FLOOR TILE MANUFACTURE, UTILIZING THE DISTRICT OF ISTANBUL (AKPINAR) CLAY, TURKEY

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SUMMARY

The investigated area is located in the province of Istanbul. The Akpinar clay under the upper coal seam has been wasted during the extraction of coal from the quarry.So far, no scientific research has been conducted qualitatively and quantitatively on this clay deposit in detail. Therefore, the possibility of using the clay (found in significant quantities) in industry has not yet been determined. Moreover, the waste clay has a negative effect on the cost of coal extraction.

The objectives of this study were to: 1) Identify the clay minerals and other minerals within the deposit and 2) Investigate the material properties to determine if the material would be suitable for consideration as a ceramic material.

Akpinar clay belonging to Akçelik Mining Co. (Table 1), standard floor tile body materials supplied by Kütahya Seramik (Hereafter KS) and the constituents of the body materials of KS were used in this investigation as raw materials.

In this study, the waste clay under upper coal seam during coal extraction in the vicinity of Akpinar village was enriched by leaching from 63μm sieve. The bulk clay, under (leached) and upper part (+63μm) of the sieved clay were all characterised chemically and mineralogically by using AAS and XRD/DTA respectively. Tile specimens were prepared by pressing from the bulk clay, leached clay (-63μm), standard floor tile body materials of Kütahya Seramik Co. (KS) and by adding leached clay in proportions of 5%, 10%, 15%, 20%, 25% and 30% to the KS standard floor tile body materials. Specimen physical and mechanical properties such as dry strength, fired strength, water absorption and fired deformation were also tested. The following results were found from these analyses:

1. While bulk clay contains 7.58% Fe_2O_3, 2.67% CO_3^{-2} and 0.66% organic materials, their amounts decreased to 3.31%, 0.21%, and 0.31% respectively for the leached clay.

2. It was observed that bulk clay samples contained approximately 5.2% iron carbonate ($FeCO_3$) - siderite -, which was not desirable in the ceramic raw material.

3. According to the XRD results, the mineralogical components of the bulk clay consist of kaolinite, quartz, siderite, montmorillonite, and illite; the leached clay consists of kaolinite, quartz and illite; the upper part (+63μm) of the sieved clay consists of siderite, kaolinite, quartz and montmorillonite. Increasing the amount of montmorillonite mineral with siderite above sieve shows the relation of siderite oolith formation with montmorillonite.

4. According to the DTA curves, the bulk and leached clay samples contain kaolinite, while the upper sieve sample contains siderite.

5. According to the results of the grain size analysis of the samples, it was observed that the leached clay contains less sand and silt-size materials and 59% more clay-size materials than the bulk clay.

Tile specimens were prepared from the bulk clay, leached clay, and standard floor tile body materials of KS by adding leached clay in the proportions defined above. Physical and mechanical tests such as the determination of dry strength, fired strength, water absorption and fired shrinkage were used to characterize the ceramic materials shaped by pressing. Test data indicated that:

1. The drying strength of the bulk clay was 35.21kg/cm^2 and that of the leached clay was 51.43kg/cm^2.

2. The leached clay fired at 1200 °C has 2.43% water absorption.

3. The fired strength of the bulk and leached clay has a proportional relationship with temperature.

4. The siderite and montmorillonite contents in the bulk clay increase the firing shrinkage and strength, and decrease the water absorption in comparison to the leached clay.

5. Increasing the proportion of leached clay in the KS body materials increases the drying strength of the KS bisque in significant amounts.

6. The addition of leached clay in proportions greater than 10% in the KS body materials decreases water absorption in significant amounts.

7. 5% and 10% additions of leached clays decrease firing shrinkage and strength of the KS body materials; the addition of leached clays in proportions exceeding 10% increases fired shrinkage and fired strength of this body in significant amounts.

8.In order to produce leached clay, bulk clay needs to be mixed, leached, dewatered and dried. The calculated cost of these four-step processes is estimated at approximately $27 per ton, indicating quite a reasonable cost.

It was thus determined that the clay under the Akpinar upper coal seam could be used in the ceramic industry after leaching. Moreover, the expected cheap extraction of the clay due to the coal mine operation and its ready transportation could make using this clay economically feasible.