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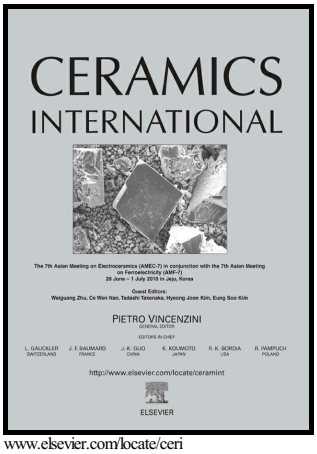

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ACCEPTED MANUSCRIPT

Solid-state synthesis of mullite from spent catalysts for manufacturing refractory brick coatings

Fabio Vargas[a*], Edward Restrepo[a], Jhon E. Rodríguez[a], Freddy Vargas[b], Lizeth Arbeláez[a], Pablo Caballero[a], Jhoman Arias[a], Esperanza López[a], Guillermo Latorre[c], Gloria Duarte[c]

[a]University of Antioquia, GIPIMME, 050010, Medellín, Colombia

[b] Industrial University of Santander, 680002, Bucaramanga, Colombia

[c] Colombian Petroleum Institute, ICP-ECOPETROL S.A, 681011, Piedecuesta, Colombia

ABSTRACT

This paper shows the results of the solid-state synthesis of mullite from spent catalysts discarded from fluid catalytic cracking (FCC); the catalysts are mainly composed of silica and alumina but are polluted with SO_X, forming a non-crystalline network. The synthesized mullite was used as a feedstock to thermally spray a coating onto a silica-alumina refractory brick, and its chemical resistance at high temperature was subsequently evaluated by contact with K_2CO_3 at 950 °C. Initially, the spent catalyst was thermally treated for 2 h at 600, 900, and 1200 ºC to eliminate the SO_X pollutant. The heat treatment at 1200 °C completely removed the SO_X in the sample. Additionally, four thermal processes were performed by heating the spent FCC catalyst in an electrical furnace to 1500 and 1600 ºC and by using an oxyacetylene flame to synthesize mullite. Thermal treatments at 1500 ºC were performed with and without alumina added to the spent FCC catalyst, whereas those conducted at 1600 ºC and using a flame were performed using only added alumina. In the powders thermally treated at 1500 °C, silica-rich mullite ($3Al_2O_3.2SiO_2$) accompanied by an excess of alumina or silica was obtained with or without alumina added, respectively. In contrast, the materials treated at 1600 °C formed alumina-rich mullite ($2Al_2O_3.SiO_2$), which was accompanied by an excess of alumina. Mullite was not synthesized in the flame-heated powder. The silica-rich mullite accompanied by an excess of alumina was used as feedstock powder to modify the surface of a refractory brick, improving its resistance to chemical attack by K_2CO_3 at high temperature.

Keywords: Mullite synthesis, Waste catalyst, Ceramic coating, High-temperature chemical resistance.

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