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Development of Red Wall Tile Composition by Dry Grinding Process with Experimental Design Method

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Ceramic wall tiles are multicomponent system primarily composed of clay, carbonates, feldspar and quartz, and is considered to be one of the most complex ceramic materials. Each component within the body contributes differently to the final properties. On sintering, wall tiles system forms a mixture of glass and crystalline phases depending upon the chemical compositions of the raw materials and processing conditions. The crystalline phases formed are responsible for important properties of the wall tiles such as high dimensional stability (low linear shrinkage), low hidratability, and high porosity.

The dry milling of ceramic raw materials offers advantages in comparison with the wet milling process. The dry grinding process is an energy saving process. The dry process strongly diminishes the thermal consumption because of the spray dryers were not used in this process. Regarding environmental impact; the granulation using dry processes presents considerable advantages, such as the reduction of the hot emissions from the drying of the ceramic suspensions, reducing energy consumption and CO_2 emission. Also with dry grinding, reology problems are eliminated so it is possible to reduce recipe cost.

In this study, the effects of dry grinding on wall tile composition are investigated with experimental design method. Experiments were designed as $2^4 3^1$ multi-level factorial design, individual effects of main five factors (temperature, clay 1, clay 2, clay 3 and feldspar) and their interactions were determined. 24 formulations are prepared with territorial clays (Turgutlu/Manisa/Turkey region) and feldspar. The samples were ground at laboratory hammer mill and unidirectional dry pressed in a die with rectangular cavity (5 cm x 10 cm) .The samples were fired at 1100 ^{0}C and 1135 ^{0}C using a fast firing cycle in a laboratory roller kiln. The samples were characterized before and after firing by using XRD, TG, DTA, EDX and SEM. The physical properties (linear shrinkage, flexural strength and water absorption) were measured. Results were analyzed by MINITAB 14 statistical software program.

Keywords: Dry Grinding, Red Wall Tile, Strength, Experimental Design Method

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