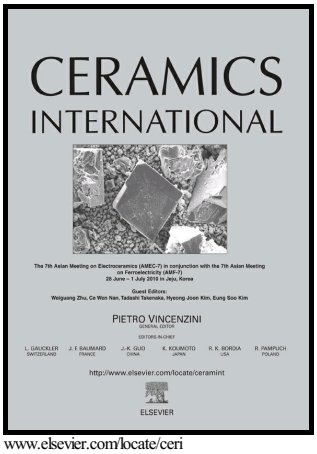

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The impact of heat treatment on the microstructure of a clay-based ceramic and its thermal and mechanical properties

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Abstract

This paper presents the results of an experimental study on the microstructure, the thermal and the mechanical properties of a clay-based ceramic used in building applications. The X-ray tomography analysis showed a layered microstructure of clay with 200µm sheets of porosity after the extrusion process. The gas release from the dehydration, dehydroxylation and decarbonation induced a 7vol% formation of porosity during the heat treatment of the clay-based ceramic up to 850°C. The porosity increase and the development of metakaolin led to a 38% decrease in the thermal conductivity. On the other hand, the Young's modulus of the clay-based ceramic was conserved due to the formation of smaller pores than the 200µm sheets of porosity. The densification and the crystallization of amorphous phases also led to a 110% increase of the Young's modulus from 850°C to 1050°C. The Young's modulus of the clay-based ceramic was only decreased by the β→α quartz inversion of the cooling due to sand addition. Hence, this study provided a useful insight into how the microstructure of fired clay bricks can be specifically transformed by the porosity during the heat treatment to control the thermal and mechanical properties.

Keywords: clay; ceramic; porosity; Young's modulus; thermal conductivity.