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Friction and wear of liner and grinding ball in iron ore ball mill

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Abstract: To understand the friction and wear of working mediums in iron ore ball mills, experiments were conducted using the ball cratering method under dry and wet milling conditions, which mimic the operating conditions in ball mills. The liner sample is made of Mn16 steel, the ball had a diameter of 25 mm and was made of GCr15 steel, and the iron ore powder was screened from the magnetite particles with mesh number of 20. The results indicate that a different wear condition makes the COF change in a converse way and causes a different wear pattern in wear craters, followed by the corresponding temperature rise.

Key words: ball mill; three-body abrasion; ball cratering; surface analysis.

1. Introduction

An iron ore mill relies on the grinding and impact of grinding balls to complete iron ore crushing. The operating process of an iron ore mill is as follows: first, the ores are poured into the mill, and both the ores and the grinding balls are lifted by the lifting bar arranged on the wall of the cylinder body to a certain height, after which they fall onto the bottom of the mill to complete the crushing. According to the internal motion characteristics, the internal barrel of the ball mill can be divided into four zones: the cataracting zone, the cascading zone, the grinding zone and the fracture zone (Fig. 1). The wear on the liners is generated in the grinding zone and the fracture zone, where the liners experience wear caused by grinding balls and iron ore powders. In addition, under the wet-milling condition, there is a slurry generated during the milling. Moreover, the generation of powder or slurry results in severe and complicated wear conditions. Furthermore, the worn liners change the kinetic characteristics of grinding balls and the aggregate, which will significantly reduce the milling efficiency. At present, Mn16 steel liners are widely used in the mineral processing industry, which have a life period of 6~12 months. Chinese iron ore dressing plants consume more than 80,000 tons of liners every year. In addition, larger grinding balls are used in ball mills in many mineral processing plants in order to reduce the proportion of failure balls. Such behavior increases the energy consumption, reduces the grinding efficiency and increases the loss of the ball steel. Therefore, it is necessary to carry out a study on the friction behavior and the wear mechanism of liners in an iron ore mill to provide a theoretical basis for the selection of liner material and the design of the liner in the iron ore mill.

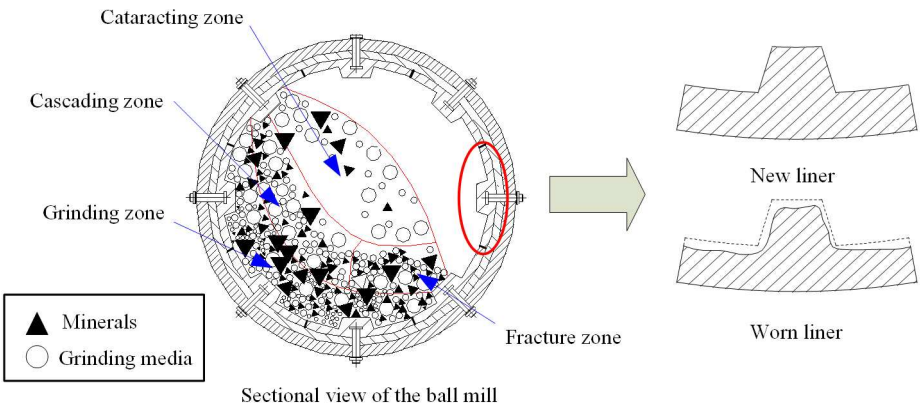

Fig. 1. Working principle of the ball mill.