POLITECHNIKA ŚLĄSKA W GLIWICACH

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PRACA DOKTORSKA

„Struktura i własności porowatych pianek szklanych modyfikowanych popiołami lotnymi”

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Abstract

The growing technological and environmental goals associated with the dynamic development of the economy are forcing the implementation of models based on sustainable resource management. The circular economy (CEE) aims to optimize the use of raw materials, mainly recycled ones, which, in the context of materials engineering, is being pursued through, among other things, research into materials recovered from waste. One material with high application potential is foamed glass, which can be produced from waste glass and combustion by-products such as fly ash. This paper presents the results of a study of the structure and properties of porous glass foams produced from recycled materials, determining the effect of different proportions of fly ash on the structure and performance properties of glass foams.

This study investigates the potential of fly ash as a foaming agent in the production of foamed glass from recycled glass cullet. The objective was to determine how varying proportions of fly ash and thermal processing parameters affect the microstructure and properties of the resulting foamed glass. A comprehensive analysis was conducted using advanced techniques such as scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD), micro-computed tomography (micro-CT), and thermal analysis. Results indicated that the addition of fly ash significantly influenced the formation of porosity and the overall microstructure of the foamed glass. The presence of calcite in the fly ash acted as a foaming agent, leading to the formation of a porous structure. The microstructure and phase composition of the foamed glass were found to be sensitive to both the thermal processing conditions and the content of fly ash. The mechanical and thermal properties of the produced foamed glass were correlated with their microstructure. A strong relationship was observed between the density, porosity, and mechanical strength of the materials. The results demonstrated that the thermal conductivity of the foamed glass could be tailored by adjusting the processing parameters and the composition of the starting materials.

The findings of this research highlight the potential of fly ash as a sustainable foaming agent for the production of foamed glass. The ability to tailor the properties of foamed glass by varying the composition and processing conditions offers opportunities for the development of novel materials for various applications, including insulation, construction, and environmental remediation.