Importance of energy dispersion on sanitaryware suspensions

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In sanitaryware formulates the clay based minerals, including ball clays and china clays, represent 50% of the composition on average. The clay based minerals are formed by the alteration of primary rocks. These alterations can occur at different geological stages: either at the source for primary clays or during transportation or after deposition for secondary clays. The combined effect of the alteration processes leads to the formation of different types of clay minerals, each presenting unique characteristics. It is therefore unlikely to find two equivalent clay mineral basins or deposits having been transformed from identical primary rocks and under the same conditions.

For example, kaolins from different deposits present different combinations of mineral constituents. In addition to this, each deposit exhibits different particle sizes and particle shapes resulting from the alteration processes. Pictures 1, 2 and 3 demonstrate it with scanning electron micrographs of kaolins from three different geographical Imerys Ceramics operations.

Picture 1 shows a mixture of coarse kaolin and halloysite from Thailand; Picture 2 shows the coarse and medium platy nature of the United Kingdom material and Picture 3 shows the fine blocky kaolin from the United States.

Figure 1: Effect of energy on a kaolin particle

Sanitaryware slurry preparation
Sanitaryware body slips are mainly prepared by the blunger process which imparts mechanical energy to the clays and other materials present in the form or shear. It is therefore very important to know which clay minerals within the body formulation are most sensitive to energy and control the process to minimise the impact.

The clay minerals are usually added at different stages of the process. Ball clays are most likely dispersed in the primary phase, then the non-plastics and finally the kaolin (china clay).

The characteristics of clay minerals will be modified during the dispersion stages. Depending on the energy of dispersion, clay particles can be delaminated and therefore rheological and casting characteristics of the final slurry are modified. Increasing the energy of dispersion tends to cause kaolin particles to delaminate to a greater extent, which usually results in a reduction of the casting rate. This will ultimately translate to a lower casting rate body. (Graph 1).

Fast kaolins tend to delaminate more easily than others; hence, high dispersion energy, long dispersing times or high intensity blunging can irreversibly and dramatically modify the kaolin casting properties. Ball clays can also experience the same effects but are generally less sensitive.

Casting property modifications
The casting properties of bodies obtained after low and high dispersion energies are measured at a given thixotropy. For instance, Graph 2 illustrates the casting rate of bodies as a function of thixotropy measured after 1 hour (V80) for different kaolins.

For a given thixotropy, the high energy dispersed body presents a lower casting rate (Graph 2). The effect of dispersion energy increases with the casting rate of the bodies. The blunging conditions, such as time, intensity, viscosity, solids content, etc., have to be monitored very carefully for fast casting kaolins.

Key steps to ensure optimal slurry performance
Clay particles are sensitive to energy input during the preparation stages. With an increase in energy, clay particles tend to delaminate and modify the casting properties of slip. Consequently, body characteristics, such as rheology, green strength, casting rate, permeability and drying rate are modified. Delamination of kaolins leads to a significant drop of casting rate at a given thixotropy, with fast casting kaolins being more affected and their properties being drastically modified.

Imerys Ceramics has developed a range of fast casting kaolins such as Prosper, SPK, MRD LW Cast and MRD Cast, to offer optimum casting performance over a range of preparation and casting conditions. The dispersion of these kaolins has to be monitored to ensure that their performance is successfully transferred to the casting slip and therefore fit the customer needs. Their combination with finer kaolins like KT-Cast, NIS-C, Remblend, KaoCast CNL80 allow to better adjust the formula performances.

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