FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

TECHNICAL MEMORANDUM NO. 40 OF 1966.

REPORT ON MAGNETIC ANALYSIS OF A MAGNETITE ORE SAMPLE RECEIVED FROM THE WANKIE COLLIERY COMPANY, LIMITED, RHODESIA.

By:

DR. W.T.E.Von WOLFF.

and

MRS.I. I. M. KESSLER.

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REPORT ON MAGNETIC ANALYSIS OF A MAGNETITE ORE SAMPLE RECEIVED FROM THE WANKIE COLLIERY COMPANY, LIMITED, RHODESIA.

(This work was done at the request of Messrs. Anglo American Corporation of S.A. Limited)

1. Preparation of Samples for Analyses.

A representative portion of the sample as received was crushed for 30 minutes in an automatic mortar-grinder (type Retsch) sufficiently fine to abstract sub-samples for analysis ("30 min. sample"). Because magnetite powder of 90% -325 mesh is suitable for coal washing plants, a sample of 100% -325 mesh was prepared according to the following method to obtain a sample as coarse as possible: A representative portion of the sample as received was ground in the automatic mortar-grinder for 10 minutes, then screened through a 325 mesh sieve. The plus material was ground again for 10 minutes and sieved, and the procedure was repeated until no plus material was left ("-325 sample").

2. Screen Analyses.

In Table 1 the results of sieve analyses of representative portions of the sample as received and of the "30 min. sample" are tabulated.

3. Magnetic Measurements.

(a) Determination of the "magnetic material" and of the "non-magnetic material".

The respective sample is washed with a weak current of water over a small sloping launder placed on a set of strong permanent magnets. The material which is retained by the magnets is defined as "magnetic material" and the material which is washed out with the effluent as "non-magnetic material".

Because the sample as received contained many grains of about 2 mm (0.08 inch) diameter, the washing process in this case was not too effective but with the "30 min. sample" and with the "-325 sample" the washing process was very satisfactory. The results tabulated in column 2 of Table 2 show a better agreement between repetitions for these two samples than for the sample as received.

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In column 3 the percentages of the non-magnetic material were calculated by subtracting the percentages of the magnetic material (column 2) from 100. The non-magnetic materials were obtained for further studies from the effluents by means of decantation and if necessary centrifugation. It is time consuming. Calculations showed that the loss during concentration of the non-magnetic material was not greater than 1%.

(b) Thermomagnetic Analysis.

A complete thermomagnetic analysis of the unseparated "30 min. sample" was done on the thermomagnetic balance by heating the sample to 900°C on the balance. It was established that the only ferromagnetic phase present is magnetite.

(c) Measurement of Magnetite Content.

The magnetite content of the unseparated "30 min. sample" (see column 4 of Table 2), of magnetic (column 6) and non-magnetic (column 7) materials of the sample as received, of the "30 min. sample" and of the "-325 sample" were measured by means of the thermomagnetic balance. For these measurements no heating on the balance was necessary. The reproducibility of the measurements are satisfactory.

The magnetite yields in percentage with reference to the unseparated samples of the magnetic (column 9) and of the non-magnetic (column 10) were calculated according to the formulae given in Table 2.

To check the measurements, the magnetite yields of the magnetic material 100e (column 9) and of the non-magnetic material 100f (column 10) were added and the results tabulated in column 5. These results of the 3 samples must be equal and must coincide with the measured magnetite content of the unseparated sample (column 4). The agreement of these four values is satisfactory.

To measure the magnetite content directly of the non-magnetic material (column 7) it must be recovered from the effluent which is time consuming. The magnetite content was therefore calculated making use of the measured value of 75.0% of the magnetite content of the unseparated sample (column 4). For this reason 100f = 100 (0.75 - e) was calculated and tabulated in column 11 of Table 2. These figures served to calculate the required magnetite content of the non-magnetic material 100d = 100f/b (see column 8).

Comparing the measured values (column 7) with the calculated values (column 8) big discrepancies can be seen. The reason for this is that the difference in 100f = 100 (0.75 - e) is of the same order as the determination errors of the two terms (0.75 and e) of the difference. It can therefore be concluded that if the magnetite content of the non-magnetic material is required, the only method is its direct measurement.

4. Conclusions .../

4. Conclusions.

From Table 2 it can be seen that the mean Magnetite Contents increase in the following order: 75.0 (Unseparated Sample, column 4), 79.1 (Magnetic Material of Sample as Received, column 6), 82.9 (Magnetic Material of the "30 min. sample", column 6) and 83.8 (Magnetic Material of the "-325 sample", column 6). The mean percentages of the Magnetic Material of the 3 size fractions decrease with the fineness of grinding from 94.5, 89.7 to 87.3 (column 2). The calculated Magnetite Yields of Magnetic Material of the 3 size fractions do not vary within the experimental error (column 9).

This result shows that the sample as received contains intergrown particles of magnetite and other minerals. This is at least still the case with the "30 min. sample", the particle size of which is tabulated in Table 1b.

One would expect that Magnetite Yields of the Magnetic Material (column 9) would increase with the fineness of grinding. This is not the case, since the very fine magnetite particles are more easily lost in the launder. This fact also explains the increase in magnetite content and magnetite yield as shown by the figures in columns 7 and 10, which is also contrary to expectations.

Therefore, it can be concluded that the true magnetite content of the magnetic concentrate can be increased by grinding the ore finer than the sample as received (see Table 1a). On the other hand one must bear in mind that the absolute amount of the magnetic concentrate decreases.

W.T.E. VON WOLFF
PRINCIPAL RESEARCH OFFICER.

I. I. M. KESSLER
RESEARCH OFFICER.

PRETORIA.
9/11/66.

TABLE

PARTICLE SIZE DISTRIBUTION

a) Sample as

Mesh	Microns
+52	295
+72 -52	211 -295
+100 -72	152 -211
+150 -100	104 -152
+200 -150	76 -104
+270 -200	52 - 76
+325 -270	44 - 52
-325	44

b) Sample ob
in Retsch gri
("30 mi

Mesh	Microns
+150	104
+170 -150	89 - 104
+200 -170	76 - 89
+240 -200	64 - 76
+270 -240	52 - 64
+325 -270	44 - 52
-325	44

TABL

CONTENT OF MAGNETIC AND NON-MAGNETIC MATERIAL AND

1	2	3	4	5	6
Sample	Magnetic Material Measured in %	Non-Magnetic Material Calculated in %	Magnetic content in		
	Obtained by Washing		Unseparated Sample		
			Measured	Calculated	Magnetic Material Measured
	= 100a	=100b = 100(1-a)		= 100(e+f)	= 100c
As Received	93.5 95.2 94.3 94.8				79.2 79.0
	Mean 94.5	5.5		74.8	Mean 79.1
Ground for 30 minutes	89.4 90.0 89.6 89.9		75.1 75.0 74.8		82.4 83.3
	Mean 89.7	10.3	Mean 75.0	75.0	Mean 82.9
-325 mesh	86.7 87.0 87.3 88.0				84.9 83.4 83.1
	Mean 87.3	12.7		74.1	Mean 83.8

1.

, OBTAINED BY SCREENING.

received

Weight percentage
70.6
7.9
7.0
6.0
2.8
2.3
0.6
2.8
100.0

tained by grinding
nder for 30 minutes
n. sample")

Weight percentage
26.6
8.8
3.2
7.7
7.4
3.7
42.6
100.0

E 2.

OF MAGNETITE OF THE DIFFERENT SIZE FRACTIONS.

7	8	9	10	11
per cent of Non-magnetic Material		Magnetite Yield in % with reference to the unseparated sample of		
Measured	Calculated	Magnetic Material Calculated	Non-magnetic Material calculated according to formula	
= 100d	= 100d = 100f/b	100e = 100ac	100f = 100bd	100f = 100(0.75-e)
1.1	5.5	74.7	0.06	0.3
5.4	5.8	74.4	0.56	0.6
6.8	14.2	73.2	0.86	1.8