

CHAPTER 5 MODIFIED LEEDS CELL

Various collectors and combinations of trithiocarbonate, mercaptans and xanthates were tested with a modified 3 litre Leeds cell at UCT. Grades and recoveries were obtained from concentrate and tail analyses.

5.1 Materials and methods

Six collectors were chosen for evaluation on Merensky ore. A solvent (polymer/SX12) for the iC_3 -TTC was used to prepare an emulsion. Two concentrations of this emulsion were prepared for batch flotation. Combinations of covalent collectors, long chain mercaptans and iC_3 -TTC (Table 5.1) were compared to the standard collector suite (SIBX/DTP). The ore was milled to 80% -75 μ m with a rod mill for 10 minutes. Samples of the tails and concentrate were analysed for S, Cu, Ni and Fe. The collector suites tested were performed in duplicate.

Table 5.1 Collectors tested with modified Leeds cell

Collector	Mixture
STD (SIBX/DTP)	1:1 mass
iC_3 -TTC(30%)	30% iC_3 -TTC in SX12
iC_3 -TTC(40%)	40% iC_3 -TTC in SX12
iC_3 -TTC	Powder
iC_3 -TTC- C_{12} -merc	9:1 molar
iC_3 -TTC(30%)- C_{12} -merc	9:1 molar

5.2 Experimental

The same experimental procedure was used as described in section 3.4.1, but with a different flotation cell. A modified three litre Leeds cell with mineral probes, pH meter, thermometer and dissolved oxygen meter was used to perform the batch flotation tests. Mineral potentials were measured during the conditioning time of the floats and will be discussed in Chapter 6. The rate of recovery can be calculated from the five concentrates taken and grade recovery curves could be plotted.

5.3 Results and discussion

5.3.1 Mass and water recovery

Water recovery is a tool to evaluate gangue entrainment. If there is a good correlation between mass and water recoveries, then the higher the water recovery the more chance there is for entrainment. Figure 5.1 and 5.2 shows the water and mass recoveries versus time for the six collectors tested.

The same trends occur from previous batch floats. The standard collector suite has the highest mass-pull of all chemicals tested, followed by the emulsion mercaptan mixture and then the rest. Appendix C shows that there is a good correlation between mass and water recovery for all the collectors tested. From this one can say that there will be more entrainment for the standard collector suite than the other collectors tested and this will reduce the grade of the concentrate and will result in lower recoveries because of the gangue recovered with the entrainment with water recovery.

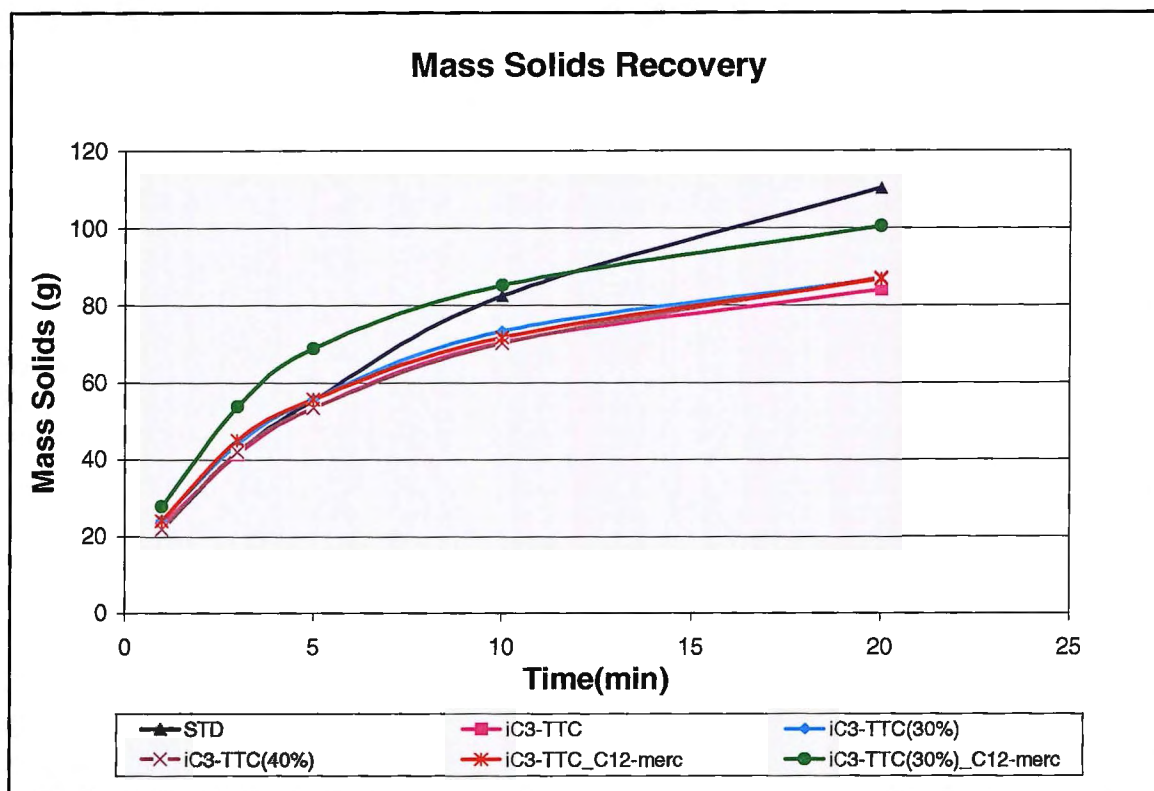


Figure 5.1 Mass recovery vs time

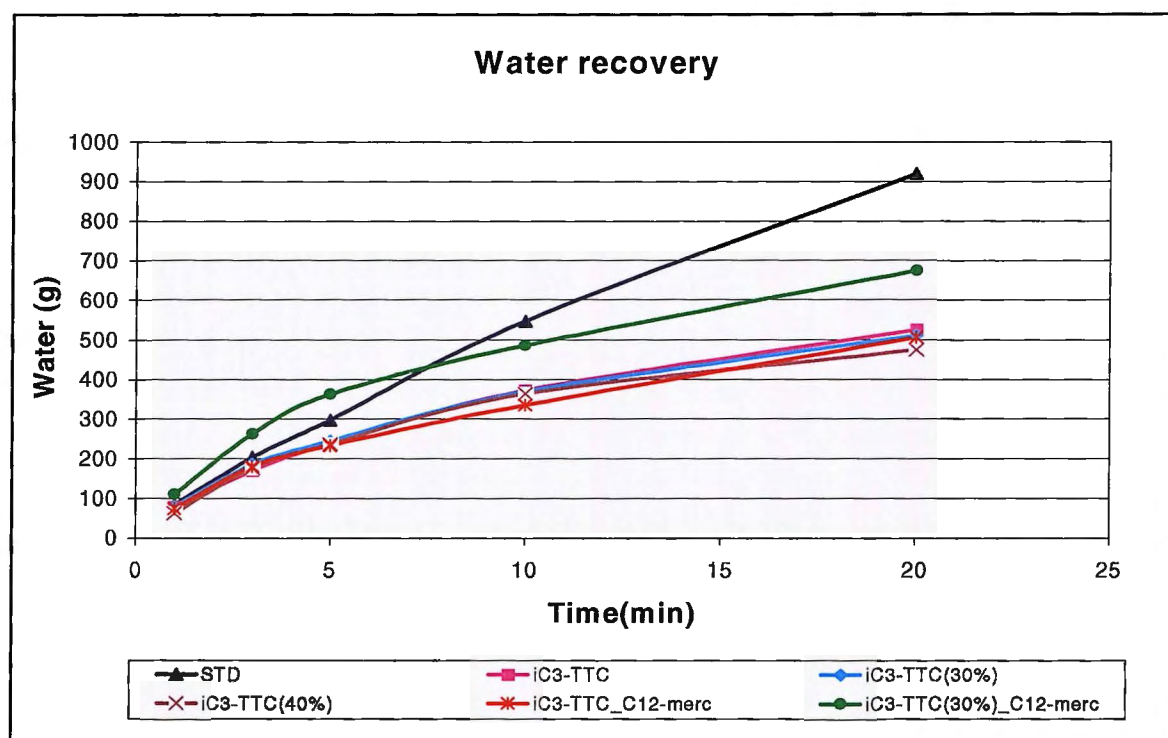


Figure 5.2 Water recovery vs time

5.3.2 Effect of collectors on grades and recoveries

The collectors tested were analysed for S, Cu, Ni and Fe. Grade recovery curves were plotted to evaluate the collectors and their rates were determined with recovery time curves. Appendix C shows the different recovery time curves for the precious metals. It could be expected that not very high grades would result from these batch tests, because no depressant was used as discussed earlier.

5.3.2.1 Sulphur

Merensky ore can be classified as a sulphide ore and all the platinum group minerals contain sulphur. An improvement on sulphur recovery would suggest an increase in PGM recovery. Figure 5.3 shows the grade recovery curves of the collectors tested. Five concentrates were taken and analysed to plot the grade recovery curves.

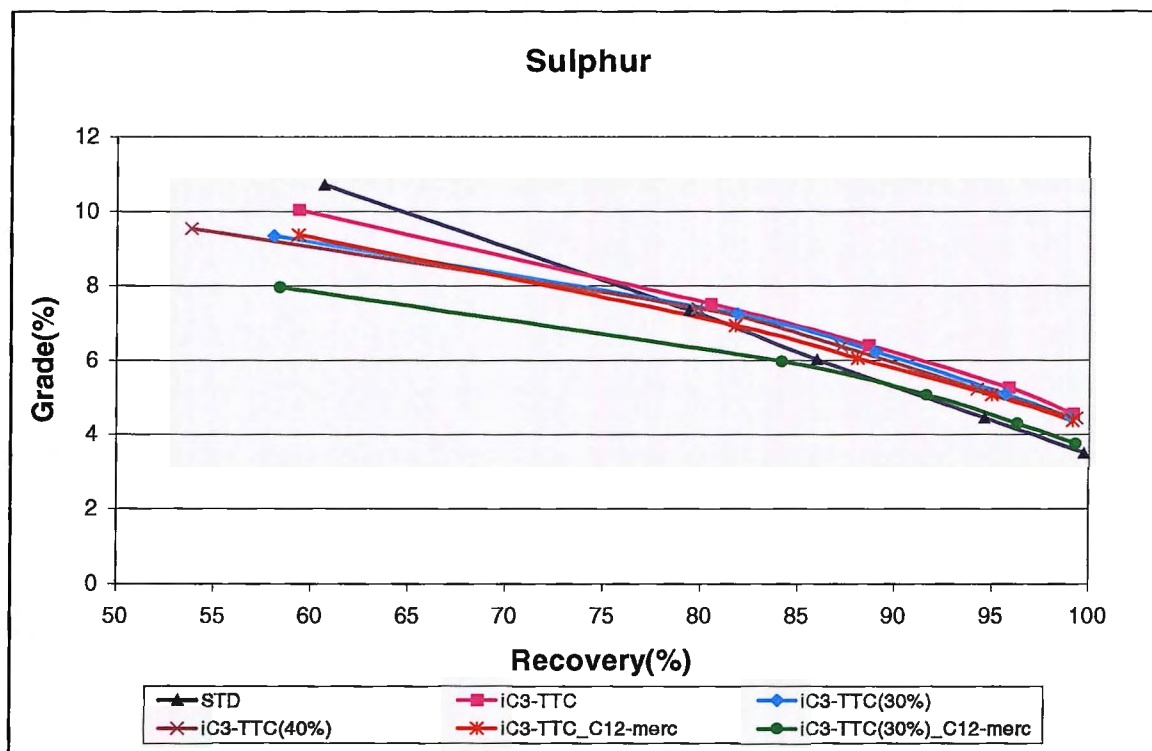


Figure 5.3 Grade recovery curve of sulphur

Final recovery of all the collectors were above 99% and one cannot draw any conclusions from this. The iC₃-TTC powder had the highest grade and from Appendix C it can be seen that the emulsion-mercaptan mixture had the highest rate of all collectors tested.

5.3.2.2 Copper

The standard collector suite, SIBX/DTP-mixture, performed better on copper from previous batch floats discussed in Section 4.5.1. The copper grade recovery curve is shown in Figure 5.4.

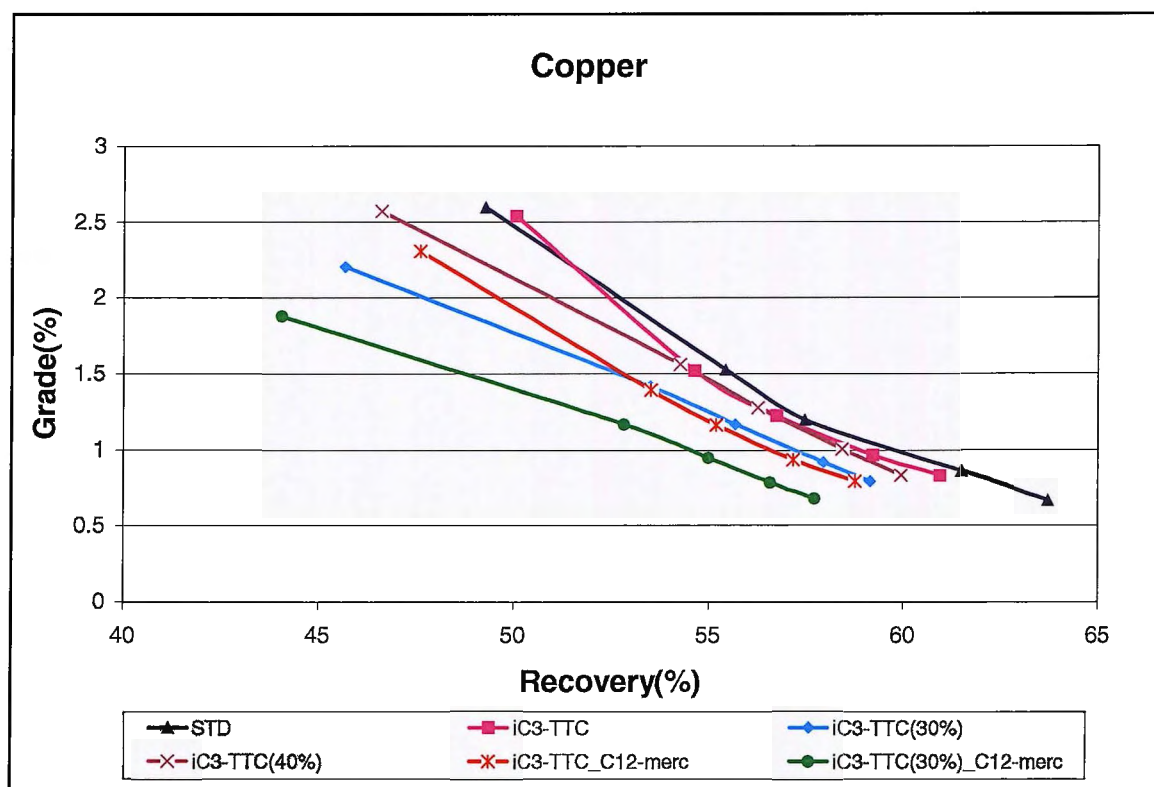


Figure 5.4 Grade recovery curve of copper

Again the standard collector outperformed the other collectors on final recovery and it is known that copper float well with xanthates. In this case the long chain mercaptans had a negative effect on copper recovery for the iC₃-TTC powder and in the solvent. The iC₃-TTC powder had better grades than the standard collector had, but the higher mass recovery of the standard resulted in higher final recovery. Figure C1.3 in Appendix C shows that the standard collector had the best rate of recovery and the order of the rates were the same as the order of recovery.

5.3.2.3 Nickel

Nickel is usually associated with pentlandite, but in general higher nickel recovery means higher pyrrhotite recovery. The nickel results are displayed in Figure 5.5 and Appendix C2.

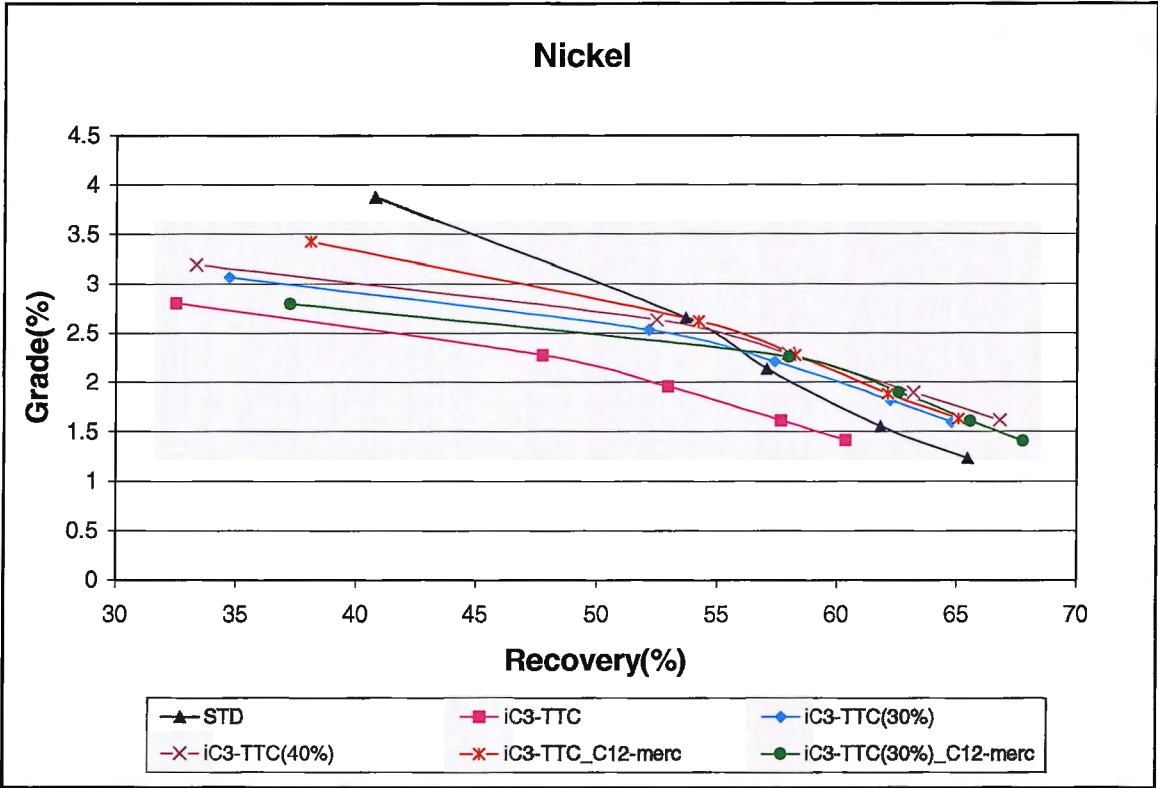


Figure 5.5 Grade recovery curve of nickel

The nickel grade-recovery curves show that the recoveries of nickel were significantly improved by some of the reagents. The best are iC_3 -TTC/ C_{12} -merc, iC_3 -TTC(30%)/ C_{12} -merc and the iC_3 -TTC in the emulsion for both concentrations. iC_3 -TTC on its own was not as good as the standard. The crossover effect of the standard collector curve emphasises the effect the reagents have on the water and solid's recoveries and rates. All the reagents tested had higher grade than the xanthate, but no great improvement is shown on recoveries because of the lower mass pull of the tested reagents compared to the standard. The TTC reagents appear to increase rates of recovery of nickel, while decreasing the rate of copper recovery. In this case the collectors with the long chain mercaptan performed better than the collectors on their own. The fact that increased nickel recovery occurs with the TTC in the emulsion is significant because it does not contain mercaptan.

5.3.2.4 Iron

Measuring pyrrhotite recovery with iron is not a good method as there is so much iron in the gangue and gangue is always the main constituent in the concentrates. Figure 5.6 and Appendix C2 show the grade recovery and recovery time curves of iron for the different collectors tested.

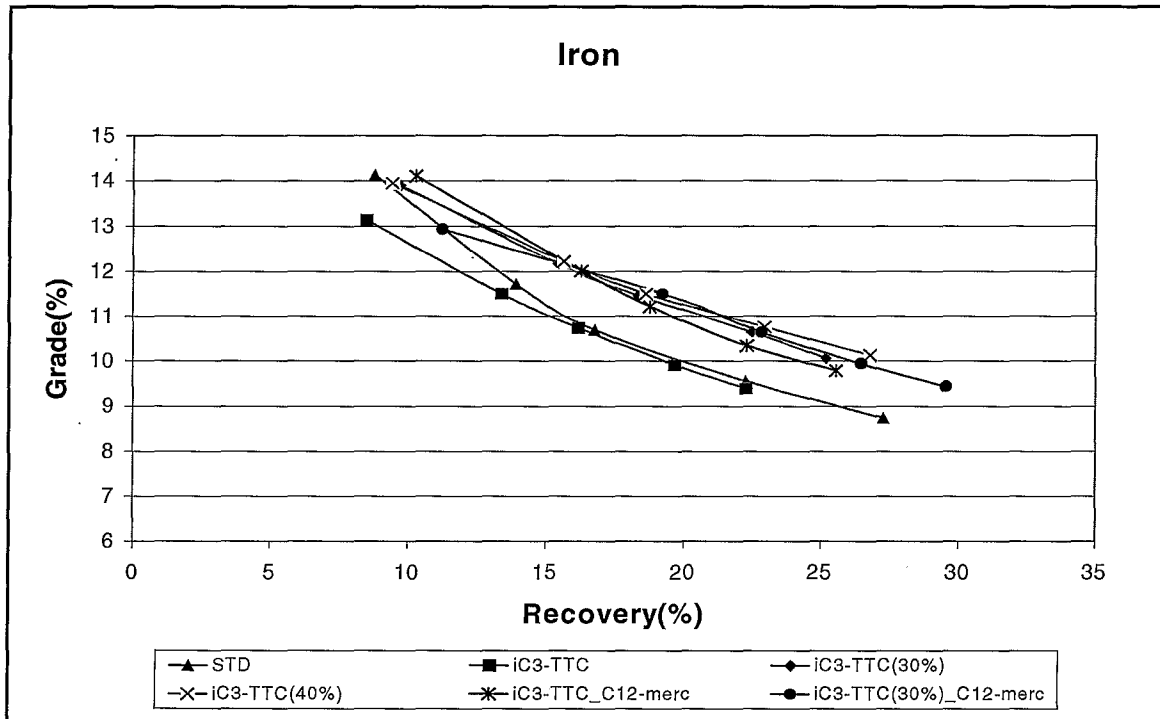


Figure 5.6 Grade recovery curve of iron

According to Steyn (1997) the iC_3 -TTC collected more PGM's as a result of collecting more iron containing minerals. Figure 5.6 shows that only the emulsion-mercaptan mixture had higher iron recovery than the standard. The iC_3 -TTC powder had the lowest iron recovery, but all the TTC collectors had a better grade than the standard collector suite. This means that the overall rate of recovery for the TTC collectors is better than the standard and the valuables spend less time in the flotation system. The introduction of the long chain mercaptans had a positive effect on iron recovery. An explanation for the low iC_3 -TTC recovery can be that the most iron is situated in the gangue. The entrainment of the standard collector was higher than that of the other collectors, because of the higher water recovery. The iron results do not represent only the iron containing minerals, but the iron associated with the gangue and the milling media.