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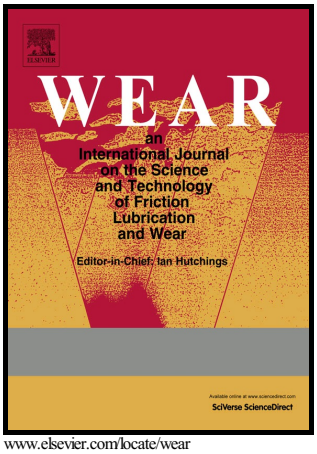

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Comparison of laboratory wear test results with the in-service performance of cutting edges of loader buckets

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Abstract

The in-service cutting edge of a mining loader bucket was investigated and its wear behavior compared with samples tested in the laboratory to assess how well the wear testing methods correlate with the in-service conditions. The examined in-service cutting edge of a bucket made of a wear resistant steel had been run in an underground mine with quarry gravel. The wear behavior of the cutting edge was simulated in the laboratory scale with several application oriented abrasive and impact-abrasive wear testing methods. In addition to the contact mode, high loads, large abrasive size, abrasive type, and the comminution of the abrasive formed the basis for the design of the laboratory experiments. The wear surfaces and cross-sections of the original cutting edge and the test samples were characterized, and the wear behaviors were compared with each other. Work hardening of the steels occurred in all cases, but the amount of plastic deformation and the depth of the wear scars varied.

Keywords:
Wear testing; Abrasion; Impact wear; Steel; Mining

1. INTRODUCTION

The simulation of in-service wear environments in the laboratory-scale is challenging. In the planning of the test procedures, the effect of many variables, such as the contact mode, loading energy, abrasive properties, and the environment on the active wear mechanism and the resulting wear rate must be carefully taken into consideration. The interpretation of the laboratory test results is normally easier and the repeatability of the tests is better than in the complex and expensive in-service tests [1]. On larger wear parts and complex applications, the comparison of materials using field tests is very difficult, laborious, and expensive. On the other hand, the utilization of the field test results is usually quite straightforward and the tests easily reveal the possible problems in the design or selection of materials. Thus, to select the best possible testing approach for each case, it is important to have a good understanding of the relevance of the laboratory wear tests compared to the in-service performance of the materials in high stress wear conditions.

The wear conditions are very demanding in hoisting and hauling of rocks in mining, excavation, and construction. One example of the used wear parts is the cutting edge of a mining loader bucket. The cutting edges are welded or mechanically attached to the front of the bucket and replaced when the worn-out edge restricts the loading procedure. With proper material selection, it is possible to markedly improve the lifetime of the wear part that affects directly the operating costs. The part must naturally resist high stress abrasive wear. Moreover, the selected material should have high strength and sufficient ductility to withstand also various dynamic loading events.

A large number of laboratory studies have been conducted for the material selection of bucket tips, teeth, and cutting edges of earth moving machines [2–6]. Some studies even compare the field tests of these kinds of wear parts with laboratory tests. However, the laboratory tests have usually been conducted as standardized rubber wheel abrasive tests with low contact pressure and fine abrasives. In these tests, it was often noted that the wear environment produced by the rubber wheel tests was not similar to the real conditions and that the laboratory tests did not correlate well with the field tests results [2].