Determination of recovery in laboratory batch flotation tests

Laboratory batch flotation testing generally involves the determination of recovery for a given component of the system, for example copper or gold. The method used to calculate recovery is not as straightforward as you may first imagine. In fact, your method may even be introducing bias into your calculations.

Commonly, recovery is defined as \( R \) and mass flows and component assays defined by capitol and lower case initials for feed, concentrate and tail streams, respectively. Most metallurgists are content with using the mineral mass flows in concentrate and tails of the test to back-calculate the head assay and calculate recovery based on this value using the following formula:

\[
R = 100 \frac{C_c}{C_c + T_t} \%
\]

However, by simply conducting a head assay there are other ways recovery can be determined. A better method is to use the two product formula:

\[
R = \frac{100c(f - t)}{f(c - t)} \%
\]

If all mass flows are also known then the quality can be tested using the following equation:

\[
F_f = C_c + T_t
\]

The problem here is that the inherent error in all measurement ensures that this equation is never perfectly satisfied by raw data. But by using a simple mass balancing technique, the values can be adjusted until we have a self-consistent set of values which satisfy the condition of input equals output. Then the recovery can be calculated according to the first equation. This is the third and preferred method. A simple least sum of squares mass balance can be performed easily.
using a solver add-in which should be available in any current computer spreadsheet application. Mass balancing the data can be further enhanced by applying a weighting to each value according to expected error and also by including more components which must also satisfy equation 3.

Studies of one particular system have shown that the more data included in the determination of recovery the lower the recovery variance (from 18.3 in the first case to 7.8 for mass balancing with one component). In fact, the same study showed a bias in the results from the first case as well, which is even more of a concern.

Using the mass balancing technique ensures that the recovery estimates from laboratory flotation batch tests is more reliable and can be used with more confidence for future analysis.

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