JKTech Specialist Software

JK SimMet

SMI Technology Transfer

In Detail

JKSimMet is an award-winning, general-purpose computer software package for the analysis and simulation of comminution and classification circuits in mineral processing operations.

Improvements in JKSimMet v5.2

- It is now possible to have up to six streams feeding any unit.
- The entire simulation/model fitting/mass balance system is now coded in double precision. This means better convergence and more stable operation.
- The number of fitable parameters and ports has been increased from 10 to 20
- The VR SAG mill model now warns if the simulated void fill fraction is >=1 and if the simulated load volume is more than 0.3% different from the measured value
- The number of units in parallel, if greater than 1, is displayed in the title bar of any associated equipment information block.
- The SG of the liquid is now a variable. The default is 1.0 but this can be changed in the flowsheet properties window.
- Four new icons are included - trommel, DSM screen, thickener, double deck screen. The trommel and DSM screen make use of existing models. A very simple thickener model is included and the double deck screen is simply two separately configurable single deck screens in series.
- The font type and size in graphs can now be selected from the available Windows fonts.
- Ball Mill power based on the Morrell formulae is now calculated for both overflow and grate discharge options and is displayable in an information block.
- The intermediate data file written to C: by the Mass Balance system has been eliminated.
- The most recent Hardlock Dongle driver is included.
- The interactive nature of data entry for t/h solids, t/h liquid and % solids has been disabled. It is now only possible to enter t/h solids and % solids.

JKSimMet Theory

JKSimMet can be used to predict the performance of a grinding circuit through the use of a circuit model which incorporates models of each unit operation in the circuit. The unit operations are linked to create a single circuit model using connecting streams. The model can be used to predict the circuit behaviour under different operating conditions, including differing breakage properties of the feed ore, changing throughput requirements or changes to the product P80 specification.

Comminution theory is an integral part of JKSimMet. Every unit operation is represented by a mathematical model describing the breakage and/or classification in that unit. The development of each model is based on years of research at the JKMRC. The details of each mathematical model in JKSimMet can be found in the User Manual or the Monograph.

The general theory behind using JKSimMet to mass balance a set of circuit data and tailor the mathematical models (model fit) to the specific circuit is covered below.

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Mass Balancing

When developing a model of an existing grinding circuit, the first step is to take a set of survey data and mass balance it. Mass balancing is a process in which the measured survey data is adjusted according to a minimisation of error method to give a set of data which balances perfectly across all units and for all components. The process is described by the following equation:

$$WSSQ = \sum_i \frac{1}{SD_i^{\,2}} \left(\mathrm{M}_i - B_i\right)^2$$

Where:
WSSQ = Weighted Sum of Squares
Mi= measured value of component i
Bi = balanced value of component i
SDi = Standard Deviation of measured value Mi

In mass balancing, the measured values include flows, densities, size fractions and components. The mass balancing method aims to minimise the Weighted Sum of Squares. For every measured value Mi there is a corresponding balanced value Bi which is an adjusted approximation of the measured value. Weighting is applied to each measured value according to the degree of confidence in the measurement of that value. The weighting or standard deviation of the measured data (SDi) affects how much the data is adjusted during mass balancing.

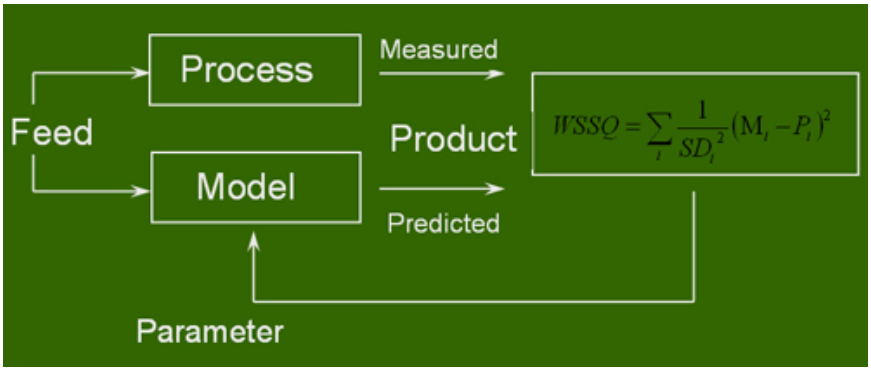
A high degree of confidence in a measured value equates to a small SD. The mass balancing process minimises the adjustment to values with small SDs since any adjustment will contribute greatly to the overall sum of squares error, according to above Equation. Conversely, a large SD means that there is less confidence in a measured value and the mass balancing process will allow larger adjustments to that value since the adjustments will not contribute as significantly to the overall sum of squares. In this way, the data is adjusted so that a fully balanced set of data is achieved which results in a minimum sum of squares error.

Model Fitting

The next step in developing a model of the grinding circuit is to take the mass balanced data and use it to customise the equipment models so that the predicted outputs from the models match the measured outputs. This process is called ‘model-fitting’.

JKSimMet contains models of many types of equipment commonly found in grinding circuits including: ball mills, AG/SAG mills, rod mills, hydrocyclones, crushers, screens and high pressure grinding rolls (HPGRs). Although the models for each unit operation are different, they have a number of characteristics in common.

Each model has two sets of parameters: machine dependent parameters and ore dependent parameters. The ore dependent parameters for a given circuit can be measured by carrying out tests on samples of the actual ore. The value of the machine dependent parameters vary depending on the specific operation and the best possible value for a given machine is determined in a process called “model-fitting”. Model-fitting is similar to the mass balancing process. The following diagram describes the process:



Parameters in the model are adjusted until the difference between the measured outputs from a process, Mi, and the predicted outputs from the model of the process, Pi, result in a minimum weighted sum of squares.

As in mass balancing, the measured values are assigned a weighting, or standard deviation, which defines how accurate the measured value is expected to be based on the confidence in the measurement procedure. A small SD means that there is a high degree of confidence that the measured value is accurate. The model parameters will be adjusted so that the measured and predicted values agree very closely. Conversely, a large SD means that the degree of confidence in the measurement technique of a value is not high and the model parameter adjustment will not be so sensitive in ensuring that the measured values agree closely with the predicted values.

The best values of the model parameters are those which give the lowest weighted sum of squares error between the measured and predicted outputs.

Simulation Studies – Existing Plants and New Plants

Once the two steps of mass balancing and model fitting are completed, the circuit model is ready to be used for simulation and optimisation studies. The comminution consultant is able to use the model to investigate the various options and determine the predicted results with changes in circuit details.

If the circuit does not exist, it is not possible to survey the plant and have real data to balance and model fit. In this case, the mass balancing and model fitting processes are impossible. Instead, suitable model parameters from a similar circuit treating similar ore are borrowed from the JKTech database of previous jobs and used in the model of the proposed new circuit. The model is developed based on these borrowed parameters and the simulation study is able to proceed.

JK SimMet

JKTech Services

- Consulting (comminution, flotation, mineralogy, mining & geometallurgy)
- Process Mineralogy and In-House Instrument Analysis
- Specialist Software (JKSimMet, JKSimFloat, JKMultiBal, JKSimBlast)
- Specialist Equipment (ore breakage characterisation, flotation characterisation)
- Metallurgical Laboratory Services
- SMI Knowledge Transfer

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