Abstract

Jigs have been used in mineral beneficiation for many years. They have a number of desirable qualities some of which include simplicity of operation and cost effectiveness. Jigs have been successfully applied for the beneficiation of a number of minerals and are extensively used in the processing of iron ore and coal.

The concept of process optimization is one that is fundamental in the processing of minerals. Likewise it applies to the jigging processes as performance has been found to be a function of the feed characteristics e.g. feed composition and density distribution. The effect of the size range and the particle size has largely been untested on jig performance. Hence, this investigation aims to shed more light on the influence of these two factors on jig performance.

Mathematical models of mineral processes have been increasingly used as a cost effective way to investigate different processing options. In the case of the modeling of jigs, King`s stratification model has been found to be particularly useful. Although its efficiency as a simulator has been proven for synthetic systems in which particles have essentially the same size and shape, its applicability has not been investigated for practical contexts where size and size range vary significantly. This context is the focus of the investigation reported in this thesis.

Using a batch jig, tests were conducted on a typical South African coal. The choice of coal as a test material was motivated by the ease with which density distributions can be measured for coal systems. The coal samples were screened into different size fractions and 15 different combinations of particle were prepared for testing in a laboratory batch jig.

The results show that for the samples tested the quality of separation increased as particle size increased i.e. improvements in jig performance of between 10% and 20% were achieved in some samples as the particle size was increased. On the other hand the quality of separation decreased as the size range increased. It was also found that the jig performance is more sensitive to particle size than it to the particle size range. The study revealed that the King model is a good simulator of stratification behaviour of jigs as it was able to produce reasonably good levels of agreement between modeled and experimental data for most samples that were tested.

No apparent trend could be observed with regard to the effect of variations in size and size range on the stratification parameter in the King model. It appears that in the context investigated in the study, this parameter is relatively independent of size and size range and was fairly similar for all tests conducted in this study. In several of the tests, particularly those with a large range of sizes, the model did not fit the data very well. However, in general, it appears that the King model can be used with the same degree of confidence as a simulator for systems where the ratio of the top to the bottom sizes of the jig is 2.4 or less.