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FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

TECHNICAL MEMORANDUM NO. 16 OF 1961.

THE PHOSPHORUS CONTENT OF WATERBERG COAL.

(ISCOR - SASOL - F.R.I. STEERING COMMITTEE)

By:

W.H.D. SAVAGE.

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In the progress report for the period October 1960 to February 1961 (F.R.I. Technical Memorandum No. 2 of 1961) certain phosphorus contents of Waterberg coal samples were reported. It was decided that further investigations be undertaken, with particular regard to the distribution of phosphorus in various specific gravity fractions of the coal.

Samples were obtained of the 10 inch cores from site 7 on Grootegeluk 1360 from zones 7 and 6, 5C, 5B and 5A, and from the lower portion of Seam 4. These samples were subjected to the normal scalping treatment, and after crushing the coal to $\frac{1}{4}$ " float and sink separations were made at 1.35 x 0.05 to 1.55 specific gravity. Determinations of ash and phosphorus contents were made on the various specific gravity fractions and cumulative yields, ash contents and phosphorus contents calculated.

Samples of the upper and lower portions of Seam 4 and the lower portion of Seam 3 from borehole GR4SA drilled near the shaft on Grootegeluk were also tested. No scalping was done on these samples, which for Seam 4 were crushed to $1\frac{1}{2}$ " and the $1\frac{1}{2}$ " x $\frac{3}{4}$ " size fraction used for testing. The Seam 3 sample was crushed to $\frac{1}{4}$ " and the $\frac{1}{4}$ " x $\frac{1}{2}$ mm fraction used.

The results of these tests, as well as those of previous tests, are given in the accompanying table.

DISCUSSION OF RESULTS:

Apart from Seam 4, concordant results were obtained on different samples from the same seam or zone.

The coal from Zone 5C had the lowest phosphorus content, followed by coal from Zones 6 and 7 and from Seam 3. All these coals had phosphorus contents of 0.01% or less. Seam 2 had 0.028%, Zone 5AB about 0.04%, and Seam 1 had 0.09% phosphorus. The phosphorus content of Seam 4 ranged from 0.035% for the lower 3'5" of the seam at site 7 to 0.256 for the upper 4'8" in borehole GR4.

The detailed float and sink tests on samples from site 4 show that there is a tendency for the phosphorus content (at least on cumulative floats) to increase with

increasing/....

increasing specific gravity, although this tendency is very slight for the zone 5AB and lower Seam 4 samples. Both the Seam 4 samples from borehole GR4SA showed a decrease in phosphorus content with increasing specific gravity, while the lower Seam 3 sample showed no change.

Where the fines were subjected to froth flotation (Part C of table), the products had similar or lower phosphorus contents than the floats at 1.40 s.g. on the corresponding coarser coal.

The Seam 4 results are difficult to evaluate due to differing thicknesses that were taken for upper and lower coal and differing treatment of the samples taken. However, it would appear that there is a fairly regular increase in phosphorus content from the bottom to the top of the seam, and fairly extensive variations also probably occur laterally.

Finally mention may be made of the only other phosphorus content available. This was obtained from all the coal to the base of zone 5B in the vicinity of shaft No. 1. The coal was washed in a cyclone washer and had 16.5% ash and 0.007% phosphorus. This value is in fairly good agreement with the values latterly obtained.

PRETORIA.
11th July, 1961.

(Sgd.) W.H.D. SAVAGE.
HEAD OF DIVISION.

PHOSPHORUS CONTENTS OF SAMPLES TAKEN FROM
10 INCH CORES FROM GROOTEGELUK, WATERBERG.

A. SAMPLES FROM SITE 7.

(Scalped to remove shale before crushing to 1/4")

Zone or Seam.	Size of Coal.	Specific Gravity Fraction	Fractional Analysis			Cumulative Analysis		
			Yield %	Ash %	P% in coal	Yield %	Ash %	P% in coal
Zones 7&6	1/4" x 1/2mm	F1.35	23.6	5.5	0.006	23.6	5.5	0.006
		1.35-1.40	14.2	14.6	0.009	37.8	8.9	0.007
		1.40-1.45	12.7	20.0	0.009	50.5	11.7	0.008
		1.45-1.50	9.0	25.4	0.010	59.5	13.8	0.008
		1.50-1.55	8.3	30.1	0.011	67.8	15.8	0.008
		S1.55	32.2	50.5	0.015	100.0	27.0	0.010
		Raw	100.0	27.6	0.011			
Zone 5C	1/4" x 1/2mm	F1.35	19.7	4.8	0.002	19.7	4.8	0.002
		1.35-1.40	8.8	13.5	0.005	28.5	7.5	0.003
		1.40-1.45	9.1	19.1	0.008	37.6	10.3	0.004
		1.45-1.50	8.0	23.8	0.008	45.6	12.7	0.005
		1.50-1.55	10.2	28.3	0.010	55.8	15.5	0.006
		S1.55	44.2	47.8	0.013	100.0	29.8	0.009
		Raw	100.0	29.7	0.009			
Zones 5B&5A	1/4" x 1/2mm	F1.35	26.3	5.5	0.033	26.3	5.5	0.033
		1.35-1.40	11.3	13.2	0.050	37.6	7.8	0.038
		1.40-1.45	10.6	18.2	0.045	48.2	10.1	0.040
		1.45-1.50	8.0	23.5	0.042	56.2	12.0	0.040
		1.50-1.55	6.9	27.6	0.043	63.1	13.7	0.040
		S1.55	36.9	49.2	0.037	100.0	26.8	0.039
		Raw	100.0	27.8	0.043			
Seam 4 Lower 3'5"	1/4" x 1/2mm	F1.35	49.6	4.2	0.033	49.6	4.2	0.033
		1.35-1.40	9.6	11.5	0.038	59.2	5.4	0.034
		1.40-1.45	5.7	16.1	0.043	64.9	6.3	0.035
		1.45-1.50	3.8	20.2	0.042	68.7	7.1	0.035
		1.50-1.55	3.8	24.7	0.043	72.5	8.0	0.035
		S1.55	27.5	43.9	0.036	100.0	17.9	0.036

B. SAMPLES FROM BOREHOLE GR4SA.

(No scalping on these samples)

Seam.	Size of Coal.	Specific Gravity Fraction	Fractional Analysis			Cumulative Analysis		
			Yield %	Ash %	P% in coal	Yield %	Ash %	P% in coal
4 Upper 9'4"	1 1/2" x 1/4"	F1.65	41.9	20.5	0.218	41.9	20.5	0.218
		1.65-1.76	23.6	36.4	0.114	65.5	26.2	0.181
		S1.76	34.5	51.8	0.093	100.0	35.0	0.150
4 Lower 4'2"	1 1/2" x 1/4"	F1.76	67.2	14.9	0.073	67.2	14.9	0.073
		S1.76	32.8	52.6	0.030	100.0	27.3	0.059
3 Lower 5'6"	1/4" x 1/2mm	F1.40	50.4	4.6	0.007	50.4	4.6	0.007
		1.40-1.50	26.2	13.0	0.008	76.6	7.5	0.007
		S1.50	23.4	39.2	0.006	100.0	14.9	0.007
		Raw	100.0	14.2	0.007			

C. DATA PREVIOUSLY REPORTED.

<u>Zone or Seam.</u>	<u>Origin.</u>	<u>Size of Coal.</u>	<u>Specific Gravity Fraction</u>	<u>Ash %</u>	<u>P % in coal.</u>
Zones 6 & 7	Site 4	$\frac{1}{4}$ " x $\frac{1}{2}$ mm $\frac{1}{2}$ mm x 0	F1.40 Product *	9.3 9.4	0.008 0.007
Zone 5C	Site 4	$\frac{1}{4}$ " x $\frac{1}{2}$ mm $\frac{1}{2}$ mm x 0	F1.40 Product *	7.2 12.1	0.004 0.004
Zones 5A & 5B	Site 4	$\frac{1}{4}$ " x $\frac{1}{2}$ mm $\frac{1}{2}$ mm x 0	F1.40 Product *	8.9 9.6	0.045 0.030
Seam 4, Upper 4'8"	B.H.GR4	1 $\frac{1}{2}$ " x $\frac{1}{4}$ "	F1.76	28.2	0.256
Seam 4, Lower 7'3"	Site 4	$\frac{1}{4}$ " x $\frac{1}{2}$ mm $\frac{1}{2}$ mm x 0	F1.40 Product *	6.5 12.4	0.170 0.106
Seam 3, Upper 21'11"	B.H.GR4		Raw Coal.	19.6	0.011
Seam 3, Lower 4'4"	B.H.GR4		Raw Coal.	15.0	0.004
Seam 2.	B.H.GR3		Raw Coal	15.0	0.028
Seam 1.	B.H.GR4		Raw Coal	26.7	0.091

*These samples are froth-flotation products.