Made in Portugal - Innovative Sanitaryware Clay Blends for State-of-the-art Production

Introduction

Over the past decade, Portugal has emerged as one of the leading European producers of sanitaryware. Third only to Turkey and Italy, the output of the industry amounts to more than 7.5 million pieces per year. Besides the two multinational companies – Roca/Sanitana and Sanitec/Eurocer – four Portuguese producers – Sanindusa, Valadares, Cifial, and Estinge – have realized substantial growth even with the stagnation in the national construction industry during the past five years, which has lead to a reduction of the internal market of more than 15%. However, as exports have increased by more than 18% the overall balance has been positive. Today, about two thirds of the production goes into international markets. Currently, substantial investments are made to increase the production capacity of some of the producers.

Raw Materials

Historically, the Portuguese sanitaryware producers were supplied from local raw material sources: china clays from the northern part of the country, feldspars from the northeastern granitic complexes with their pegmatites and plastic clays from the central regions between Coimbra and Leiria, namely the Barracão-Pombal deposits. With the introduction of modern production techniques such as pressure casting, almost all raw materials were replaced by imported products from England, France and Spain often following recommendations from equipment suppliers. Whilst the national producers of ceramic raw materials did not follow-up on the development of state-of-the-art products, the market for specialty ball clays and china clays was increasingly controlled and monopolized by major multinational groups who also invested in raw material resources. Only over recent years could this trend be reversed as MOTA® Ceramic Solutions developed high quality sanitaryware china clays by investing in modern kaolin washing plants which now serve both local and foreign customers with technically and economically competitive products.

Characterisation of Ball Clays from Central Portugal

Mineralogically the deposits of Barracão-Pombal district are comparable with the English deposits of Devon and Dorset which contain disordered-to-ordered kaolinite, micaceous minerals and quartz in varying ratios. Some of the clay seams of the district also contain up to 5% of carbonaceous material. In slip casting, the rheological properties of the slip assumes an important role, therefore it is of extreme importance that the raw materials have the required properties and that they remain constant through time. In order to guarantee the stability of the production processes, it is necessary to have a sound knowledge of the physical, chemical and rheological properties of the ball clays used in the formulation of a sanitaryware body. Initially, studies were performed on a group of 22 ball clay types, that involved determining the chemical composition including carbon- and sulphur content, soluble salt concentrations, pH-value, measuring the physical properties and the rheological behaviour (casting concentration and V<sub>90</sub> curves at 0, 24, 48, 72, 144 hours using a Brookfield viscosimeter).

Following the initial assessment, four clays were chosen from the original
Speciality Clays
Sanitaryware Clays
Engobe Clays
High Strength Ball Clays

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Corbário has been founded as one of the first speciality clay mining companies in Portugal in the early 1950s. Since then the company has contributed to the development and growth of the Portuguese ceramic industry and has always been recognized for its high standards of quality.

With substantial reserves of high alumina speciality clays and installations which allow the selective preparation of sophisticated products Corbário is perfectly situated for the future and is a cornerstone for the development of MOTA Ceramic Solutions.
22 as promising components for a sanitary ware ball clay blend. The results for the chemical analysis are shown in Tab. 1 and the physical properties in Tab. 2, together with the results obtained for two widely-used sanitaryware clays (Standard 1 and Standard 2), under the same testing conditions.

### Specification of Sanitaryware Clays

In order to obtain a clay suitable for sanitaryware body formulation, a series of 20 clay blends were prepared and tested. This was done taking into account the following characteristics that a sanitaryware clay should attain:

- The ball clay should have a casting concentration (the amount of solids in a fully deflocculated slip which has a minimum viscosity of 500 cP) of more than 60% solids.
- At its casting concentration, the deflocculant demand should not be higher than 2% (based upon a mixture of 4 parts sodium silicate, density about 1.35 : 1 part of sodium carbonate).
- When deflocculated at its casting concentration to produce a slip with a starting viscosity of 700 cP, this should rise to not more than 25 000 cP after sixty minutes.
- As the ball clay gives strength and plasticity to the body, the green strength of the ball clay is important and should normally not be less than 50 kg/cm².
- The ball clay should not be too refractory and its water absorption after firing at 1220 °C should be less than 4%.

### Sanitaryware Bodies

In order to test the blends described previously, standard bodies were prepared and tested. The results for the chemical analysis are shown in Tab. 1 and the physical properties in Tab. 2, together with the results obtained for two widely-used sanitaryware clays (Standard 1 and Standard 2), under the same testing conditions.
mulated using those blends and other standard raw materials in the following proportions [%]:
- 23 ball clay
- 28 kaolin
- 26 feldspar
- 23 Silica Sand

The results for the physical properties are given in Tab. 3. The casting rates were also assessed and are given in Tab. 4.

To test these blends of clays under semi industrial conditions, casting tests were made with closet tank moulds used in industrial production lines.

**Interpretation of Results**

The plastic clay deposits of central Portugal contain substantial quantities of raw materials suitable for the production of sanitaryware clays. With the selection of 4 standard components, MOTA Ceramic Solutions is now able to prepare specific blends for modern sanitaryware production requirements. While the current ball clay blends are prototypes aimed at standard casting technique markets they can be fine tuned according to market feedback. Future developments will be geared to the needs of faster pressure casting systems.

Selective mining methods and standardisation of the single components assures constant and stable product quality parameters.

A beneficiation process which includes blunging and filter pressing of certain components precedes the final blending and preparation of the noodled products which provide:
- stable viscosity of the casting slip
- high density
- rapid build-up of thixotropy
- high casting rates
- short drying periods.