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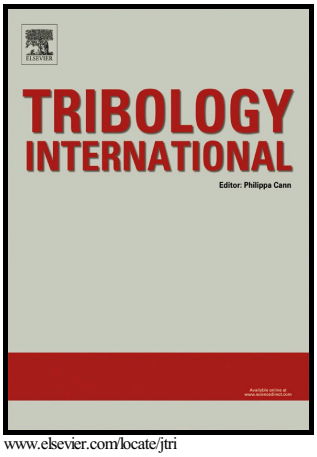

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ANALYSIS OF FRICTION COEFFICIENTS IN A VIBRATING CUP MILL (RING MILL) DURING GRINDING

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Abstract
This work describes how a ring mill is used as a friction coefficient analysis system for granular materials during grinding. This assessment method was mainly created to analyse energy consumption in comminution processes in friction mills. A ring mills consists of a cylindrical jar containing the grinding masses as coaxial cylinders and rings, made from high strength materials, moved by an oscillating movement caused by eccentric masses arranged on the mill motor axis. Inside the jar the masses rotated by the jar's eccentric oscillation rotate freely, at a speed that depends on the friction between the grinding bodies and the jar's inner surfaces. The work checked how the grinding masses rotate, the mechanism causing coupling and the relations between these movements and the friction coefficient. With this model it is possible to measure grinding energy consumed instant by instant and the energy lost through heat and average pressure generated by the thrust of the grinding masses; and, lastly, the friction coefficient between the mass and the material interposed.

Key words: Friction, Measurement, Frictional heating, Tribochemistry

Introduction

A ring mill (figure 1) is a grinding system well known to laboratories analysing inorganic materials, attributable to the friction mills category [1, 2]. Compared to other mill types, the ring mill enables much greater comminution of materials in the same grinding times. This mill type is used to cause mechanical-chemical and tribo-chemical reactions between materials, because of the great quantity of energy put into the system for the same grinding time, respect to other milling devices [1, 2]. The quantity of deformation energy imposed on the material by the mill is an important finding for the energy assessments of mineralurgic processes performed on minerals for industrial use. For this assessment, we need to know how the grinding masses move, their speed and the friction generated. The possibility to assess friction effects on granular materials dissolved during grinding also has bearings on purely economic considerations. These considerations lead to the research concept being introduced here; based, in fact, on calculating the friction coefficients of materials being ground, by using the mill as a "tribometer". From the physical point of view, a "tribometer" mill is a system where grinding granular material causes one or more physical phenomena that can be measured outside the mill; such as, for example, the increase in heat caused by friction, sending electromagnetic signals or noise and vibrations, or other external manifestations of what is happening inside. Once a way has been found to hear what is happening in the mill, you need to study a mathematical model of the phenomena occurring when the grinding masses move and associate data measured with the mechanical occurrences and, from there, with fundamental parameters such as force, pressure, energy dissipated, etc. etc.. For various reasons the ring mill has not become as well known as the planetary ball mill, which several authors have modelled [3, 4, 5, 6]. In 1999, for a degree thesis on mechanical-chemistry applied to the