CHAMOTTE: A PAN-ACEA?

sanitaryware gains from material upgrades

Erdem Kurt, Technical Manager of KAOLIN Endustriyel Mineraller San. ve Tic. A.S discusses the vital role that increased use of chamotte is playing in the role of improving sanitaryware manufacture.

A need for change

It is one of the most popular aspects of business world. Because of competition becomes harder and harder every day, producers try to differentiate from each other to survive. In this regard, the ceramics industry is no exception to increasingly tough competition, and manufacturers across the whole sector are being compelled to find more and more solutions to differentiate themselves in the eyes of their customers.

Importance of design

We all know that first impressions are very important, and when it comes to consumers (particularly in the end-user sense), then lifestyle and appropriate design are key constituents. In this regard, sanitaryware manufacturers are continually trying to stretch boundaries and re-position themselves to accommodate the changing needs of the public.

As well as design innovation, however, sanitaryware manufacturers must also pay continual attention to production costs, as that will also assist in increasing competitiveness. In this sense, the worlds of design and manufacture become intrinsically linked, since because of the technical limits in manufacturing sanitaryware items, new raw materials and production methods are needed to enable companies to meet these more exacting requirements. For example, these days the more fashion-conscious designs are much larger than traditional pieces, and more involved in their design.

Traditional sanitaryware (vitreous china)

Non-plastic raw materials; feldspar, silica sand (or quartz) and plastic raw materials; ball clay and kaolin are the main components of traditional sanitaryware body composition. After the preparation of the slip, there is a casting step to produce the green body. Following the drying and glazing steps, the body is fired at around 1200oC in order to have a vitreous (non-porous) product which has suitable dimensions with a glossy smooth surface and desirable appearance. As a result of the vitrification during firing, vitreous china bodies tend to shrink between 10-12% and face pyroplastic deformation at high firing temperatures which may cause sagging. For this reason, there are limits that can be applied when it comes to size and design by using a traditional vitreous china body composition. Production of big kitchen sinks, complex designed washbasins or large shower trays can therefore be extremely problematic for sanitaryware manufacturers. As a result, companies have to think outside of the box and find ways to make things happen.

The importance of chamotte

In order to produce larger sanitaryware pieces more easily, pyroplastic deformation of the body during firing has to be either decreased or eliminated. The reduction or complete removal or feldspar helps, but it is not enough. As such, an unique raw material has to be used in the composition which can show resistance to deformation. Fortunately, such a material exists: namely, “chamotte”.

Chamotte is a calcined material which is produced by firing of kaolin at 1,300-1,350 oC in rotary kilns and milling it in order to get an appropriate thermal expansion and particle size distribution. Chamotte can be produced by firing of raw ball clay as well. However, Mr Erdem Kurt, Technical Manager (Sales) from Kaolin AD Bulgaria recommends using chamotte produced from refined kaolin as it is much more consistent in chemical, mineralogical and physical terms and as a result it is possible to minimize a lot of the problems that can be otherwise encountered in the production of sanitaryware.

There are two critical parameters for chamotte: thermal expansion and particle size distribution. Chamotte has a relatively high and consistent thermal expansion, 0.42-0.45% at 600oC. This enables the body and glaze expansion to be matched without the addition of large amounts of sand or quartz in the body recipe. By using chamotte instead of high amounts of sand/quartz, it is possible to minimize the tendency to dunting. Using high amounts of silica sand or quartz in the composition increases the risk of crack formation because of instable thermal expansion of body.

Particle size distribution is the second critical parameter of chamotte. This characteristic affects the final properties of sanitaryware product such as surface smoothness, tendency to sagging and deformation. The granulometry of chamotte also dictates the properties of the final sanitaryware which is produced using this method and in that sense there are two types of body which are called Fire Clay (FC) and Fine Fire Clay (FFC).

Fire Clay (FC) and Fine Fire Clay (FFC)

The term “Fire Clay” comes from the material which has been used in traditional fireclay bodies. Pre-fired clay bricks are crushed and/or grinded and used in recipe to make the body resistant to deformation during firing. This refractory material is also called “grog” and it is possible to produce large sanitaryware bodies in this way. Of course, there are disadvantages of this traditional process. The risk of contamination is much higher in low quality fire clay bricks and it may cause spots on the glazed surface of sanitaryware after firing. A layer which is called “engobe” has to be formed between body and glaze in order to eliminate the spot problems and this application means extra cost for the manufacturers. Another negative point is inconsistent thermal expansion coefficient of fire clay bricks. It increases the risk of crazing or dunting too much which is big headache for sanitaryware producers.

FC/FFC composition

	FC	FFC
Chamotte (%)	40 ÷ 50	30 ÷ 40
Silica Sand / Quartz	10 ÷ 15	15 ÷ 20
Ball Clay (%)	25 ÷ 30	25 ÷ 30
Kaolin (%)	10 ÷ 15	15 ÷ 20
Density of Slip(g/lt)	2000 ÷ 2050	1950 ÷ 1970
Brookfield Viscosity (Poise)	18 ÷ 20	15 ÷ 18
Gallenkamp Viscosity	180 ÷ 200°	190 ÷ 220°
Gallenkamp Thixotropy	40 ÷ 50°	30 ÷ 50°

The difference of the modern FC body is the quality of chamotte which is used instead of fire clay bricks. Chamotte which has controlled thermal expansion, stable chemical and mineralogical composition and coarse granulometry with a top cut of 300-400 microns and average particle size of 100-125 microns is the suitable material for FC production. By using high quality chamotte, it is possible to minimize the problems in production of big size sanitarywares and it is possible to increase the final quality of these items.

Fine Fire Clay (FFC) body is a little bit different from the FC body which the difference is about particle size of chamotte. In FFC bodies, finer size chamotte is used to achieve better surface smoothness. Finer particle size of chamotte reduces the roughness on the surface and helps to get better view after firing. It also helps to eliminate the engobe which is used for covering irregularities on the body surface.

Formulation of FC/FFC Bodies

Another important difference between FC and FFC body is the amount of chamotte in recipe. Ratios of raw materials in body recipes vary in factories, it depends on the quality of other raw materials. But, it is possible to say that the ratio of chamotte is 40-50% in FC body and 30-40% in FFC body. Rest of non-plastic part is quartz or silica sand (10-20%) which is critical for thermal expansion coefficient. Thermal expansion of body is controlled by changing the amount of quartz used.

FC/FFC composition is one of the best solution for manufacturing trendy sanitarywares; large kitchen sinks and big shower trays, rectangular or square washbasins. High quality chamotte is the key raw material for this type of production.

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