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FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

TECHNICAL MEMORANDUM NO. 5 OF 1963.

A REPORT ON THE RESULTS OBTAINED FROM WASHABILITY TESTS CARRIED OUT ON A BULK SAMPLE OF HLOBANE COAL.

BY:
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INTRODUCTION.

In order to investigate the possibility of increasing the output of coking coal from Hlobane Colliery by crushing run-of-mine coal, comprehensive washability tests were carried out on a bulk sample of run-of-mine coal despatched to the Fuel Research Institute by the colliery.

THE COAL:

A bulk sample of Hlobane run-of-mine coal weighing about 40 tons was collected by colliery officials and despatched to the Fuel Research Institute's pilot plant in Pretoria in railway truck No. 67750.

TREATMENT OF THE SAMPLE.

On arrival in Pretoria the bulk sample was screened in 9" x 6", 6" x 3" and 3" x 0" size fractions in the following manner:

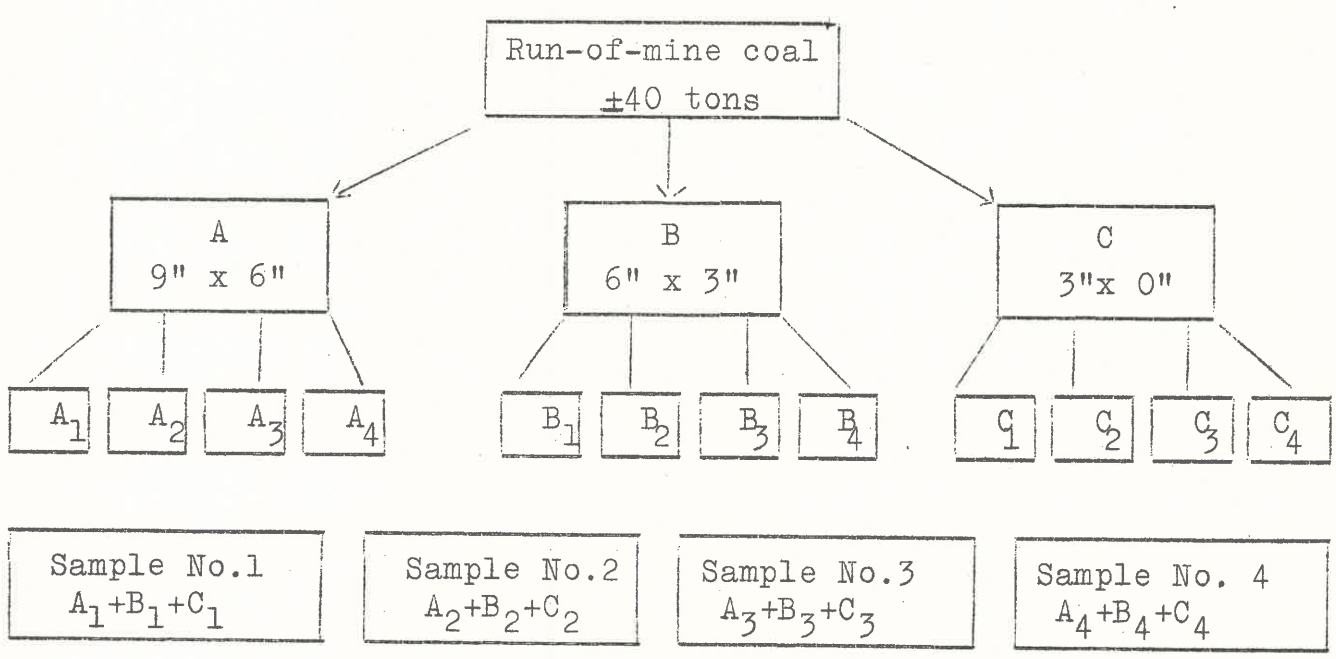
While the coal was off-loaded into a track hopper fitted with a grid having 6" square apertures, the +6" coal was collected by hand and reduced to -9" by hammering the +9" coal through a 9" square aperture. The -6" coal was transported by conveyor belt to a 3"

grizzly.../

grizzly where the +3" coal was collected in bags.

The 3" x 0 underflow from the grizzly was transported by conveyor belt to a storage bin in the plant.

Each of these size fractions, viz. 9" x 6", 6" x 3" and 3" x 0 was then divided into four equal portions, and each quarter of the 9" x 6" size fraction was then recombined with corresponding quarters of the 6" x 3" and 3" x 0 size fractions to produce four representative sub-samples of run-of-mine coal as illustrated below:



SAMPLE NO. 1.

This sample was taken to represent the present feed to the preparation plant after crushing run-of-mine coal to -9" and is hereafter referred to as "natural arisings".

The 3" x 0 coal was screened by hand at the following apertures $1\frac{1}{2}$", $\frac{3}{4}$", $\frac{3}{8}$" and 0.5mm (square apertures) and the screen analysis of the original sample was reconstructed. These results are reported in Table 1A.

Representative samples of all the different size fractions except the -0.5mm size fraction were then subjected to detailed float and sink analyses on a fractional basis at the following specific gravities:
1.35, 1.40, 1.45, 1.50, 1.60 and 1.70.

Froth ..../

Froth flotation tests were carried out in the laboratory on the -0.5 mm material.

Composite samples of F.1.40, F.1.45 and F.1.50 were made up on all size fractions, and a composite sample of F.1.60 was also made up on the $\frac{3}{8}$" x 0.5mm size fraction. Froth flotation product in the correct proportions was added to the composite samples on the $\frac{3}{8}$" x 0 size fraction.

These samples were tested for coking properties, proximate analysis and calorific value.

Composite samples of probable middlings products viz. F.1.40 - 1.70, F. 1.45 - 1.70 and F.1.50 - 1.70 were also made up for proximate analysis and calorific value determinations.

These results are reported in Tables 1 and 2.

SAMPLE NO. 2.

The +6" material in this sample was broken to -6" by hammering them trough a 6" square aperture, and a screen analysis was done on the crushed product (Table 1 A).

Because of the small percentage (±4%) of +6" material present in the original sample it was decided that very little additional coking coal could be recovered from crushing +6" coal to -6". No further analysis was therefore carried out on this sample.

SAMPLE NO. 3.

The +3" size fraction in this sample was crushed to -3" in a single roll crusher and the crushed product was screened at $1\frac{1}{2}$", $\frac{3}{4}$", $\frac{3}{8}$" and 0.5 mm. Results of this screen analysis are also reported in Table 1 A.

Representative samples of the different size fractions arising from the screen analysis were subjected to float and sink analyses in exactly the same way as the natural arisings. Composite samples were made up and analysed in the same way as for Sample No.1.

Froth ..../

Froth flotation product on the -0.5mm material was again added to the composites on the $\frac{3}{8}$" x 0.5mm size fraction.

These results are reported in Tables 3 and 4

SAMPLE NO. 4.

The +1$\frac{1}{2}$" material in this sample was crushed to -1$\frac{1}{2}$" in the single roll crusher and a screen analysis carried out on the crushed product (Table 1 A.)

Float and sink analyses were again carried out on all size fractions of the crushed product and composites were made up in the same way as for the other samples.

Results of these analyses are reported in Tables 5 and 6.

FROTH FLOTATION TESTS ON -0.5mm MATERIAL.

Froth flotation tests were carried out on -0.5mm material arising from sample No. 1 and the crushed products from samples No. 3 and 4 in a Denver laboratory flotation cell. All samples were treated in the following manner:

Five hundred grams of coal was introduced into the cell and water added to make a pulp containing about 20% solids. Then 2 ml. paraffin was added and the charge conditioned by stirring for 2 minutes. After this 50 mg. of M.I.B.C. was added and the pulp density adjusted to 10% solids. Aeration was then started and the froth was collected and dried.

The ash contents of the products and tailings were determined, as well as the swelling index of the products.

The results of these tests are reported in Table 7.

CONTAMINATION BY COKE:

On analysing the sample it was found that it was to some extent contaminated by coke. Larger lumps of this coke were sorted out and discarded, but it was impossible to remove the smaller particles. As these particles appear

to have ..../

to have been concentrated in the 1.45-1.60 specific gravity fractions, it was decided not to abandon test work on the sample. It can be assumed that the coal having a specific gravity of less than 1.45 was not appreciably affected by the presence of the coke.

DISCUSSION OF RESULTS:

Results of this investigation have already been discussed in Technical Memorandum No. 23/1962.

A few notes on matters not touched on, or on which data were not yet available, can be added.

TREATMENT OF -0.5mm FINES.

To achieve optimum extraction of coking coal the up-grading of -0.5mm fines is imperative. In order to utilize the maximum available reserves of coking coal in the larger sizes, they will have to be washed at the highest permissible specific gravities, which will leave no room for the addition of raw fines at prevailing ash contents.

The results of froth flotation experiments in the laboratory (Table 7) indicate that fair beneficiation could be attained at acceptable yields.

INCREASE IN COKING COAL PRODUCTION, BY WASHING -$\frac{3}{8}$" COAL AT S.G. 1.60.

By washing naturally arising -$\frac{3}{8}$" coal at s.g. 1.60 instead of 1.50 (p. 5 Technical Memorandum No. 23 of 1962) the analysis of the sample (Table 2) shows that an extra 3.2% of coking coal can be recovered.

Washing the -$\frac{3}{8}$" material at 1.60 instead of 1.50 would cause approximately the same gain in coking coal as washing the $\frac{3}{4}$"x$\frac{3}{8}$" coal at 1.45 instead of 1.40. In the former case the ash content of the final product will be slightly higher (0.8%) but the coking properties should be better.

COAL ..../

COAL FOR GENERAL TRADE:

Table 8 gives theoretical yields of coking coal and general purpose coal obtainable when treating run-of-mine coal.

CASE A. (i) Washing 9"x$\frac{3}{8}$" coal at 1.70
(ii) Re-washing $\frac{3}{4}$"x$\frac{3}{8}$" coal at 1.40
(iii) Washing -$\frac{3}{8}$" coal at 1.60.

CASE B. (i) Crushing total production to -3"
(ii) Washing 3"x$\frac{3}{8}$" coal at 1.70
(iii) Re-washing $\frac{3}{4}$"x$\frac{3}{8}$" coal at 1.40
(iv) Washing -$\frac{3}{8}$" coal at 1.60.

These calculations indicate that by crushing the coal to -3", the additional yield of coking coal is approximately 5%, while the output of general purpose coal remains fairly constant.

Should the ash content of the general purpose fuel be inacceptable, washing will have to be done at a specific gravity lower than 1.70, with corresponding lower yields.

(SIGNED) S. F. STREICHER.
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PRETORIA.
12/3/63

TABLE 1A

SCREEN ANALYSIS OF SAMPLES.

SIZE	NATURAL ARISINGS		9" x 6" CRUSHED TO -6"		9" x 3" CRUSHED TO -3"		9" x 1½" CRUSHED TO -1½"	
	FRACT.YIELD %	CUM. YIELD %	YIELD %	% OF ORIGINAL	YIELD %	% OF ORIGINAL	YIELD %	% OF ORIGINAL
9" x 6"	3.98	3.98						
6" x 3"	10.68	14.66	77.90	3.11				
3" x 1½"	11.18	25.84	10.84	0.43	15.94	2.33		
1½"x ¾"	14.63	40.47	3.75	0.15	24.34	3.57	40.84	10.55
¾" x ⅜"	15.77	56.24	3.03	0.12	21.33	3.13	21.06	5.44
⅜" x 0.5mm	36.10	92.34	3.88	0.15	32.94	4.83	31.80	8.22
- 0.5mm	7.66		0.60	0.02	5.45	0.80	6.30	1.63
TOTAL	100.00	100.00	100.00	3.98	100.00	14.66	100.00	25.84

TABLE 7.

FROTH FLOTATION TESTS ON -0.5MM MATERIAL.

-0.5 mm MATERIAL EX	F E E D		FLOTATION PRODUCT				TAILINGS		
	% OF ORIGINAL	ASH %	YIED %	% OF ORIGINAL	ASH %	SW NO	YIELD %	% OF ORIGINAL	ASH %
NATURAL ARISINGS	7.7	22.8	72.9	5.6	12.3	3½-4	27.1	2.1	49.3
9" x 3" CRUSHED TO -3"	0.8	23.0	79.3	0.6	14.0	2½-3	20.7	0.2	56.1
9" x 1½"CRUSHED TO -1½"	1.6	24.1	81.8	1.3	14.8	2½-3	18.2	0.3	60.3