METHODOLOGY TO PREDICT PRODUCT SIZE DISTRIBUTION OF A VERTICAL STIRRED GRINDING MILL USING BOND’S MILL BALL

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ABSTRACT

The fine, re-grind, and ultra-fine comminution processes are energy intensive resulting in high operating costs. The use of conventional ball mills for grinding in fine size ranges is inefficient and, therefore, vertical stirred mills are becoming increasingly popular in the mining processing industry. This work presents hypotheses of a new methodology to predict the product size distribution of a vertical stirred grinding mill using the population balance model. Initially, detailed experimentation was carried out in a Bond Ball Mill and the breakage and selection functions were determined for the aggregate material tested. After collection of the breakage parameters, it was possible to predict the product size distribution as a function of grinding time. The aim of this work is to use the breakage parameters determined from the Bond’s batch ball mill test to predict the product size of a vertical stirred mill. The effects of changing the mill’s agitator velocity on the final product size distribution may be demonstrated through this methodology and optimization of grinding performance can be assessed.

INTRODUCTION

In the last decade there has been an increase in demand for fine grinding due to the depletion of coarse-grained orebodies and an increase of processing fine disseminated minerals and complex orebodies (Partiyà & Yan, 2007). These ores have provided new challenges in concentrator design because fine and ultra-fine grinding is required to achieve acceptable recovery rates. The smaller the size necessary to achieve liberation the greater the energy needed in the comminution process. Therefore, the correct design of a grinding circuit becomes important in minimizing unit costs and increasing product quality. Stirred milling technology has been firmly established in the last 20 years as superior to ball mills for fine and regrinding operations due to its superior energy efficiency (Jankovic et al., 2006). Stirred Mills are now commonly used in many sectors of the mining industry, though they have been used in other industries for many years (Stehr & Schwedes, 1983). This technology has proven to be more energy efficient with greater opportunities for future optimization in both fine and coarse grinding.

OBJECTIVE

Develop a method of predicting the product size distribution from a vertical stirred mill based on the particle’s rate of breakage through the use of Population Balance Model and Discrete Element Method.

MATERIALS AND METHODS

Testwork to be conducted in this project is separated into three major components:

1. Characterization of fine particles breakage using the Bond Mill;
2. Laboratory size vertical stirred mills; and

Commercial aggregate used for pavement (granite) is used for the grinding tests. The agitator diameter and aggregate of minus 10 mm size was characterized for Bond Work Index, which represents the specific power required (kWh/ton) to reduce the ore from an infinite size to 80% passing 100µm. The Bond Work Index test is performed in a 305 mm diameter by 305 mm length ball mill (Bond Ball Mill).

Figure 1: Tower Mill (Eirich, 2014).

Figure 2: product size distribution as a function of grinding time

REFERENCES


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