INVESTIGATION OF THE EFFECTS OF CLAY IMPURITIES ON CERAMIC TILES AND NOVEL METHODS FOR IMPROVEMENTS

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Kaolin and clays form the basis of classical ceramics due to their plastic shaping properties. Clays usually occur under certain conditions, from the dissociation of feldspars or the dissolution of volcanic rocks. Besides the clay minerals formed by the collapse of the rocks, there are minor minerals such as feldspar, quartz, mica, iron minerals and carbonate minerals. The minor minerals in the clays form raw material-induced defects on the surface of the tile. Ceramic bodies used for floor and wall tiles fabrication are normally composed of a complex mixture of different raw materials. For preparing ceramic body recipes, raw materials are ground and sieved in wet system together then granulated in the spray driers. Granulated powders are sent to the shaping, glazing and sintering processes. Finally, sintered tiles are examined by quality control department. Clays provide a basis of traditional ceramics by the reason of the plastic properties for shaping tiles. 30-40% amount of clays are used in both floor and wall tile body recipes. The clay samples used in production were subjected to sieve analysis in the laboratory and sieve residue was defined 150, 90, 64, 45 and 32 micron. Optical microscope and SEM images were taken (Figure 1).

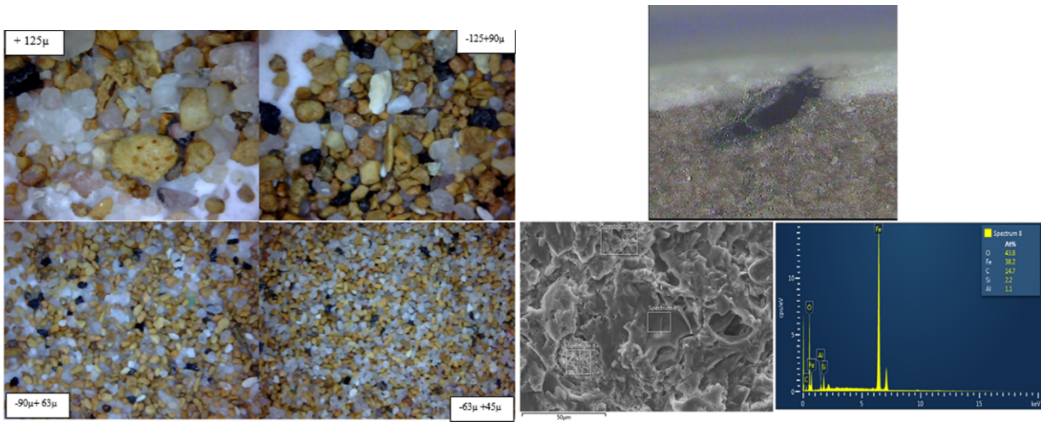

Figure 1. *(a) Optical Microscope Images for Different Size Fractions- CLAY – (b) Iron Mineral Defect on the Sintered Tile*

The chemical analysis and XRD analysis were also performed on the sieve residue given above. The type of impurities and their effects on the creation of defects in products have been diversified. It has been found that defect caused by impurities of raw materials is characteristic and vital on the product quality. Along this finding, a new method for separating the impurities was investigated. A design of new separation system was suggested for Kaleseramik production line in Çan, Turkey. The simulation results of the proposed separation system were illustrated in the paper.

The flowchart of the developed separation system is illustrated in Figure 2. At the first step, the clays are mixed with water in a blunger that is a mechanical stirrer. The water was added to reach the slurry density of 1.65 g/l and it was stirred until it became a homogenous suspension. The slurry was sieved on the vibrating screen of 150 micron to remove organic matter. Then the hydrocyclone method was implemented on a clayey slurry. The working principle of hydrocyclone is centrifugal sedimentation, when two phases mixed liquid is fed into hydro cyclone by a certain pressure liquid and produces strong three-dimensional-elliptic rotational movement. Due to the different density and size of particles, the centrifugal force, the centripetal buoyancy and drag force is different. So most coarse particles (or heavy phase) are discharged from cyclone underflow outlet, and the fine particles (or light phase) from the overflow tube, so as to achieve separation. The slurry density and fluidity are adjusted to a suitable degree before feeding to the selected hydrocyclone of gMAX4U. Vortex finder and Apex insert were decided to obtain high efficiency of separation for cut size of 45 micron. The other important operational parameter is the slurry pressure in the input of hydrocyclone that was adjusted accordingly. The underflow of hydrocyclone is the bigger sized particles than 45 microns that are collected in a tank to be used for other areas.

The overflow of hydrocyclone has unwanted water so that it is pumped to a dewatering unit. Dewatering unit is a new technological development that is capable of working on continuous operation and achieving slurry density of 1650-1700 g/l for ceramic raw materials. The underflow of dewatering system is the enriched clay product from impurities. The overflow is water having a little clay that is stored in water tank to be reused in the process.

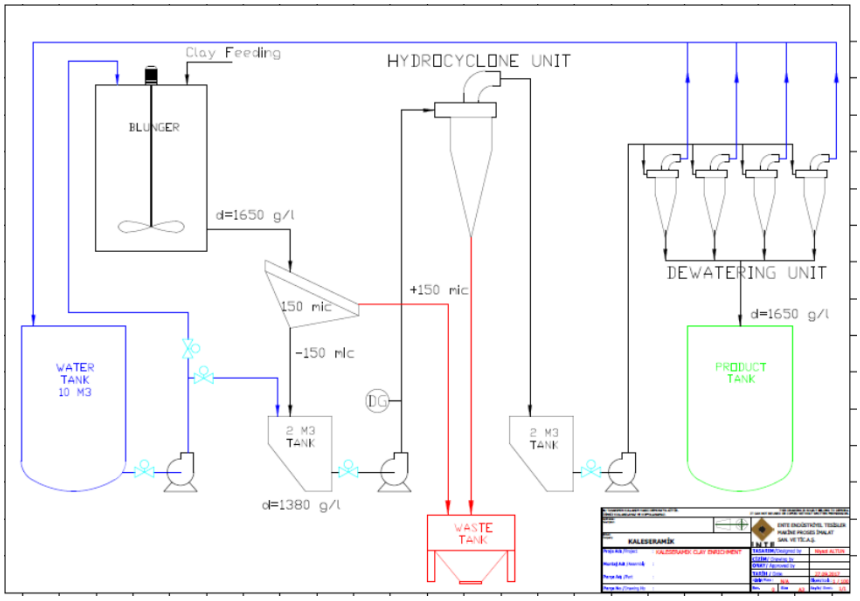

Figure 2. *The flowchart of the developed separation system*