Ultrafine grinding of powder oxides aqueous slurries with a controlled viscosity

Houivet David, Bernard Jerome, Haussonne Jean-Marie

LUSAC, Laboratoire Universitaire des Sciences Appliquées de Cherbourg (EA2607), Université de Basse Normandie, B.P.78, 50130 Cherbourg Octeville, France

Previous studies [1] have shown the importance of controlling rheological behaviors of slurries during the attrition milling in aqueous medium. Indeed, during grinding, the creation of new surfaces that react with the aqueous dispersing medium has for consequence to modify the slurries properties, in particular their pH and their rheological behavior. The slurry can then flocculate and its viscosity increases. Thus grinding efficiency can very quickly become null and a "setting" of the slurry in the grinder is sometimes noted.

Our approach of the problem is in two steps. First, we determine the optimum dispersion conditions to obtain deflocculated slurries. It's possible by the control of the solid load, of the pH, or by addition of dispersant in order to enhance electrostatic and/or steric repulsion between particles. The characterization of the dispersion state is also possible with tools as zetametry and rheology. The second step is to preserve during the whole milling process this deflocculated state of dispersion. This is possible, for example, by maintaining relatively constant the pH optimized value of slurry.

We applied this concept for the grinding of classically used powder oxides TiO_2 and Al_2O_3. We implemented with this intention a horizontal attrition mill (dyno-mill), using different kind of balls: zircon or stabilized yttrium-zirconia with diameters ranging from 0,4 to 1,6 mm. We have appreciated the grinding efficiency by powder BET specific area measurements, by DRX and TEM observations. So, powder areas about 10 m^2/g have reached higher than 40 m^2/g that is to said average grains diameter lower than 50 nm.

[1] Houivet D., El Fallah J., Haussonne J.M., Dispersion and grinding of oxide powders into an aqueous slurry, J. Am. Ceram. Soc., 85,2, pp 321-328, 2002