Laboratory Services

JK Rotary Breakage Test

In Detail

The JK Rotary Breakage Test is now commercially available, and offers industry a rapid method for determining accurate and reliable impact breakage characterisation data for plant design and optimisation.

JKRBT® Test Procedure

The JK Rotary Breakage Test procedure was developed in conjunction with the new JK Rotary Breakage Tester® (JKRBT®) at the JKMRC for the purposes of characterising the impact breakage of ore for use in AG/SAG mill and crusher modelling.

Firstly, the available sample is sized into four (4) size fractions: -45+37.5mm, -31.5+26.5mm, -22.4+19mm, -16+13.2mm. For each size fraction, between 20 and 30 particles are broken in the JKRBT® at three (3) set energy levels, giving twelve (12) size/energy combinations.

The particles are broken under impact at the required specific energy level using the JKRBT®, which simply involves placing the individual particle into the JKRBT® feeder and accelerating them to a predetermined velocity before impacting an anvil. The required specific energy Ec for a particle of mass m can be precisely controlled as the impact specific energy is solely dependent on the impact velocity v, since:

\[ Ec = \frac{1}{2} m v^2 \]

The breakage products of all particles for each size/energy combination are collected and sized. The size distribution produced is normalised with respect to original particle size. For a wide range of energy inputs, particle sizes and ore types, the relative size distributions remain similar in shape and can be described by a single point on the distribution. The JKTech convention is to use the percentage passing one-tenth of the original particle size. This is referred to as the “t10”

For the size fractions in the JK Rotary Breakage Test, the original particle size is estimated by the geometric mean of the size range eg. -45+37.5 = 41.1mm.

The set of t10 and Ec values produced by the tests at the 12 energy/size combinations are used to determine the ore specific parameters using the which are related using the New Breakage Model.
New Breakage Model

In conjunction with the development of the JKRBT®, the JK Centre has also developed a new breakage model. The new model links t10 and specific impact breakage energy Ecs via 2 material specific parameters (fmat and Emin) by

\[
t_{10} = M(1 - \exp[-fmat \cdot x \cdot k(Ecs - Emin)]
\]

where M (%) represents the maximum t10 for a material subject to breakage, fmat (kg/J/m) is the material breakage property, x (m) the initial particle size, k the successive number of impacts at the single impact energy, Ecs (J/kg) the mass-specific impact energy, and Emin (J/kg) the threshold energy below which breakage does not occur.

The JK ore hardness indicator Axb can be calculated using:

\[
A_{xb} = 3600 \cdot M \cdot fmat \cdot x
\]

where the constant 3600 is used for unit conversion. This relationship gives the size-specific Axb values. The overall Axb value from the JKRBT® results can be taken as an average of all particle sizes tested.