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Ceramic Conversion of Geopolymers by Sintering: Influence of Composition and Temperature

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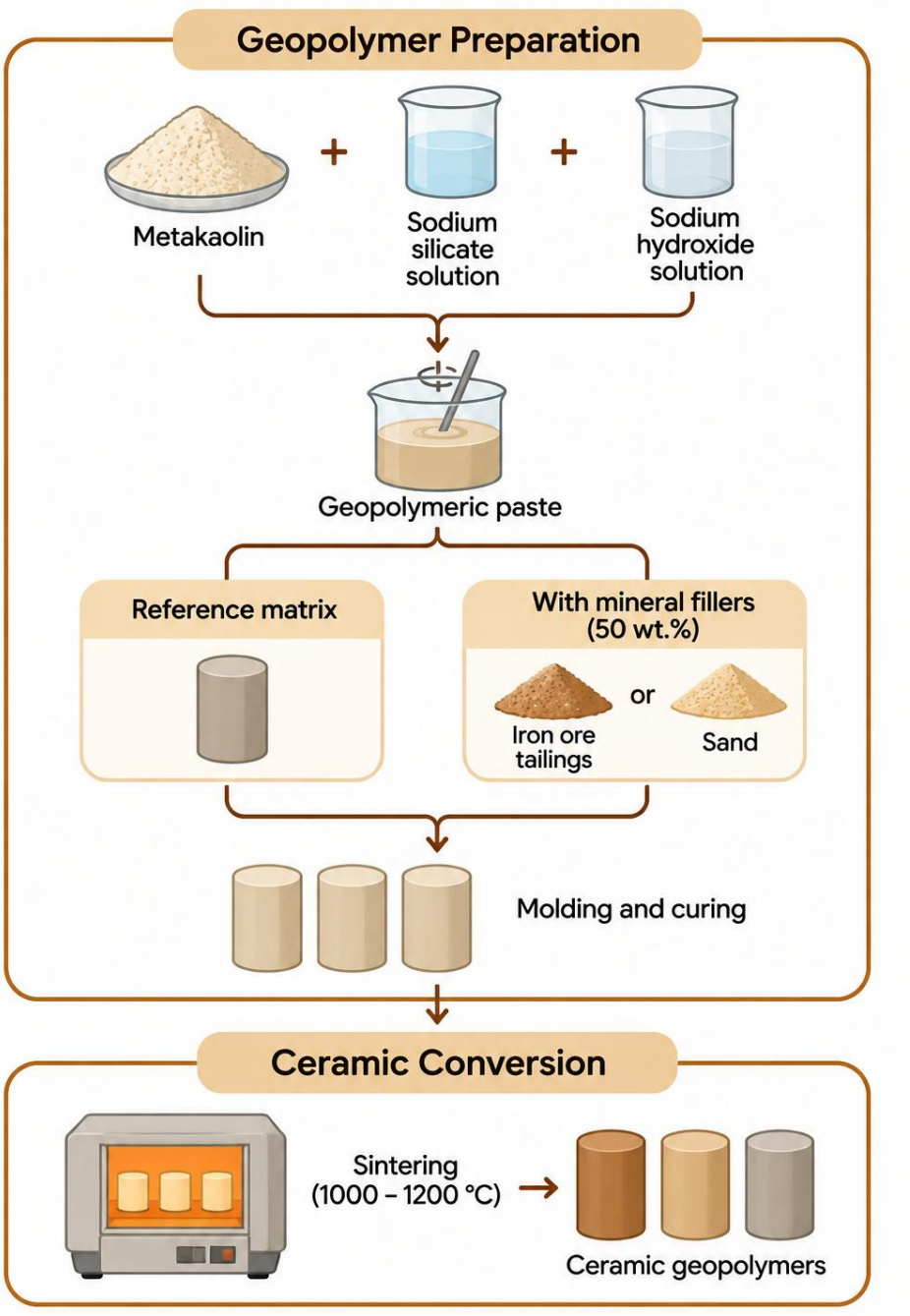
Introduction

Geopolymers are inorganic aluminosilicate materials with potential for conversion into ceramics through thermal treatment. This process promotes structural transformations and crystallization, offering an alternative route for ceramic production. Furthermore, the incorporation of mineral fillers, including mining tailings, may contribute to more sustainable material development.

Objectives

This study aims to investigate the influence of sintering temperature and mineral filler incorporation on the ceramic conversion and structural characteristics of geopolymers.

Methodology



Results and Discussion

Effect of Si/Al molar ratio: Formulations with Si/Al ratios of 2.0–4.0 were evaluated. The Si/Al = 3.2 formulation (Geo32) showed the best structural integrity after sintering.

Effect of sintering temperature: Sintering at 1020–1100 °C promoted ceramic conversion, with XRD confirming nepheline crystallization. At 1200 °C, significant deformation and a broad amorphous hump (20–30° 2θ) suggested partial vitrification.

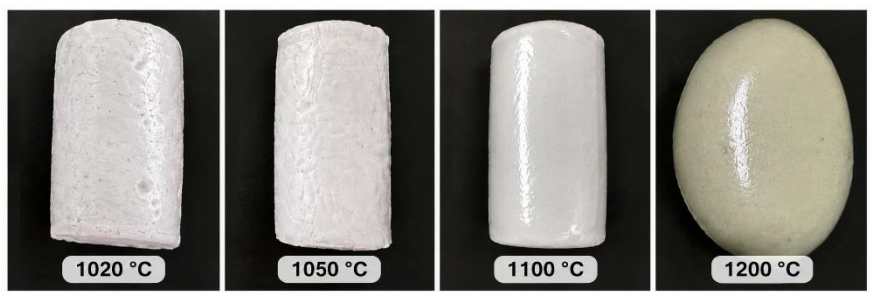


Fig. 1. Visual appearance of Geo32 samples sintered at different temperatures.

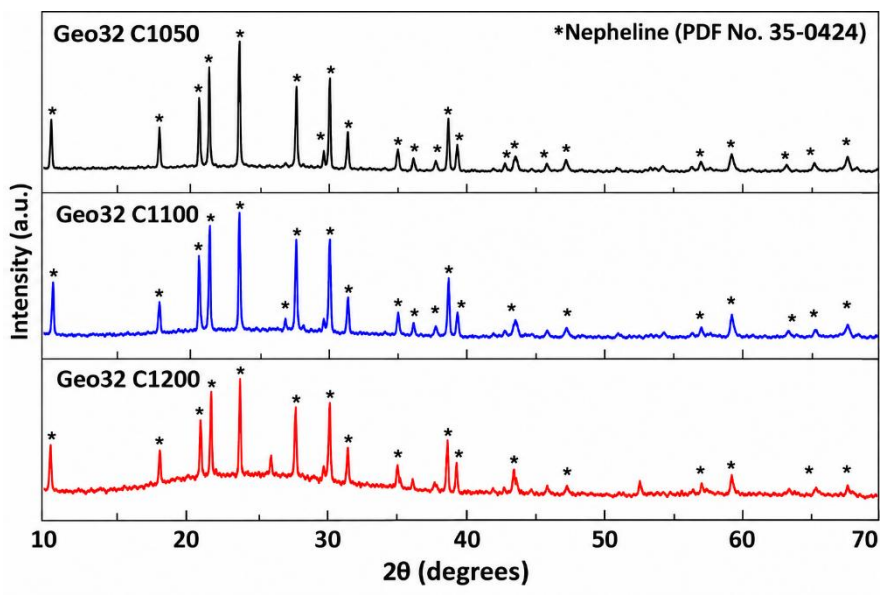


Fig. 2. XRD patterns of Geo32 samples sintered at 1050, 1100, and 1200 °C.

The incorporation of 50 wt.% sand or iron ore tailings produced structurally stable ceramics, with XRD confirming nepheline formation and highlighting the potential for mineral waste valorization.



Fig. 3. Ceramic plates containing 50 wt.% sand (left, 1020 °C) and iron ore tailings (right, 1060 °C) after sintering.

Conclusions

Geopolymer-derived ceramics show promising potential for sustainable applications and mineral waste valorization.

References and Acknowledgments

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