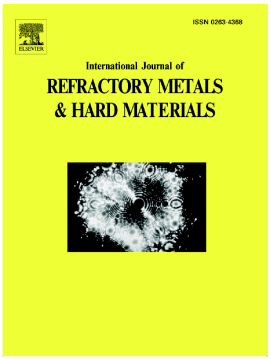

Initial deformation and wear of cemented carbides in rock drilling as examined by a sliding wear test

Jannica Heinrichs, Mikael Olsson, Staffan Jacobson

PII: S0263-4368(16)30624-2
DOI: doi: 10.1016/j.ijrmhm.2016.12.011
Reference: RMHM 4388

To appear in: *International Journal of Refractory Metals and Hard Materials*

Received date: 14 October 2016
Revised date: 16 December 2016
Accepted date: 19 December 2016

Please cite this article as: Jannica Heinrichs, Mikael Olsson, Staffan Jacobson , Initial deformation and wear of cemented carbides in rock drilling as examined by a sliding wear test. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Rmhm(2016), doi: 10.1016/j.ijrmhm.2016.12.011

Initial deformation and wear of cemented carbides in rock drilling as examined by a sliding wear test

Jannica Heinrichs[a]*, Mikael Olsson[a,b], Staffan Jacobson[a]
[a]Ångström Tribomaterials Group, Uppsala University, Box 534, SE-751 21 Uppsala, Sweden
[b]Materials Science, Dalarna University, SE-791 88 Falun, Sweden

*Corresponding author e-mail address: jannica.heinrichs@angstrom.uu.se

ABSTRACT

Due to a combination of high hardness and toughness, resulting in excellent wear resistance, cemented carbides are commonly used as the rock crushing component in rock drilling. The present paper presents a unique study where the very initial stages of deformation and wear of cemented carbide in sliding contact with rock are followed in small incremental steps. After each step, a pre-determined area within the wear mark is characterized using high resolution SEM and EDS. This facilitates analysis of the gradual deformation, material transfer, degradation and wear. The deterioration mechanisms found in this sliding test are similar to those observed in actual rock drilling. Cemented carbide grades with different microstructures show significant differences, where a higher amount of Co and a larger WC grain size both are associated to more wear.

Key words; Cemented carbides, sliding, wear, deformation, granite, rock drilling

1. INTRODUCTION

Cemented carbides constitute a range of composite materials, consisting of hard carbide particles bonded together by a metallic binder. The basic grades consist of uniformly distributed WC grains in a binder of Co. These composites display a combination of high hardness and toughness, resulting in excellent wear resistance in many demanding engineering applications, such as rock drilling. However, despite their proven superiority in rock drilling applications, the detailed understanding of the prevailing wear mechanisms is far from complete. With a deepened knowledge about the wear, drill bit buttons could possibly be designed to last longer, thereby decreasing the costs for down time, materials and regrinding.

Characterization of the surface of a worn drill bit button usually reveals a very smooth worn surface, where the roughness typically is limited to the size of individual WC grains, or even less, indicating that the deformation and wear chiefly operates on a sub-μm scale [1,2]. Beste and Jacobson [1] have estimated the wear depth to be 1 μm per 20 impacts for rotary/percussive drilling in granite. The low wear rate and the observed plastic deformation, cracking, chipping and crushing of individual WC grains indicate that wear is dominated by removal of individual grains or grain fragments, while removal of large clusters of grains is unusual [1,2]. In addition to the fractured WC grains, the worn drill bit button also shows depletion of Co in the top surface and instead rock material intermixed with Co act as a binder between worn WC grains.