

5 EFFECT OF MAGNETIC FIELDS ON FLOTATION CHEMISTRY.

5.1 Introduction

The effects of magnetic fields on chemical reactions were, until recently, viewed with skepticism. However, Hayashi (1992) reported on the possible effects of magnetic fields on chemical reactions. It was reported that many chemical reactions, which occur through radical pairs, are influenced by magnetic fields below 2000 Gauss. However, although individual molecules in solution generally exhibit either diamagnetic or paramagnetic behaviour, Hayashi (1992) showed that the reactions of these molecules are not easily influenced by magnetic fields strengths of 2000 Gauss.

Another effect that a magnetic field may have on chemical reactions is by an induced electro-motive force (emf). An oscillating magnetic field induces an emf on any material in the magnetic field. Since the reaction between xanthate ions and pyrite is an electrochemical reaction, it is possible that the induced emf could alter the potential on the pyrite surface, which would in turn influence the chemical reactions supporting the development of hydrophobicity.

The reactions between pyrite and potassium amyl xanthate (PAX) during conditioning in a magnetic field were investigated. This was to establish if a magnetic field has any effect on the type of species that formed during the conditioning and/or the rate at which the species formed. Micro flotation tests were also done to evaluate the effect of conditioning pyrite in a magnetic field.

5.2 Experimental set-up

UV spectrophotometry was used to examine the species formed during conditioning of pyrite and PAX in the presence and absence of a magnetic field. One gram of pyrite, as prepared for the micro flotation tests, was conditioned in 200ml of 10mg/l PAX solution. A water-cooled copper coil similar to the one shown in figure 3-1, was used to produce a magnetic field of 1000 Gauss at 100Hz. The beaker containing the pyrite and xanthate solution was placed in the magnetic field and agitated using a stirrer with a perspex impeller. Five 4ml samples were withdrawn from the beaker and filtered to remove any pyrite, after 2.5, 5, 10, 15 and 20 minutes. The same experiment was done without a magnetic field. The filtered solution was analysed using a UV spectrophotometer, scanning from 200 to 400nm at a rate of 2nm/second.

The pyrite flotation tests were done in a Hallimond tube where all the procedures, as described before, were followed. The flotation tests were done after 2.5, 5, 10, 15 and 20 minutes of conditioning. The flotation test conditions are shown in table 5-1.

Table 5-1: Experimental conditions to examine the effect of conditioning in a magnetic field on the flotation of pyrite

Flotation Device	Hallimond Tube
Flotation Time	60 sec
Conditioning Time	Variable min
Conditioning Temperature	20 °C
pH	7.4
Xanthate Concentration	10 mg/l
Magnetic Field Frequency	100 Hz
Magnetic Field Strength	1000 Gauss
Magnetic Field Type	Coil

5.3 UV-results and discussion

Figure 5-1 shows the various wavelengths where characteristic xanthate species peaks are observed with the relative molar absorptivities indicated. Xanthate ions ($-\text{OCS}_2^-$) exist in solution and decompose by numerous reactions, depending on the pulp potential and pH as shown by Prestidge et al (1993). At a neutral pH, the xanthate ions form attached dixanthogen which dissolved (Ralston, 1991). As the molar UV absorptivities of the different xanthate species differ, it is possible that some of the species with weaker absorptivities were not detected, as the result of the intensity of the xanthate ion and CS_2 peaks.

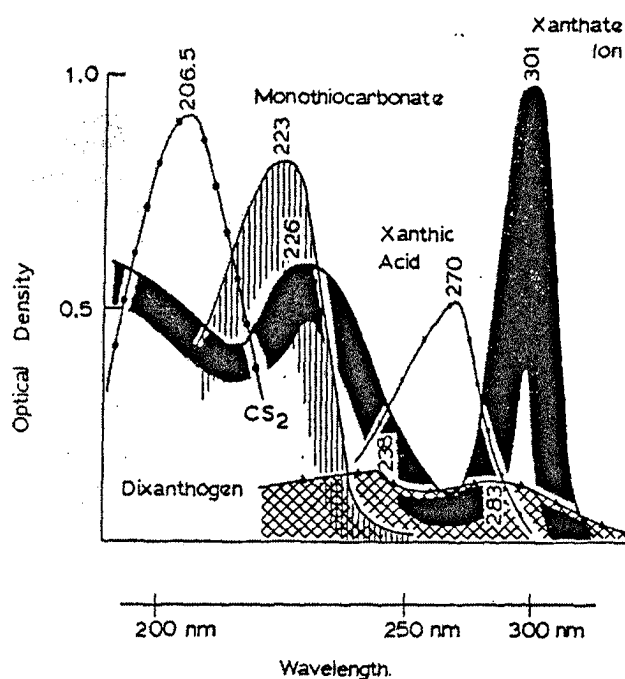


Figure 5-1: UV Spectra of characteristic xanthate species in solution.

Figure 5-2 shows the UV spectra for a xanthate solution and for a xanthate solution in contact with pyrite, both in the presence and absence of a magnetic field after 20 minutes. It is evident from figure 5-2 that an applied magnetic field did not significantly change the spectra. No new peaks appeared on the UV-spectrum, indicating that the xanthate species present during conditioning were not

altered by the magnetic field, at least not in a way that could be discerned on the UV-spectra.

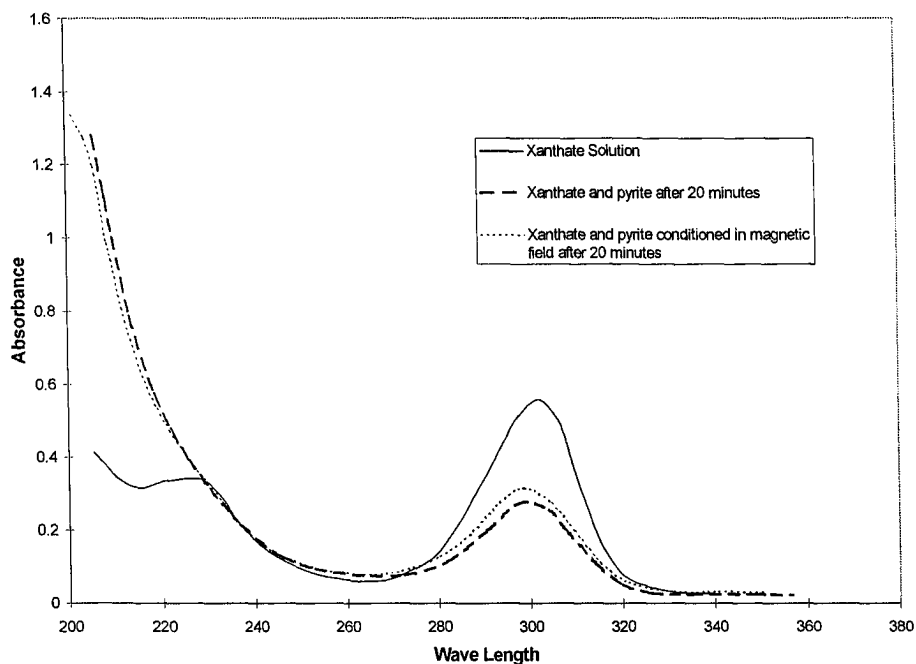


Figure 5-2. UV spectra of 10mg/l xanthate solutions, and xanthate in contact with pyrite at pH 7 after 20 minutes in the presence and absence of a magnetic field.

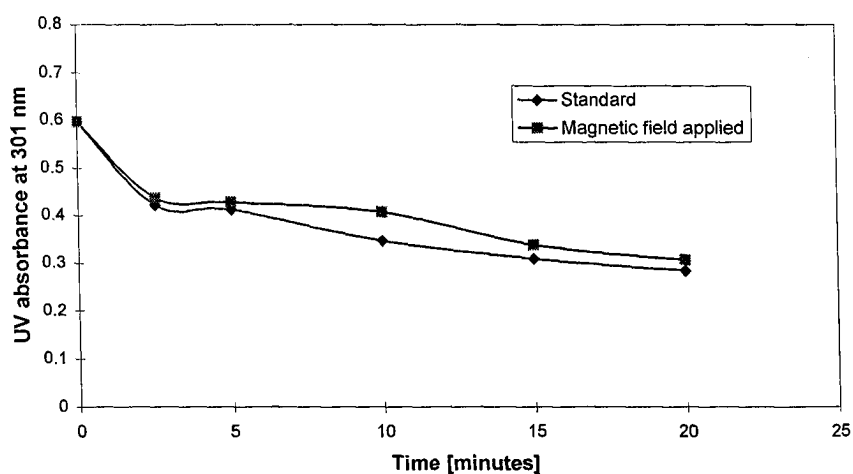


Figure 5-3. Decrease with time of xanthate absorbance at 301nm in the presence of pyrite, with and without an applied magnetic field.

Figure 5-3 shows the concentration of xanthate ions as characterised by the height of the 301nm peak with time, both in the presence and in the absence of a magnetic field. The rate at which xanthate ions react with the pyrite surface is similar in the presence and absence of a magnetic field, although the absorbance obtained in a magnetic field was slightly lower than without the field.

5.4 Flotation test results and discussion

Figure 5-4 shows the effect of conditioning time on the flotation response when pyrite is conditioned in a xanthate solution with an applied magnetic field. The flotation recovery increases with time and then leveled off after 5 minutes of conditioning time, as can be expected for a batch experiment. No significant difference was found between the tests done with and without a magnetic field.

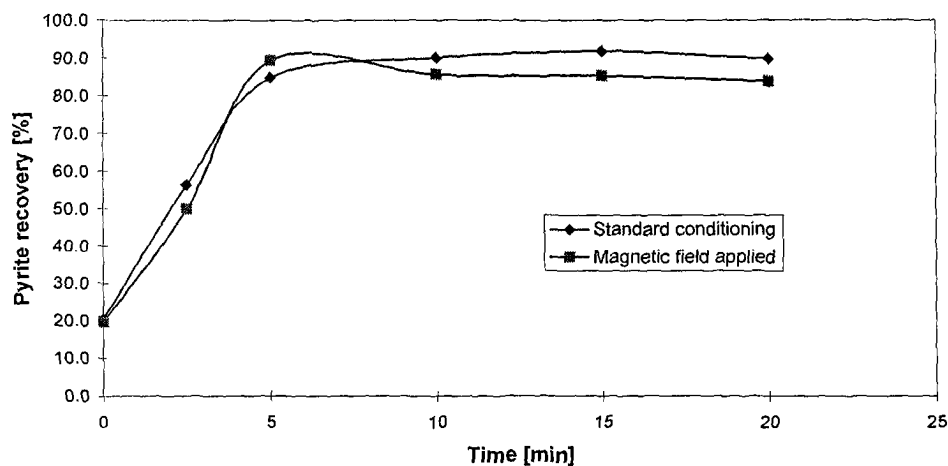


Figure 5-4. The effect of conditioning time and the presence of a magnetic field during conditioning on the flotation of pyrite.

5.5 Conclusions

The presence of a magnetic field did not change the species present during conditioning of pyrite in a xanthate solution. The rate at which xanthate disappeared from solution was also not affected by the magnetic field. Flotation tests also showed that magnetic fields applied during conditioning did not influence the flotation response of pyrite.