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Technical Article

A Way to More Accurate Grinding Media Wear Prediction

Paper in Brief

A way to more accurate grinding media wear prediction

By Tapiwa Chenje

This is a technical note based on the development of the grinding media wear SWAT Test.

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Background

Although considerable research has been carried out on the mechanisms of ball wear, most of this work has concentrated on validation of the known theories of wear and their application to predicting ball size distribution in ball mills [Rajagopal and Iwasaki, 1992; Yelloji and Natarajan, 1991; Natarajan, 1992]. Consequently, the Bond abrasion test, dating back to 1963, is still used to estimate total mill media wear. This is a purely empirical test based only on ore properties.

A comparison of the wear/energy values resulting from the Bond abrasion test with actual mill data for five ores and 11 mills is shown in Figure 1.

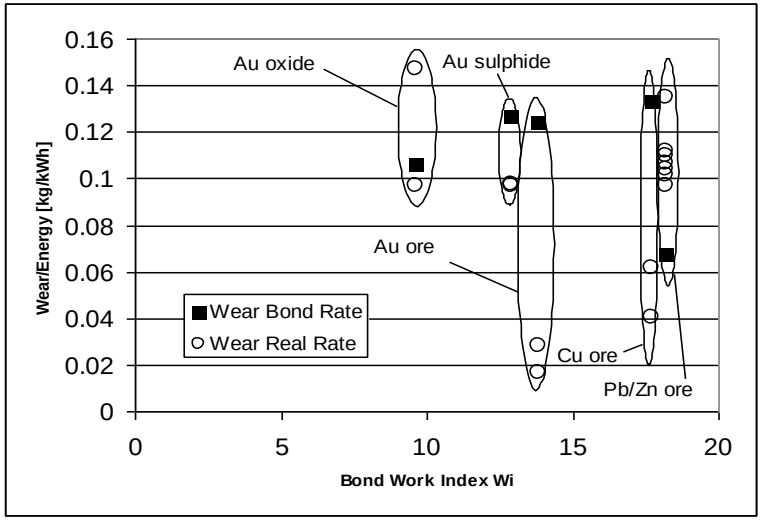

Figure 1: Wear/Energy results for the cases tested

The results showed an average error of –73% with a standard deviation of 192.5% [Radziszewski, 1999]. Such error significantly increases financial risk due to incorrect predictions of the cost of grinding, especially when applied to greenfield mining projects. The Bond test only considers ore characteristics, whilst neglecting other important parameters such as steel quality and operating conditions, which also affect media wear. The test is also unable to quantify the relative magnitudes of the three wear modes (abrasion, corrosion and impact) responsible for media wear.

The ability to quantify the relative contributions of each of the three wear modes to the total wear is vital in developing a method of accurately predicting the wear experienced in tumbling mills. Researchers in the Dept of Mechanical Engineering at McGill University in Canada have proposed a total media wear model that attempts to quantify the three wear modes and is also an alternative method of determining expected wear rates [Radziszewski,1999; Chenje and Radziszewski, 2004, 2005a, 2005b; Chenje et al. 2006, 2009; Radziszewski et al, 2005]. The researchers demonstrated that impact is not a significant contributor to incremental media wear and, short of catastrophic failure, is not easily quantifiable. Consequently, the resulting grinding media wear model only considers and measures the abrasion and corrosion components.

The SWAT Test

The grinding media test named SWAT, based on this total media wear model, uses a Steel Abrasion Wheel, a laboratory mill, as well as DEM modelling to determine the abrasion and corrosion components of overall grinding media wear. A comparison of the new test methodology with the same mill data used for the Bond comparison yielded an error and standard deviation of 0% and 17% respectively, which is significantly more accurate than the Bond Abrasion Test.

This grinding media wear test methodology has been licensed to JKTech which now offers it as a service to its clients.

SAMPLE AND DATA REQUIREMENTS

- Representative samples including ore, mill (process) water and any mill added chemicals like lime collected as per normal sampling procedures.
- Unused grinding media (minimum size 3 in) for testing.
- Operating data and dimensions of the mill in question

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