG50/50-L was dominated by SiO_2 (54.66%), ZnO (3.431%), and Cl (22.80%), with the main phases being halite, augite, and albite. It had a compressive strength of 12.25 MPa, density of 1.22 g/cm³, and porosity of 68%. The pore size ranged from 80-150 μm. CG30/70-L is more suitable for thermal insulation and high pressure applications, while CG50/50-L is better for high-temperature applications.

Keywords: *composite, cellular glass ceramic, basalt, geothermal silica.*