CHAPTER 5
SUMMARY AND CONCLUSIONS

The main objective of this investigation was to compare the various forms of release analysis used to determine optimum flotation response through the use of computer simulation and experimental techniques. The purpose of this work was to identify the best release analysis technique or techniques, determine if these techniques approach the ideal flotation separation, and propose alternative methods or concepts for producing an ideal separation curve. The main conclusions from this investigation are summarized as follows:

1. Of timed release analysis, simplified release analysis and tree analysis, the original timed release analysis technique yielded the best overall yield-vs.-ash curve both in terms of experimental data and simulation.

   Timed release analysis is able to extend down into the low-ash, low-yield region of the curve due to the refloating of the various timed fractions. This gives misplaced particles additional opportunities to end up in the proper flotation fraction. Timed release analysis is slightly low at the “elbow” of the curve, but this problem is generally small. Simplified release analysis is good at the “elbow” of the curve, but does not do a good job of representing the low-ash, low-yield region. This is due to the fact that in the second stage of the simplified procedure, some high-ash particles will always report into the first low-ash fraction (i.e., the high-ash particles have some probability of floating, even if the rate constant is low). Tree analysis can extend down into the low-ash, low-yield region, but this generally requires a 5- or 6-level tree. Such procedures require an inordinate amount of effort. For a 4-level tree, the curve is truncated prior to the low-ash, low-yield region. Tree analysis also tends to miss the “elbow” of the curve.

2. An alternative technique known as reverse release analysis was found to be the best technique of all procedures tested.

   The new procedure provides the advantages of simplified release analysis in terms of predicting the “elbow” and the advantages of timed release analysis in terms of extending into the low-ash, low-yield region. This finding was confirmed both by simulation and experimental data. The procedure is similar to simplified release analysis except the order of flotation is reversed in the second stage. Products in the second stage are produced starting with high-ash, high-yield and proceeding to low-ash, low-yield. Concentrates are refloated each time and the tailings are saved for analysis. As a result of reversing the order of flotation, the entrainment of high-ash material or the misplacement of high-ash material is minimized.
3. A technique based on a rougher-cleaner-scavenger circuit with recycle would be capable of approaching an ideal separation and would provide the best form of release analysis. None of the existing release analysis procedures was able to approximate an ideal flotation separation.

Simulation tests showed that a locked-cycle RCS circuit is capable of approaching the ideal separation. One stage of cleaner and scavenger cells is roughly equivalent to the best of the release analysis techniques currently available. Three stages should provide an adequate separation curve. Five stages is almost ideal. Recycle is important in making sure misplaced particles end up in the correct products.

4. Mathematical models and simulations of the various release analysis procedures were found to accurately describe the trends observed in the experimental data.

A simple batch flotation model was used to describe each flotation event in each of the analysis techniques. Flotation rate constants were estimated from one simplified release analysis tests. These rate constants were then used in all other simulations. The accuracy of the prediction in the trends of the various types of release analysis as compared to the experimental results was quite remarkable.