7 CONCLUSIONS

In the present work it was found that an oscillating magnetic field, applied to a flotation column, affected the flotation of magnetically susceptible sulphide minerals under specific magnetic field conditions (frequency and magnetic field strength). This technique can be used to *depress* the flotation of magnetically susceptible minerals such as pyrrhotite which occurs naturally with nickel bearing minerals such as pentlandite.

The mechanism by which the magnetic field influenced the flotation of the magnetically susceptible minerals is probably due to the mechanical oscillation of magnetically susceptible minerals. For conditions where the particles oscillated, the flotation recovery of sulphide sample decreased due to loss of contact between the particle and the bubble. Increasing the number of oscillations on the magnetically susceptible particles attached to the air bubble, by increasing the retention time, caused the flotation recovery to decrease. Increasing the amount of collector strengthened the bond between the particle and the bubble. This countered the negative effect of the magnetic field on the flotation recovery of the magnetically susceptible minerals.

The orientation of the magnetic field determined the direction of oscillation of the magnetically susceptible particles. A field perpendicular to a rising air bubble caused particles attached to the bubble to rotate freely, whilst a field oscillating parallel to the rising bubble, challenged the contact bond and caused the particles to lose contact with the air bubble.

The flotation of monoclinic pyrrhotite was depressed by a magnetic field. There was no significant difference in the depressing action of the magnetic field when changing the position of the magnetic field from the collection zone at the bottom of the flotation column to the rising bubble zone in the middle of the flotation column. The detachment of the rotating pyrrhotite particles seemed to dominate the flotation behavior of the pyrrhotite in a magnetic field.

For synthetic samples of pyrite and pyrrhotite it was found that the pyrrhotite could be selectively depressed by oscillating the pyrrhotite particles using a magnetic field.

In the presence of chrysotile, the flotation recovery of pyrrhotite was greatly depressed by a magnetic field as a result of the restriction of the movement of the pyrrhotite by the chrysotile fibers. On the other hand, the flotation recovery of the non-magnetic pyrite was not influenced by the magnetic field. Weakly hydrophobic quartz was dislodged from the air bubble by collisions with the oscillating pyrrhotite particles. This improved the grade of the flotation concentrate.

The chemical reactions between pyrite and xanthate did not appear to be affected by an external magnetic field. A magnetic field with maximum frequency of 140Hz and a field strength of 1200 Gauss did not alter the speciation of the xanthate products in the solution nor did it alter the rate of decomposition of xanthate ions. The flotation response of pyrite did not change by conditioning the pyrite in a magnetic field.

Pilot column testwork, carried out at Nkomati Mine, on a nickel sulphide cleaner stream, showed that copper recoveries were not significantly affected by the magnetic field. The copper grade obtained was higher than that for the standard test at low airflow rates, possibly due to the depression of pyrrhotite. Nickel in the cleaner feed stream is closely associated with pyrrhotite and depression of pyrrhotite caused some loss in nickel recovery. The combined base metal grade recovery curve, where a magnetic field was applied to the flotation column, was higher than that obtained under standard test conditions. This indicates that improved flotation efficiency can be obtained by applying a magnetic field to a flotation column.

This work has shown that pyrrhotite can be successfully depressed by applying an oscillating magnetic field to a flotation column. Both the grade and recovery of a base metal flotation concentrate can be improved by applying an oscillating magnetic field to a flotation column.

Finally, due to practical constraints of applying a uniform magnetizing field to a large diameter flotation device, this technique is best suited for specialized applications with small diameter columns.