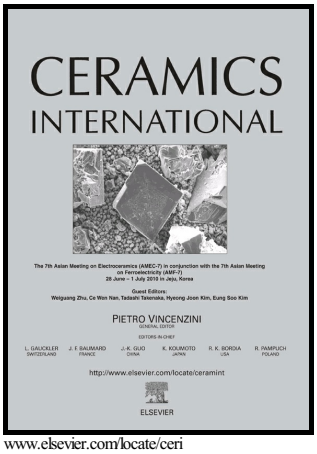

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Thermal conductivity modeling based on physical and chemical properties of refractories

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Abstract

Thermal conductivity (*k*) is one of the most important properties in the design and optimization of refractory linings, as well as for defining safe heating and cooling schedules. Mathematical models for predicting refractories' thermal conductivity have been proposed in the literature but, in general, they were simplified equations focusing on correlating *k* with density, alumina content or temperature. This work addresses the development of general expressions for *k* predictions as a function of physical (density, porosity) and chemical (oxide content) parameters with the temperature for Al_2O_3-SiO_2 and Al_2O_3-CaO-based refractories. The parallel hot wire technique was used to measure the thermal conductivity of insulating, dense and low-cement-containing (LCC) commercial products in the temperature range of 25°C to 1000°C. According to the results, the most suitable mathematical model correlating *k* with the samples' density (apparent, volumetric or geometric) and temperature was the geometric one (r^2 = 97.1%). When considering multi-linear models and the combination of more parameters (oxide content, density, temperature), lower r^2 values were obtained (74.1-75.5%), indicating that this more complex and all-inclusive expression should lead to a less accurate prediction of thermal conductivity values. The advances presented will be a helpful tool for refractory producers and end-users.

Keywords: thermal conductivity, refractory, regression model, physical properties.

1. Introduction