

# GEOPOLYMER-BASED NEPHELINE CERAMICS

Ahmad ROMISUHANI\*1, Mustapa NUR BAHJAH1, Abdullah MOHD MUSTAFA AL BAKRI2, Wan Ibrahim WAN MASTURA1, Wan Mohamed Saimi WAN HASNIDA1

1Faculty of Engineering Technology, Universiti Malaysia Perlis (UniMAP), P.O Box 77, D/A Pejabat Pos Besar, 01000 Kangar, Perlis, Malaysia.

2Center of Excellence Geopolymer and Green Technology (CEGeoGTech), School of Materials Engineering, Universiti Malaysia Perlis (UniMAP), P.O Box 77, D/A Pejabat Pos Besar, 01000 Kangar, Perlis, Malaysia.  
\*bahijahmustapa@gmail.com

## Abstract

Geopolymerization has been explored as an alternative method to produce ceramics with high mechanical strength, as traditional methods require high temperatures and can encounter issues with agglomeration, irregular grain growth, and furnace contamination. This study examined the effects of sintering temperature on the crystallization kinetics of geopolymer ceramics made from kaolin and alkali activator (sodium silicate and sodium hydroxide). The geopolymer is sintered at different temperature; 200°C, 400°C, 600°C, 800°C, 1000°C, and 1200°C for 3 hours soaking time with the heating rate of 5°C/min. Results showed an increase in flexural strength with higher sintering temperature, with a maximum strength achieved at 1200°C and a minimum at 200°C. Microstructure and phase characterization were examined using SEM and XRD, respectively. The XRD analysis indicates that the ceramics contain Nepheline crystalline, which further enhances their properties.

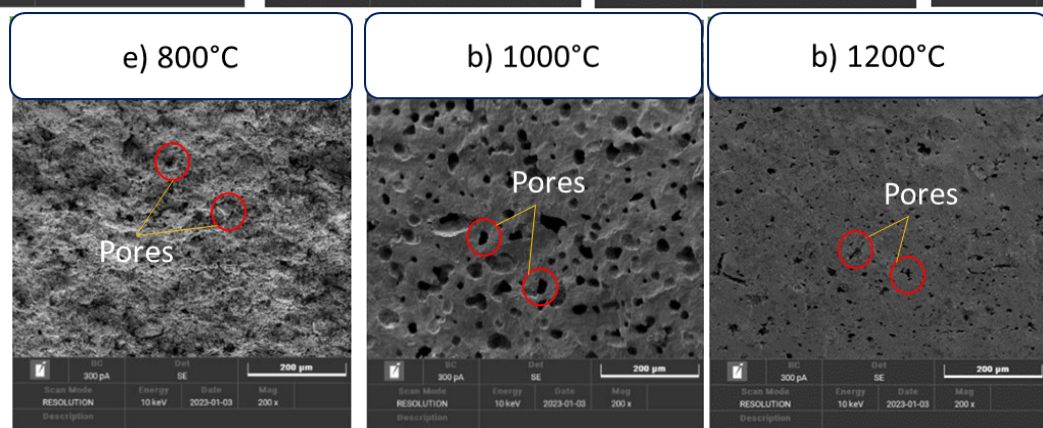
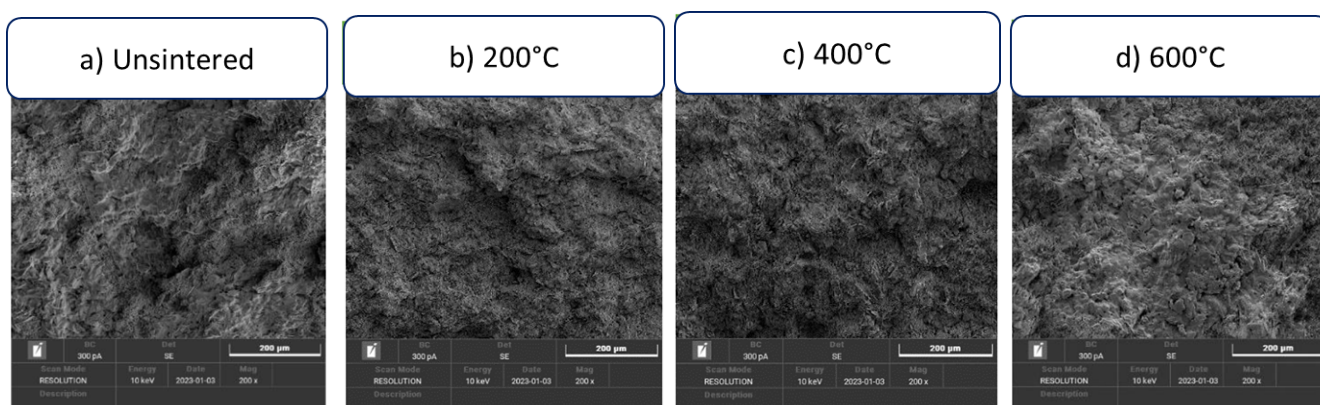
## Description

Geopolymers are an alternative ways of producing ceramics. it is sustainable and environmentally friendly material, used in variety of applications, including infrastructure, building materials, and industrial products. Geopolymer possess high strength and durability, resistance to acid and fire, and low shrinkage. Due to a novel method of synthesizing ceramics with the addition of geopolymer precursor that benefits compressive strength, low permeability, superior chemical resistance, and outstanding fire resistance behavior, the production of ceramics employing geopolymer materials is currently on the rise. Geopolymer ceramics are expected to show a promising performance when sintering at optimum conditions.

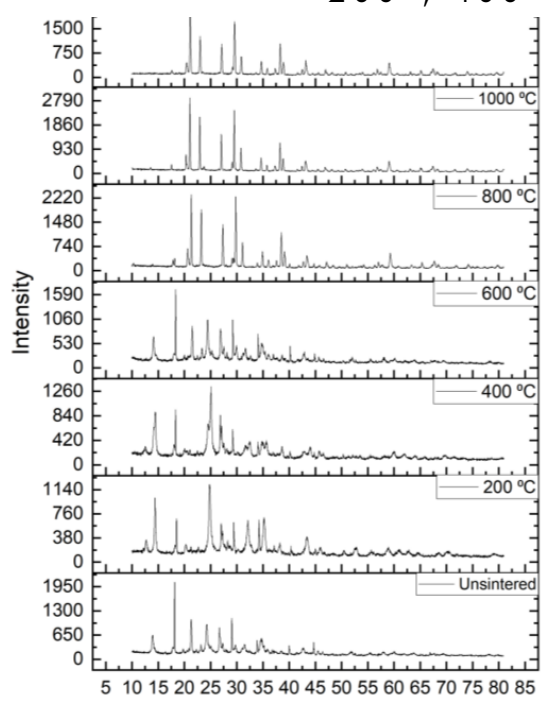
## Objectives

- To study the effect of densification behavior and mechanical properties based on flexural strength.
- To investigate the effect of crystallization kinetics of geopolymer ceramic

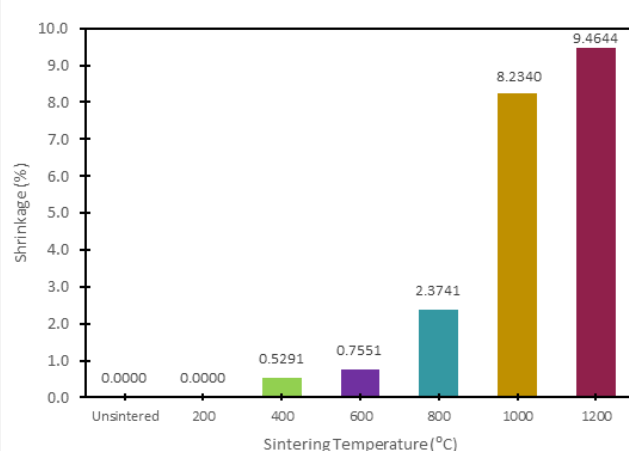
## Result & Discussion



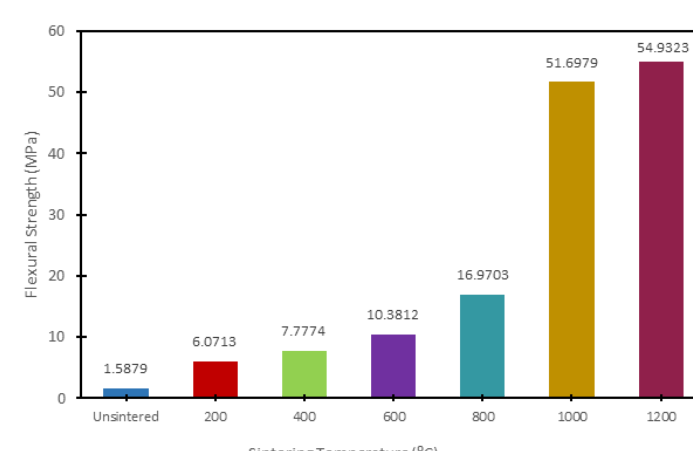
SEM images of unsintered and sintered kaolin geopolymer at 200°, 400°C, 600°C, 800°C, 1000°C, and 1200°C



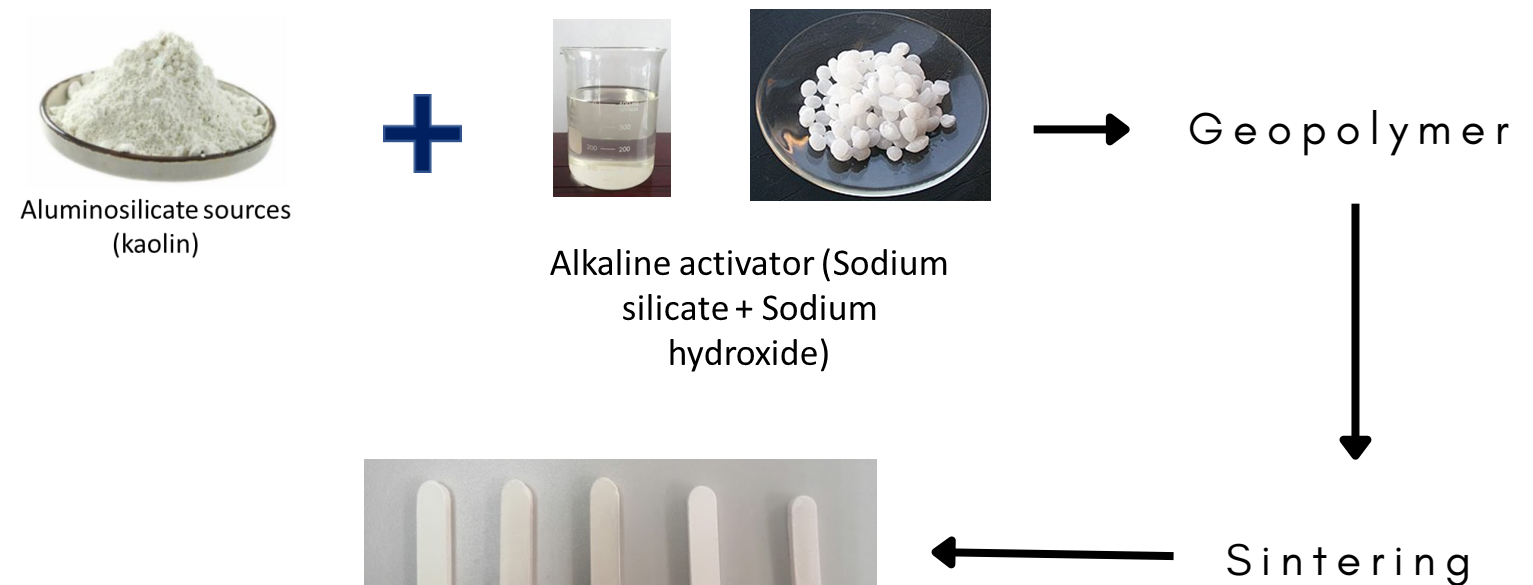
XRD diffraction patterns of geopolymer ceramics at various temperature



Shrinkage and flexural strength obtained when sintered at different sintering temperature



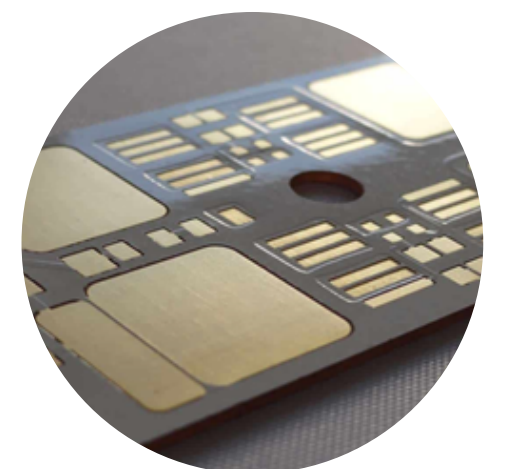
## Methodology



## Applications



Construction



Electronic



Biomedical



Environmental

## Publications

- Ahmad, R., Abdullah, M. M. A. B., Ibrahim, W. M. W., Sandu, A. V., Vizureanu, P., & Tengah, M. S. (2020, June). Comparison Study on Microstructure Properties of Kaolin Based Geopolymer Ceramics with Addition of UHMWPE under Different Sintering Condition. In IOP Conference Series: Materials Science and Engineering (Vol. 877, No. 1, p. 012015).
- Ahmad, R., Al Bakri Abdullah, M. M., Hussin, K., Sandu, A. V., & Binhussain, M. (2019). The Relation between Density and Flexural Strength of Geopolymer Based Ceramic with Addition of Ultra High Molecular Weight Polyethylene (UHMWPE) for Lightweight Ceramics. In Materials Science Forum (Vol. 967, pp. 286-291).
- Ahmad, R., Abdullah, M. M. A. B., Hussin, K., & Ibrahim, W. M. W. (2021). Fabrication of lightweight ceramic materials using geopolymer technology. In Sustainable Waste Utilization in Bricks, Concrete, and Cementitious Materials (pp. 167-189).
- Ahmad, R., Abdullah, M. M. A. B., Ibrahim, W. M. W., Hussin, K., Ahmad Zaidi, F. H., Chairapa, J., ... & Nabiatek, M. (2021). Role of Sintering Temperature in Production of Nepheline Ceramics-Based Geopolymer with Addition of Ultra-High Molecular Weight Polyethylene. Materials 2021, 14, 1077.