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High-stress abrasion of wear resistant steels in the cutting edges of loader buckets

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Abstract

To simulate the wear behavior of the cutting edge of the mining load-haul-dumper bucket, high-stress abrasion laboratory wear tests were conducted and compared to the in-service tests. The effects of test parameters and different abrasives on the wear rates and wear mechanisms of wear resistant steels were studied using the high-speed slurry-pot with a dry abrasive bed (dry-pot) and in the actual in-service use as a cutting edge. The laboratory wear tests produced results that are well comparable with the in-service case observations. Especially at the higher sample rotation speed with granite as an abrasive, the wear rates were quite similar as determined from the cutting edge of a loader bucket that had been used in a mine.

Keywords: Wear testing; Abrasion; Steel; Mining, mineral processing

1. Introduction

In the mining conditions, it is practically impossible to perform two or more identical wear tests for the cutting edges of the mining loader buckets. Good examples of the variables affecting the results are the different types of rock being loaded, and even the different driving styles of the drivers. During a workday, the loader can be used to load slurry, gravel or large rocks, or simply to scrape the roads clean. The weight of the entire loader concentrates on the cutting edge when the bucket is being filled, especially when the rear tires lift up. Consequently, the cutting edge of the bucket may bend down as much as 50-60 mm [1]. Furthermore, the wear environment and also the mechanical properties of the cutting edge material and the welds affect the lifetime of the cutting edge, which may need to be replaced only once or several times a year.

There are several standardized tests for evaluating the abrasiveness of the rock. The most used ones are the LCPC test (Laboratoires des Ponts et Chaussées, Paris [2]), the Cerchar Abrasivity Index (CAI) test, and the determination of the equivalent quartz content (EQu) from a thin section or using an X-ray diffractometer [3]. In the LCPC test, two steel impellers are rotating five minutes at 4500 rpm in a pot with 500 g of 4-6.3 mm gravel [2]. The limitations of the LCPC test procedure are the quite small amount of abrasives of rather small size, the high rotation speed, and the use of structural steel with low hardness (60-75 HR B [4]) as impellers. In the LCPC tests, quite small differences in the steel properties may have a marked effect on the wear rates that naturally affects directly the obtained abrasiveness values [4,5]. On the other hand, the used steel grade is also quite different from the wear resistant materials used in the mining operations.