Application-oriented wear testing in the mining industry

Rock and mineral handling applications, such as earthmoving, excavating, drilling, crushing, and screening, impose high local forces on the wearing parts of machinery. However, researchers have been unable to simulate these demanding industrial wear problems in laboratory conditions with standard testing methods.

In his doctoral dissertation, MSc **Niko Ojala** has studied how mining conditions could be simulated with laboratory wear testers.

“What is required is a step towards practice from fundamental research,” says Niko Ojala.

The main reason for the disconnect between research and practice is that most testing methods commonly available are based on low-stress wear conditions, while the most prevalent conditions in the mining industry are high-stress wear conditions. To rectify this, Tampere Wear Center has developed wear testers that can utilise large abrasive particles to create high-stress wear conditions. In his dissertation work, Ojala developed one such tester, a high-speed slurry pot that enables conducting tests in both slurry and dry conditions. The main goals of Ojala’s work were to study how the test method and the test device should be set up for the purpose of simulating real mining-related applications, and how the obtained results correlate with real-life material behaviour in the applications.

Replicating mining conditions on a laboratory scale

The wear resistance of steels in low-stress wear conditions does not increase substantially over the course of the process due to the lack of plastic deformation and, consequently, the lack of work hardening. In high-stress wear conditions, on the other hand, work hardening can almost double the hardness of the wear surfaces and consequently increase the material’s wear resistance.

“And yet, it is also shown that the hardness of the steel – neither its initial hardness nor its hardness after being hardened by strain – is not the only factor determining the material’s wear performance,” says Ojala.

Proper material response during the test is a crucial factor in the simulation of mining wear with a laboratory wear tester. For that to be achieved, the correct stress state prevailing in the actual wear process must also present in the tests. For steels, deformation, tribolayer formation, and work hardening are important phenomena that strongly influence the wear performance of the material in high-stress wear conditions. In low-stress conditions, these phenomena are mostly absent or have only a minimal effect. For these reasons, researchers do not usually recognise much correlation between low-stress laboratory wear tests and high-stress industrial applications. However, good correlation between laboratory and field tests can be achieved with a wear tester that can sufficiently reproduce the high-stress wear environment of a mining application.

Niko Ojala’s dissertation was conducted within the DIMECC Breakthrough Materials Doctoral School in the framework of the DIMECC DEMAPP and BSA programs.

Public defense of a doctoral dissertation on Friday 28 April

MSc Niko Ojala will publicly defend his doctoral thesis “Application oriented wear testing of wear resistant steels in mining industry” on Friday 28 April 2017 at 12:00 at Tampere University of Technology in Konetalo lecture hall K1702. Associate professor **Pål Drevland Jakobsen** (Norwegian University of Science and Technology, Norway) and PhD **Steven J Shaffer** (Bruker Corporation, USA) will act as opponents. Professor **Veli-Tapani Kuokkala** from the Laboratory of Materials Science will act as Chairman.

Niko Ojala comes from Tampere, Finland, and works as a researcher at the Tampere Wear Center of Tampere University of Technology.

The dissertation is available online at http://urn.fi/URN:ISBN:978-952-15-3941-1

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