Effects of Milling pH and Hydrothermal Treatment on Formation of Nanostructured Boehmite Binder for Alumina Extrusion

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Organic binders are added to ceramic powders as forming additives and are eliminated during firing as gases that contribute to greenhouse effect. Such environmental impact could be reduced by replacing organic by inorganic binders. The *in situ* formation of aluminum hydroxides on alumina particles which can work as inorganic binders was investigated, considering the effects of pH during milling of an alumina powder followed by hydrothermal treatment. A low soda alumina powder was ball milled in three pH conditions: basic (pH 9.2 to 10.3); acid-basic (pH 4.1 to 8.4); and acid (pH 4.0 to 4.2). Structural analyzes indicated the formation of bayerite [$Al(OH)_3$] on the surface of powders milled in basic and acid-basic conditions, but not in acid condition. After hydrothermal treatment, all the bayerite was converted to boehmite (AlOOH) for the powder milled in basic condition, while only a fraction of this conversion occurred for the powder milled in acid-basic condition. Thermal analyzes indicated the formation of 3.2 and 0.5 wt% of boehmite on these powders, respectively, which consisted of nanometric hydroxide particles. The treated powders were mixed with varied amounts of carboxymethyl cellulose (CMC) and tested using an extrusion device coupled to a universal testing machine. The powder milled in acid condition required an addition of 2.0 wt% CMC to achieve good plasticity, while only 1.0 wt% CMC was needed for powder milled in basic condition. Although powder milled in acid-basic condition needed 2.0 wt% CMC, it resulted in smoother extruded segments. The extruded segments were pre-sintered at 1100°C and tested for flexure strength in a four-point bending device, which showed that samples containing aluminum hydroxides had higher strength. Milling of alumina powder in basic pH followed by hydrothermal treatment generated nanostructured boehmite binder, which improved the rheological behavior during extrusion.