ABSTRACT

The prevalence and treatment of low grade, finely disseminated iron ore has resulted in the production of primary and secondary slimes that constitute potential resources. Slimes processing is hindered by the particle size limits of current process equipment and this dissertation explores the potential of coupling selective flocculation with magnetic and gravity separation to improve separation efficiencies.

Base case tests (without selective flocculation) were conducted on the SLon-100 (laboratory scale pulsating Wet High Intensity Magnetic Separator) and the laboratory scale Reflux Classifier (RC). The base case tests were conducted to determine the optimal intensity for the SLon-100 and a semi-batch test was done on the RC to determine the effect of increasing water fluidisation rates on the response variables namely Fe concentrate grade, Fe concentrate recovery and separation efficiency. Thereafter selective flocculation conditions were optimised by coupling the process with magnetic separation in order to determine the effect of the operating variables on the response variables mentioned above. A Box-Behnken design was utilised and the ANOVA models developed for the significant response variables were used to optimise the selective flocculation process by simultaneously maximising the response variables whilst minimising the three factors (sodium oleate, paraffin dosage and conditioning time). The optimised selective flocculation conditions were then coupled with the RC in order to compare magnetic and gravity separation with and without selective flocculation.

The optimised selective flocculation conditions (1 kg/ton sodium silicate; pH 10; 500g/t sodium oleate; 1431.1g/t paraffin and 4.6 min conditioning time) coupled with magnetic separation showed improved metallurgical performance when compared to the base case test. Selective flocculation coupled with magnetic separation improved the magnetic product Fe grade from 52.28±0.38% to 59.21±0.42% Fe whilst simultaneously improving the separation efficiency from 40±1.46% to 56.8±2.0% and maintaining the Fe concentrate recovery within the 95% confidence limits (69.9% to 72.1%). These results were achieved under laboratory and ideal conditions and may differ from industrial scale results. Inconclusive results were achieved with selective flocculation coupled with the RC and additional testwork is recommended.