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Agglomeration and aggregation study of hydrous alumina nanoparticles during calcination induced by microwave heating

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Abstract – This investigation was focused on the influence of particle size and kind of thermal treatment on the characteristics of alumina powder obtained from calcinate hydrous alumina powder. It were studied too the agglomeration/aggregation degree as a function of temperature and and time of the thermal treatment. The results showed the decrease of calcination time and temperature treatment of the powders. It was not observed changes on the aggregation/agglomeration degree of the alumina particles after the heat treatments.

The processing of materials ceramic based on heating by microwave energy has gained increasing importance in diversify ceramic processing such as: powder drying and synthesis, calcination or organic elimination, and sintering, because of the advantages offered as the reduction of energy, shorter processing times and improved microstructural homogeneity of ceramic bodies [1-3]. Ceramic powder compaction by pressing requires weak-agglomerated nanopowders to obtain high dense compacts and consequently dense sintered ceramic bodies [4]. Chemical methods are frequently used to obtain nanoparticulated and homogeneous powders. Ceramic nanoparticles prepared by chemical methods have advantages over physical methods in some respects such as lower cost, higher productivity level and easier to store. However, the critical steps in these methods of obtaining of nanopowders is the extraction of the liquid phase (generally water) from the solid precipitated, drying of the precipitate and the calcination to obtain oxide compounds [3-6]. The way adopted to dry and calcinate the precipitate particles influences the amount of agglomerates and/or aggregates in the powder [5].

In this investigation intends to calcinate hydrous alumina powder in the conventional furnace and home microwave oven. The microwave oven was modified focusing mainly the fine temperature control, to investigate the kinetic of the adsorbed and hydrated water lost. The hydrous alumina powder presented 3 different particle size distribution with average particle sizes of 80, 10 and 0.7 μm. The powder samples were characterized by ATD/ATG to obtain data from conventional heat treatment. The fixed mass of powder were treatment by conventional and microwave heating. The powders were characterized by Hg and N_2 porosimetry, X-rays diffraction and SEM.

The results showed the decrease of the temperature and time for the water desorbtion and dehydratation, and crystalline phase transformation to zirconia for the powder treated in microwave heating, when compared to the conventional thermal treatment. Nitrogen porosimetry and SEM analyses indicated that the microwave heating promoted a smaller nanoparticle agglomeration.

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