Optimize the efficiency of raw material grinding through variation of size ratio of grinding media in ball mills

A dissertation submitted to the

Faculty of Science & Technology

Uva Wellassa University

In partial fulfillment of the requirements for the award of the

Degree of Bachelor of Science

by

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Mineral Resources and Technology Degree Program

Uva Wellassa University, Sri Lanka

2014

Abstract

Sri Lanka is rich in minerals, such as kaolin, ball clay, feldspar, silica quartz and dolomite, which are used in the manufacture of ceramic products. Using of modern manufacturing techniques and quality assurance methods allow for efficient and cost effective production.

The ceramic industry consumes much energy. It is also noted for great percentage of the energy cost in the total production cost. Besides of kiln systems and other energy consuming manufacturing processes, optimizing the energy of ball mill grinding helps to an efficient product.

The ball mill grinding in ceramics are classified mainly as plastic and non plastic material grinding. Plastic ceramic raw materials are any clay material that reveals a property called plasticity when mixed with water. Plastic raw materials include kaolin, clay and Bentonite. Non-plastics include minerals that not plastic when mixed with water such as feldspar, quartz, limestone, dolomite, talc.

For the fine and efficient grinding, there are several grinding parameters that have to be considered. The material type, the input sizes, specific gravity, hardness, plasticity and the quantity of material are some of them with relevant to the material that ground. As parameters of milling, the ball mill volume(contacting area), filling ratios, inside liner, rotation speed, the grinding media; grinding media ingredient, hardness, the input size ratio can be consider here . The water quantity also effects to this grinding due to the wet grinding process requirement of ceramic slurry.

Grinding media size ratio of ball mill is the parameter that choosed, for change the grinding time to obtain the required particle size. Study through a small scale ball mill, two hour save from plastic materials and twelve hour save from non-plastic material were resulted using 1% of large pebbles and 79% of small pebbles.

At initial time large size pebbles affect much more than medium and small sizes. After crush into the next size portion by large size pebbles, the medium sizes effect to milling process, via impact rotation motions. Small size pebbles influence at last to reduce the particle size. Depend on test ball mill results, a small quantity of large pebbles and high quantity of small pebbles is the requirement for an efficient and fine ceramic grinding.

Due to the plasticity property of clay materials, continuous increment of small size pebble fraction is not fruitful. After obtaining the required particle size, only mixing is take place and sizes of pebbles are not much influence to reduce the grinding time.