ABSTRACT

The work presented in this study involves investigation of ways of improving recovery of slow floating minerals in a single stage (MF1) Platinum Group Metal milling and flotation plant at the Zimplats Selous Metallurgical Complex. This study was conducted with an aim of improving flotation of PGMs by measuring the slow floating ratio (SFR) and analysing the effect on grade and recoveries as dosages of flotation reagents are altered. The fast floating fractions are usually recovered earlier on in the flotation circuit whilst the slower floating values are recovered at the back end of the circuit in the scavengers, cleaners, and high energy cells. The work presented here investigates the use of reagents in improving flotation kinetics of the slow floating fraction and improve its recovery in this part of the circuit to prevent the values being lost with the tailings.

Batch flotation rate tests were conducted on "in plant pulp" sampled from three sections of the flotation circuit namely, the scavenger, cleaner and high energy cells as the sections of the circuit where the slow floating fraction was most likely to be present. Different dosages of collector and depressant were added and flotation response measured. Chemical determination of the float test results was conducted by Nickel Sulphide fire assay with Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) finish. The kinetic parameters were investigated by fitting the experimentally obtained data into the Kelsall's unmodified rate equation using the KinCalc® flotation kinetics calculator.

Rate tests carried out on scavenger feed indicated that feed to the third bank of the scavenger circuit was most appropriate reagent testing station. Scavenger Bank 3 Feed was chosen as point of addition of reagents to isolate the banks with the majority of slow floating mineral. Addition of depressant to the feed to the third bank showed an improvement in SFR from 12.28 to 21.64 with the addition of 25g/t of depressant as the depressant acted on the floatable gangue. However, further depressant addition had a secondary effect of also reducing floatability of mineral values and SFR fell to 20.07 with 50g/t depressant and further to 11.69 with 100g/t depressant. These results showed the potential of staged addition of the depressant to the cells processing material with mostly slow floating values. Results on collector addition to third scavenger bank feed showed a minimal change in SFR with collector addition, however there were higher recoveries obtained due to the high mass pull

observed. Better grades were obtained at a dosage of 30g/t collector than at 60g/t because the excess collector increased the pulp viscosity which led to massive entrainment of fine gangue material.

Rate tests done on cleaner feed showed a decrease in slow floating ratio (SFR) with depressant addition. Recovery of PGMs also fell with depressant addition as the depressant inhibited the flotation of both floatable gangue and mineral. Tests carried out with collector addition to cleaner feed indicated a small increase in SFR from 1.88 to 2.01. The recoveries achieved were lower with collector addition than without any reagent addition to cleaner feed.

Depressant addition to the high energy cell tailings showed that SFR increased in direct proportionality to dosage. Good recoveries of above 90% were obtained with all tests within the range of reagent dosage considered. The concentrate grades achieved were higher than as received flotation as floatability of gangue was reduced by the depressant. Collector addition also led to improvements in SFR however those improvements as well as recoveries obtained were generally lower than those observed with depressant addition as collector works less efficiently due to the lower number of liberated mineral faces to attach to in this part of a flotation circuit.

Sieve analysis was carried out on high energy cell tailings to ascertain if there was any need for regrinding showed that the particle size distribution of the tailings was 89.6% passing 75µm. This grind is adequate for the flotation of PGMs and hence regrinding was not done.