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THE EVALUATION OF HGMS FOR MINERAL PROCESSING WITH A SINGLE WIRE

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Abstract

In this short communication it is shown that it is possible to undertake inexpensive but useful preliminary mineral studies using single-wire HGMS. Such studies enable an assessment to be made of the viability of HGMS as a large-scale processing technique for particular mineral slurries.

INTRODUCTION

Expensive pilot tests on high gradient magnetic separators(HGMS) can be circumvented (or at least partially replaced) by studies in a single-wire cell. Material captured on a magnetised wire takes either the shape of spikes, for the ferromagnetic case, or a smooth deposition for the paramagnetic material. In either case, the collected material could be further evaluated microscopically (e.g. using a scanning electron microscope) in order to establish the correct percentage composition of the constituents of the test material.

This paper reports on some of the studies outlined above which have been carried out on a variety of mineral ores.

EXPERIMENTAL

Material analysis using the single-wire cell encompasses the use of a flow cell in which the wire is incorporated, an electromagnet, a microscope and a video camera coupled to a recorder and

a monitor, as shown in Figure 1.

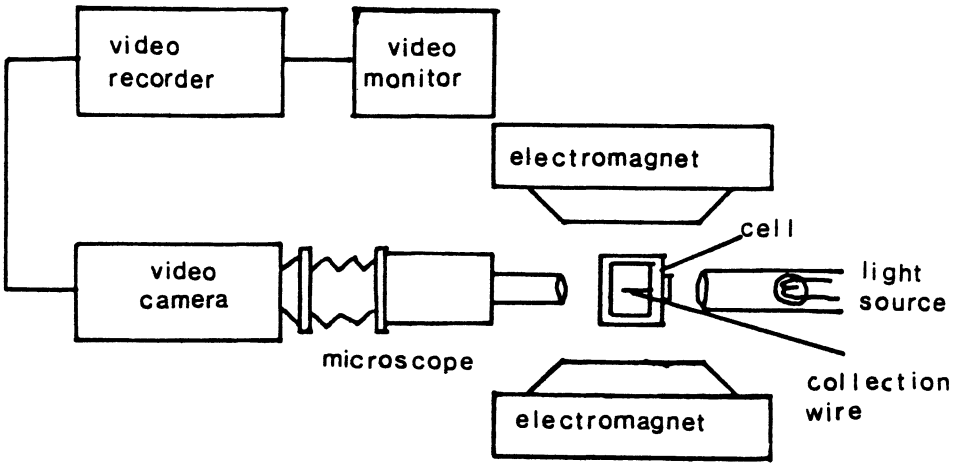

Fig. 1 Schematic diagram of the single-wire apparatus.

The flow cell used consisted of a perspex channel 35 cm long, 0.61 cm wide and 1.1 cm deep, and a demountable perspex lid. The wire was mounted on a perspex plug which screws into the back of the channel, 30 cm from the fluid entrance end of the cell. An optical quantity glass window is mounted in the perspex lid opposite the plug, through which the cross-section of the wire could be viewed. The cell was placed between the poles of the electromagnet with the wire lying at the centre of the field and perpendicular to its direction. Dimensions of the channel and the position of the wire were chosen such that turbulent flow in the cell was prevented [1,2].

A typical experiment involved the introduction of small quantities of the sample under test into the channel in which a carrier fluid (water) was already flowing at the prescribed velocity. Particle build up on the wire was then recorded under different field and flow conditions.

RESULTS AND DISCUSSION

Observation of the build-up of particles on the wire as a function of carrier fluid velocity and magnetic field intensity can lead to important conclusions concerning the magnetic properties of the sample. To illustrate this, an investigation was carried out on the leached residue of Witwasersrand (S.A.) gold ore to determine the performance of HGMS in the beneficiation of the gold and uranium contents, which were typically of the order of 1 ppm and 100 ppm respectively.

Initially, the sample was put through a woven stainless-steel wire mesh matrix which was placed in a superconducting solenoid HGMS. The results showed a high magnetic capture and low beneficiation [3].

In order to determine the reasons for this the magnetic properties of the sample were closely studied in a single-wire cell. The build-up of the particles on the wire indicated a strong ferromagnetic component (Figure 2). This component is captured strongly and forms an irregular spiky surface which serves to entrain material by mechanical filtration which would not have been captured magnetically. This invariably leads to a lowering of the grade of the capture material. On the light of this finding, the ferromagnetic component was scalped off using an aluminium wire matrix [4].

With the magnetic field on, the scalping operation resulted in a ferromagnetic component which was retained on the aluminium matrix and a paramagnetic component which passed through it. Separate tests using the single-wire cell were carried on both components. Figure 3 shows a typical spiky build-up on the wire of the ferromagnetics, whereas, the smooth deposit produced by the paramagnetic is indicated on Figure 4.

Further processing of the scalped material in the HGMS has led to factor of two improvement in the beneficiation[3]. This emphasises the usefulness of single-wire studies in the preliminary evaluation of the viability of HGMS for a particular sample.

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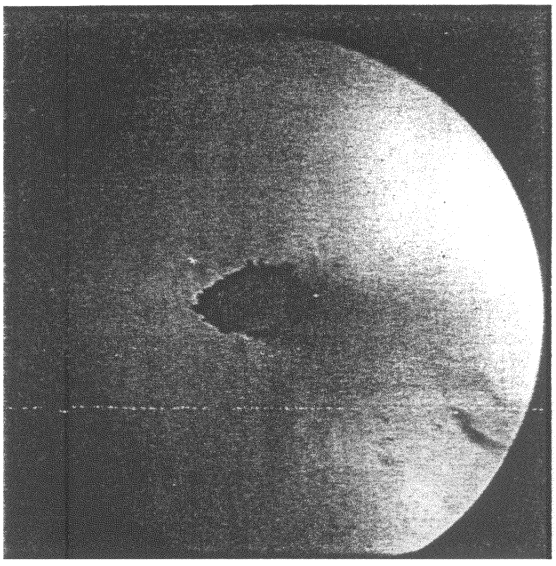

Fig. 2. Collection on the wire of a mixture of ferromagnetic and paramagnetic material.

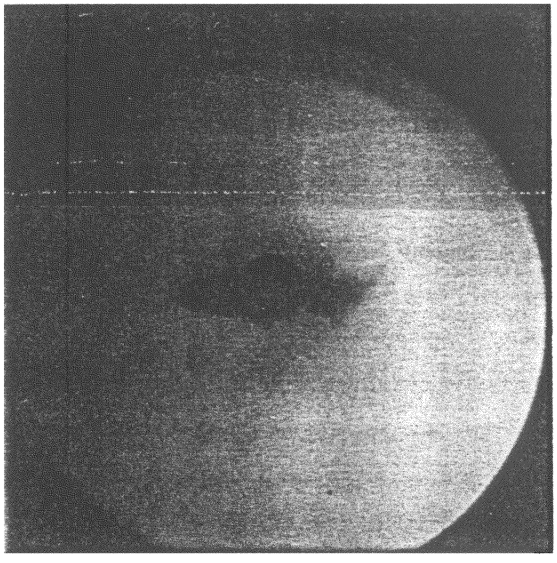

Fig. 3. Spiky build-up on the wire of the ferromagnetic component.

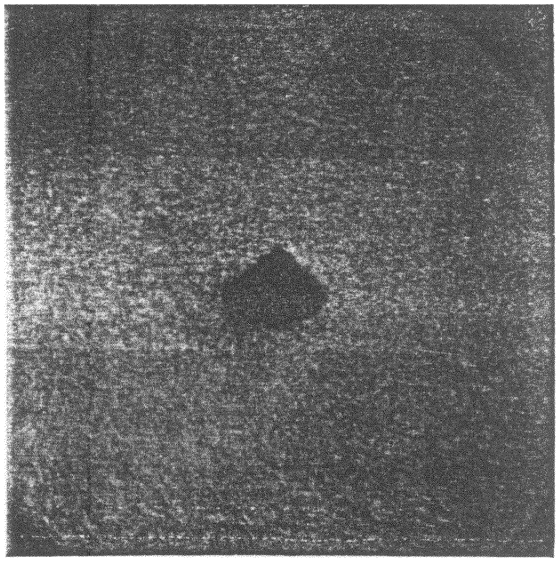

Fig. 4. Smooth deposit by the paramagnetic component.