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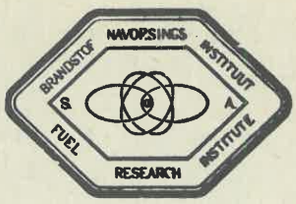

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BRANDSTOFNAVORSINGSINSTITUUT
VAN SUID-AFRIKA

FUEL RESEARCH INSTITUTE
OF SOUTH AFRICA

ONDERWERP:
SUBJECT: EFFECTS OF SELECTED OPERATING VARIABLES ON THE FROTH FLOTATION OF D.N.C. COAL

PART II: INFLUENCE OF THE POSITION OF THE IMPELLER AND THE IMPELLER SPEED ON THE FROTH FLOTATION OF THE COAL.

AFDELING:
DIVISION: CHEMISTRY

NAAM VAN AMPTENAAR:
NAME OF OFFICER: P.C. DAVIS and J.C. SMALL

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

REPORT NO. 15 OF 1964

EFFECTS OF SELECTED OPERATING VARIABLES ON THE FROTH FLOTATION OF D.N.C. COAL

PART II

INFLUENCE OF THE POSITION OF THE IMPELLER AND THE IMPELLER SPEED ON THE FROTH FLOTATION OF THE COAL

EFFECT OF THE POSITION OF THE IMPELLER

The machine used for flotation experiments was such that the impeller could be raised to various positions. A range of experiments was done to investigate the influence of the distance of the impeller from the bottom of the cell on the product yield and ash content of the products.

The following flotation conditions were applied:

Initial pulp density	:	11.1 per cent
Impeller speed	:	1500 r.p.m.
Aeration rate	:	0.009 cu. ft. /min. /sq. in. of the cross section of the lower part of the cell.
Conditioning time (mins)	:	2
Product collection period (mins)	:	3
Amount of paraffin	:	1.55 lb/ton of coal
Amount of M.I.B.C.	:	0.05 lb/ton of coal.

The distance from the bottom of the cell to the surface of the pulp was 19 cm. In each case the pulp was conditioned with the impeller at the bottom of the cell, after which the impeller was raised to the predetermined level just before the flotation was started.

It was found that the yield decreased as the distance of the impeller from the bottom of the cell was increased – from 59 per

cent/...

cent with the impeller at the bottom to 34 per cent with the impeller 12.4 cm above that level. The results are illustrated in Figure 1.

The ash content of the products increased almost linearly with the yield. Comparing the results with those that had been obtained by varying the quantities of the flotation reagents (Part I, Figure 5), it was found that the ash content of products for corresponding product recoveries was practically the same. The results are given in Figure 2.

IMPELLER SPEED AND FROTH FLOTATION

Increasing the impeller speed gives an increase in the aeration rate. This increase in the rate of aeration should result in an increase in the flotation rate and should, therefore, affect the product recovery over the collection period of three minutes.

The impeller speed also determines the degree of agitation of the pulp. When the impeller speed is too high, it may happen that material, which should appear in the discard, is forced into the froth and held therein, with a resulting increase in recovery and ash content of the product.

IMPELLER SPEED AND PRODUCT RECOVERY

The aeration rate, i.e. cu.ft. air/min./sq.in. of the cross-sectional area of the lower portion of the cell, was determined for various impeller speeds. It was found that the aeration rate varied from 0.0013 to 0.0114 cu.ft./min./sq.in. as the impeller speed was changed from 1090 to 1740 r.p.m. The results are given in Figure 3. During experiments with water containing M.I.B.C., it was noticed that in this cell the air bubbles were smaller at the lower impeller speeds.

The flotation conditions were similar to those employed in previous experiments, but the pulp was conditioned at impeller speeds corresponding to those used during the flotation process. 1.55 lb of paraffin and 0.05 lb of M.I.B.C. per ton of coal were used.

With this particular coal, a change in the aeration rate from 0.0013 to 0.0114 cu.ft./min./sq.in. had a negligible effect on the yield, as shown by line A in Figure 4. The impeller speed can, however, have a very marked effect on the product recovery. This was proved by experiments done on Waterberg No. 3-seam coal, where it was found, as shown by line B in Figure 4, that the product recovery was practically proportional to the rate of aeration.

IMPELLER/...

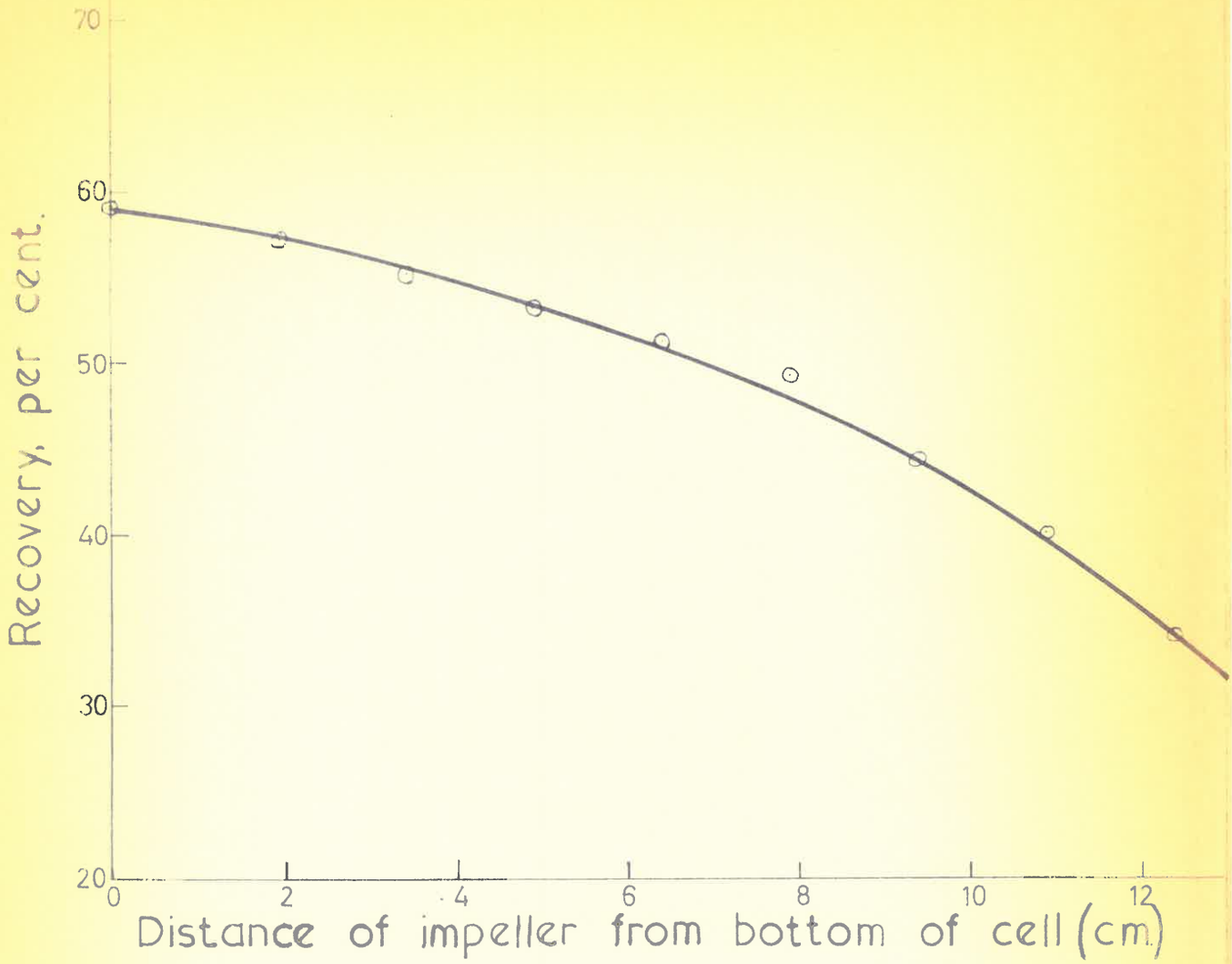

Fig.1

Effect of the distance of the impeller from the bottom of the cell on the product recovery.

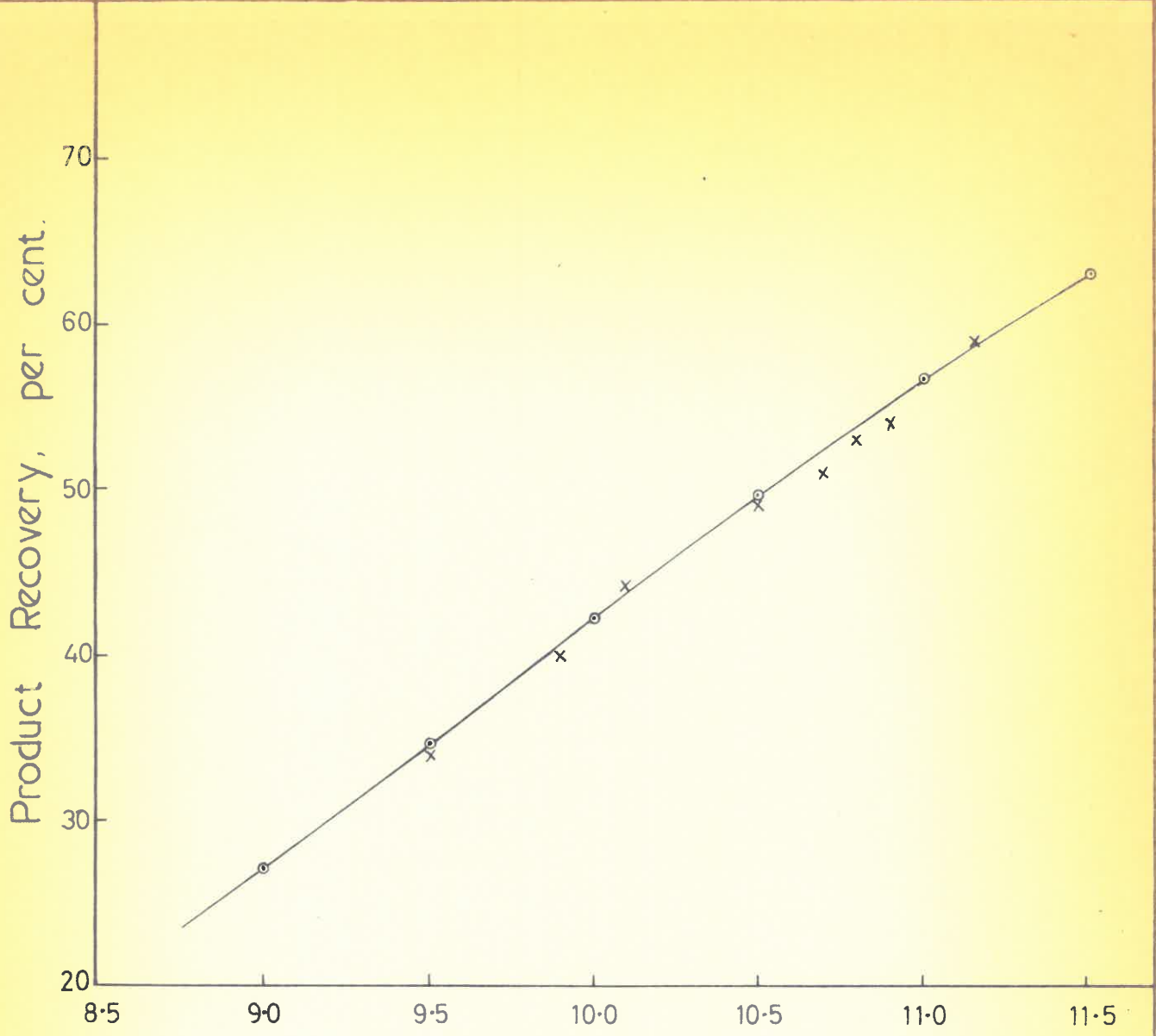

Fig. 2.

Comparison of ash content of products.

⊙ = Various proportions of paraffin and MIBC.

× = Various distances of impeller from the bottom of the cell.

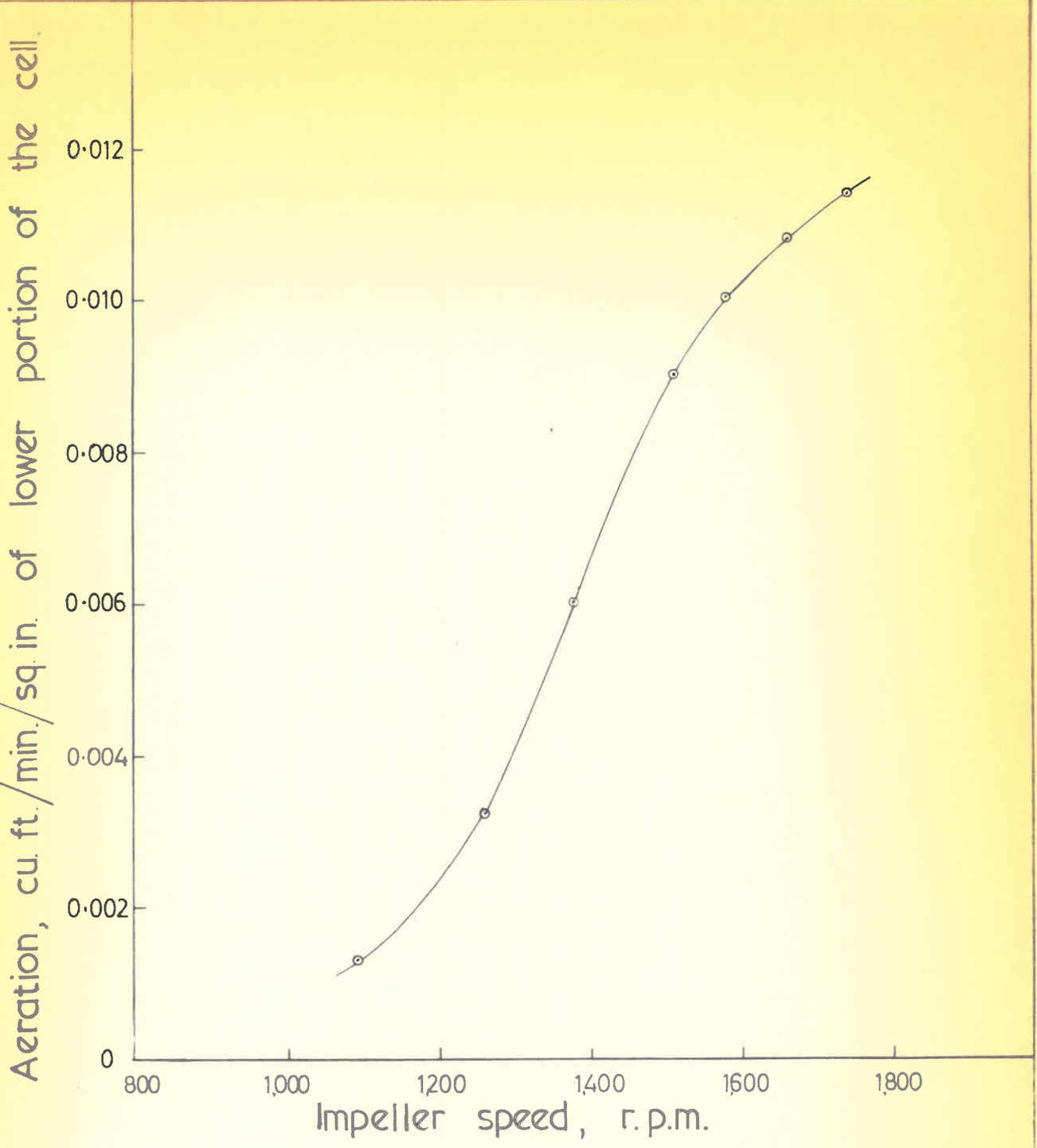

Fig. 3.

Effect of variations in impeller speed on rate of aeration.

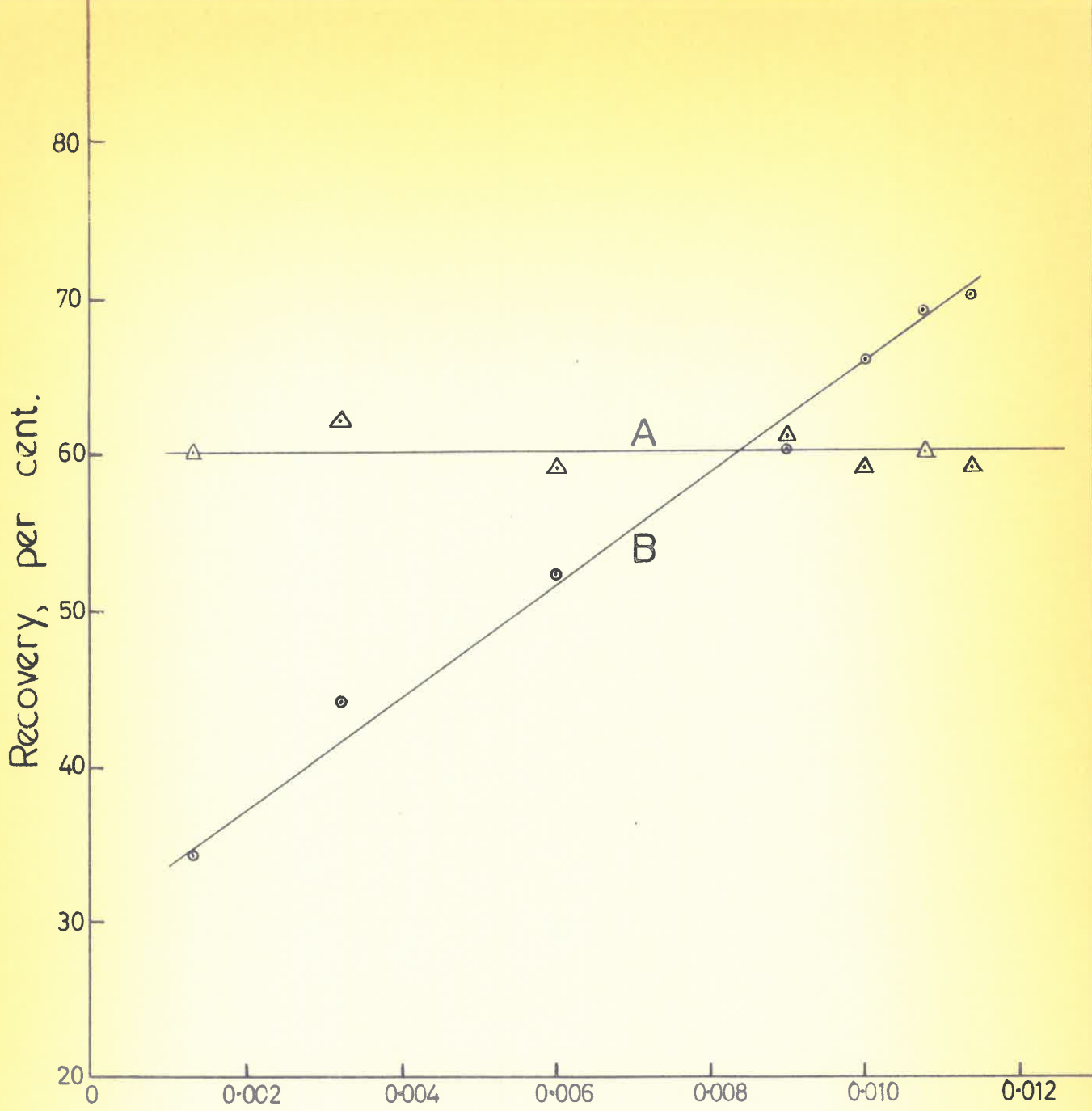

Fig. 4.

Effect of variations in aeration rate on flotation recoveries.

△ = D.N.C. coal.

⊙ = Waterberg no.3 seam coal.

IMPELLER SPEED AND ASH CONTENT OF THE PRODUCTS

Although the product yields were the same for variations in the impeller speed, it was noted that the product obtained at the lower speed contained a higher proportion of coarse particles and that its ash content was accordingly somewhat higher (see ash distribution in the Table).

TABLE 1

INFLUENCE OF IMPELLER SPEED ON PRODUCT RECOVERY AND ASH CONTENT OF THE PRODUCTS

Percentage Ash in Feed : 17.3%

Impeller Speed r.p.m.	Aeration cu. ft. /min. through cell	Aeration cu. ft. /min. /sq. in.	Product Recovery %	Ash %
1090	0.047	0.0013	60.1	12.0
1260	0.117	0.0032	61.6	11.8
1380	0.217	0.0060	59.3	11.3
1500	0.323	0.0090	60.9	11.3
1580	0.360	0.0100	59.4	11.2
1660	0.390	0.0108	59.7	11.2
1740	0.410	0.0114	59.2	11.1

INFLUENCE OF THE RATE OF AERATION ON THE PRODUCT RECOVERY WHEN THE AMOUNT OF REAGENTS WAS VARIED

The previous experiment was repeated, using various quantities of the flotation reagents. Tests were done where the following mixtures of paraffin and M.I.B.C. were used per ton of coal:

1.55 lb of paraffin and 0.02 lb of M.I.B.C.
1.55 lb of paraffin and 0.12 lb of M.I.B.C.
0.78 lb of paraffin and 0.05 lb of M.I.B.C.
3.10 lb of paraffin and 0.05 lb of M.I.B.C.

With the first three mixtures of paraffin and M.I.B.C. the same phenomenon which had been observed previously was noticed again, i.e. that the product recovery was independent of the rate of aeration used, but the product obtained at the lower impeller speed had a higher ash content.

When 3.1 lb of paraffin and 0.05 lb of M.I.B.C. per ton of coal was used, the lower impeller speed gave a somewhat lower

product/...

product recovery compared with those at higher speeds. The ash content of this product was lower than those of products obtained at higher aeration rates. The results are given in Figure 5.

IMPELLER SPEED AND RATE OF FLOTATION

It was mentioned above that the impeller speed determines the aeration rate and, consequently, the rate of flotation of the coal. It was found, however, that the product yield and, therefore, the average rate of flotation over a collection period of three minutes, were independent of the aeration rate when 1.55 lb of paraffin and 0.05 lb of M.I.B.C. per ton of this coal were used.

The test was repeated, but in this case the flotation product was collected at one-minute intervals over a period of three minutes. After each minute the impeller was stopped and the product was collected separately. By this method the rate of aeration had very little, if any, effect on the rate of flotation, the product recovery after one minute flotation being practically the same.

Another range of experiments was done in which the products were collected at 15-second intervals for the first minute and subsequently at one-minute intervals for two minutes. The results are illustrated in Figure 6.

It was found that, for the various aeration rates, the maximum rate of flotation occurred during the first fifteen seconds, the rate of flotation increasing with increasing aeration rate. In the case of the lowest aeration rate, i.e. 0.0013 cu.ft./min./sq.in., the rate of flotation remained practically constant over the first half minute.

After the maximum, the flotation rate decreased with time. After one minute, during which ca. 90 per cent of the floatable coal had been collected, the product recovery was practically the same in all cases, and thereafter the rate of flotation was very low and was the same for the different aeration rates.

P.C. DAVIS
Senior Technical Officer.

J.C. SMALL
Assistant Technical Officer.

PRETORIA,

7th December, 1964.

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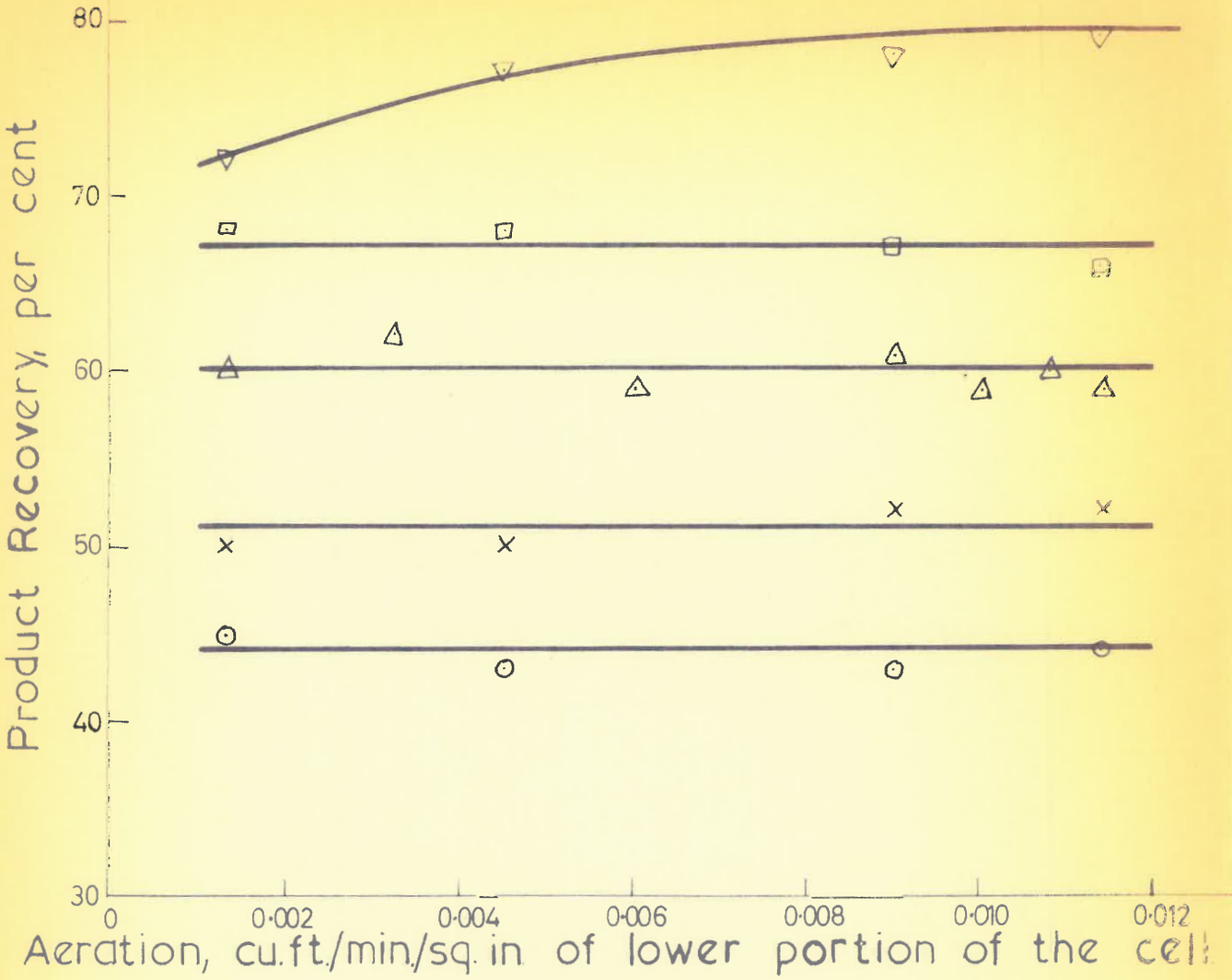

Fig. 5

Effect of variation in aeration rate on flotation recoveries using various amounts of flotation reagents.

× = 1·55 lb paraffin and 0·02 lb MIBC per ton of coal.
△ = 1·55 " 0·05 " "
▽ = 1·55 " 0·12 " "
⊙ = 0·78 " 0·05 " "
□ = 3·10 " 0·05 " "

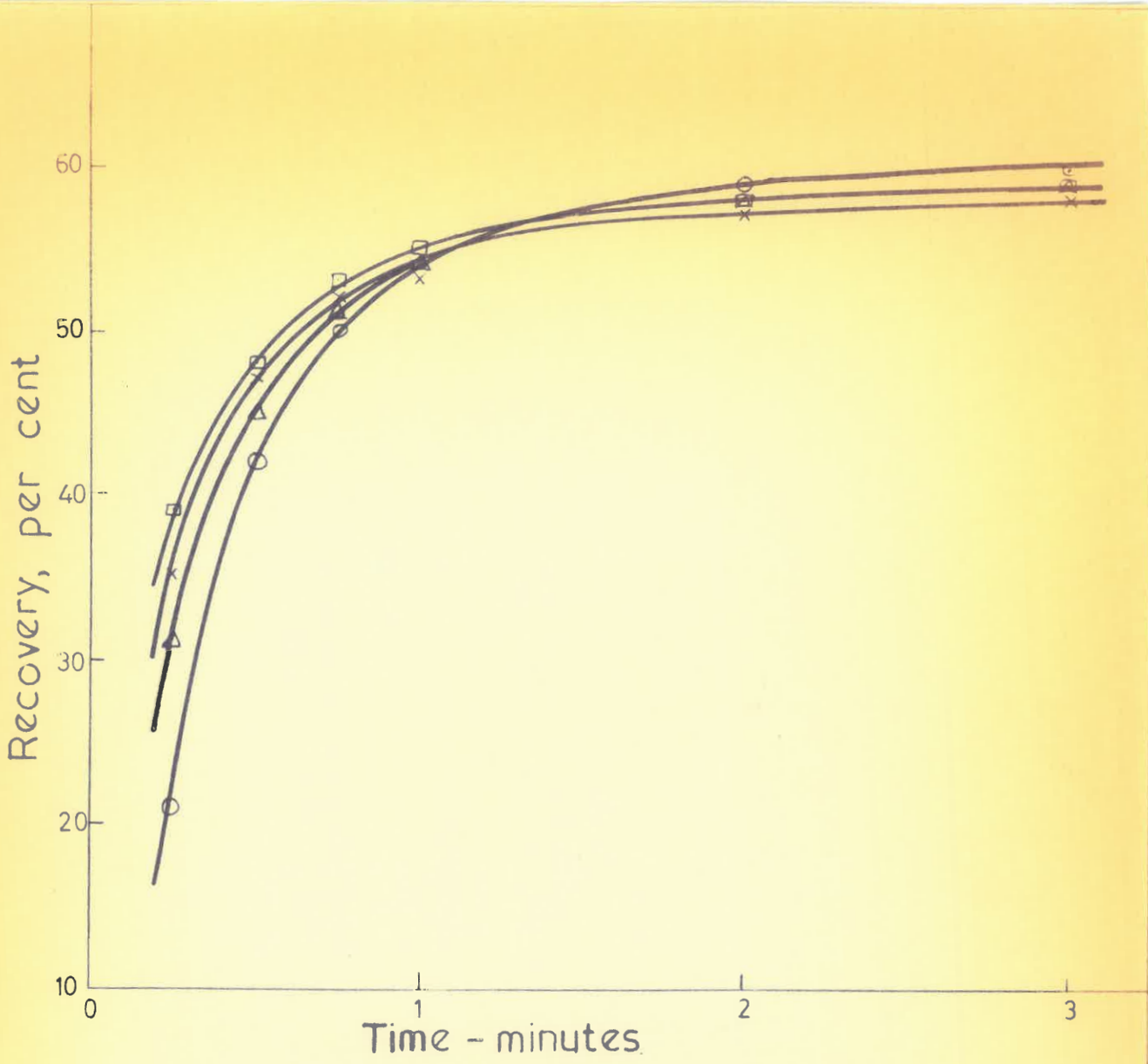

Fig. 6

Rate of flotation for various aeration rates.

⊙ = 0·0013 cu ft / min / sq in of the cross section of the lower part of the cell.
△ = 0·0046 " " " "
× = 0·0090 " " " "
□ = 0·0112 " " " "