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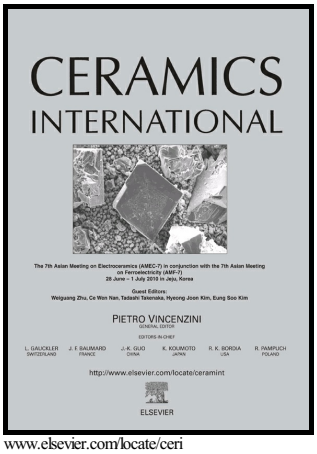

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Maximum working temperature of refractory castables: do we really know how to evaluate it?

A. P. Luz[1,*], D. T. Gomes[2], V. C. Pandolfelli[1]

[1]Federal University of São Carlos, Materials Engineering Department, Rod. Washington Luiz, km 235, São Carlos, SP, 13565-905, Brazil

[2]Petrobras, Research and Development Center, Rio de Janeiro, RJ, 21941-915, Brazil

*Corresponding author at: Tel.: +55-16-33518253; fax: +55-16-33615404. anapaula.light@gmail.com

Abstract

Refractoriness under load (RUL) tests are usually indicated to evaluate the maximum working temperature that refractory materials can withstand by measuring their linear dimensional change when subjected to compressive stress. Nevertheless, ASTM C832 and ISO 1893 standards do not point out which sort of samples (pre-fired or not) should be used during the measurements of this property. Thus, this study addresses the evaluation of different refractory castable systems, focusing on analyzing calcined (fired up to 600°C for 5h for the decomposition of the hydrated phases) or pre-fired (1550°C for 5h) samples in order to identify the effect of the material's thermal treatment on the RUL results. Additional properties (i.e. linear expansion change, apparent porosity and cold flexural strength after firing at different temperatures) of the designed compositions were also evaluated. Based on the results, it can be concluded that the maximum working temperature of monolithics should not be assessed via one single test (i.e. RUL), but only a set of techniques (RUL, dilatometry, assisted sintering, creep and others) can provide useful data to better understand the refractories performance. RUL measurements should be carried out after a preliminary sintering step of the castables (where the selected firing temperature might be as close as possible to the expected $T_{0.5}$) to enable most of the microstructural changes resulting from heating up and sintering could already have taken place. Furthermore, it is most likely that numerical solutions (modeling) could help to better understand and interpret the multivariable aspects of this complex issue. However, reliable and accurate values of the refractory properties (based on well-selected tests) must be fed to the software to permit calculations that yield meaningful and accurate results, and conclusions.