

RAPPORT No.....

REPORT No. 14

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FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA.

SURVEY REPORT NO. 102.

ONDERWERP:
SUBJECT:

THE PHYSICAL AND CHEMICAL SURVEY OF THE NO. 2

SEAM AT TRANSVAAL NAVIGATION COLLIERY,

BEHTAL DISTRICT, TRANSVAAL.

AFDELING:
DIVISION:

SURVEY DIVISION

NAAM VAN AMPTENAAR:
NAME OF OFFICER:

H. BERRY.

FRI. 14/1949

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

REPORT NO.14 OF 1949.

SURVEY REPORT NO.102

THE PHYSICAL AND CHEMICAL SURVEY OF THE NO. 2 SEAM AT TRANSVAAL
NAVIGATION COLLIERY, BETHAL DISTRICT, TRANSVAAL.

This colliery is situated on the farm Vlaklaagte 35, close to the northern boundary of the Bethal Magisterial District and approximately midway between the towns of Witbank and Bethal. The five major seams of the Witbank coalfield have been proved in the area during boring although the upper seams have been denuded in the low-lying ground in the vicinity of the Olifants river which traverses the farm in a general east to west direction.

The Nos. 1 and 2 seams lie close together, nowhere separated by more than 6 ft. 6 in. of strata but, as the No.1 seam is of poor quality, only the No. 2 seam is worked. The latter is present over the entire farm but varies in height from about 6 ft., in the south, to 24 or 25 ft.; boreholes indicate that a thickness of 19 ft. is generally maintained but it is only the bottom 9 to 10 ft. which is considered to be commercially workable.

The section presented by the No. 2 seam on Vlaklaagte differs considerably from that found in the northern Witbank field and very little remains of the high grade gas and smithy coals which are so characteristic of the seam further north.

Judging from the diagrammatic representations of the seam as mined (see end of report), the structure varies to only a small extent as far as the present development of the mine is concerned. For descriptive purposes each section may conveniently be divided into distinct horizons comprising, respectively, an upper horizon of dull coal (subsections E and F), a middle horizon of dull coal containing a proportion of bright coal (subsections C & D), separated from a uniform layer of homogeneous bright coal (sub-section A) by a variable, sometimes inferior, dull band B.

Except for a variable thickness of roof coal G, the remainder of the seam above the mined portion was only accessible in the incline and ventilation shafts where it was obviously too weathered for sampling. A full section of the Nos. 1 and 2 seams exposed in the former gave the following measurements :-

ROOF:		Hard, dark shale.
	5 ft. 0 in.(approx.)	Shale, carbonaceous shale and coal bands.
	2 ft. 3 in.	Mainly dull, shaly coal.
	6 in.	Hard, grey shale.
	1 ft. 6 in.	Friable, dull, pyritic coal.
	8 ft. 6 in.	<u>No. 2 seam as mined,(described later)</u>
	1 ft. 6 in.	Hard dark shale.
	6 ft. 0 in.	<u>No. 1 seam.</u>
<u>FLOOR:</u>		Black shale.

Sampling.../

SAMPLING:

A detailed underground sampling programme was carried out at the colliery by Officers of the Institute on 31st. March, 1949. Samples were taken from three freshly-prepared faces, the seam at each face being subdivided into subsections according to the different types of coal present.

A sketch plan indicating the various underground sampling positions is given at the end of the report together with diagrammatic representations of the seam illustrating the scheme of subdivision at each point.

In addition to underground samples, three complete series of commercial grade samples comprising mixed rounds and cobbles, nuts, peas and duff, were also taken during the period 31/3/49 to 12/4/49, both dates inclusive. Although the latter strictly do not form part of the survey programme, the analytical results have been included in the report to provide a comparison and to indicate to what extent mining operations affect the quality of the seam during extraction.

ANALYTICAL:

In general, proximate analyses; calorific value determinations and B.S.I Crucible Swelling Tests were carried out on all samples.

Although mainly of academic importance, in order to gain fuller information concerning the type of coal, its chemical characteristics and classification, etc., more detailed analyses of a composite sample of the seam from the three sampling points was also undertaken. These comprised ultimate analyses, (i.e. determination of elementary composition), determination of sulphur content and ash fusion point, etc. Prior to such analysis the composite sample was floated in a medium of 1.58 specific gravity to remove extraneous dirt - the determinations of carbon, hydrogen, nitrogen, etc., were then carried out on the clean float fraction.

Since the samples did not evince any marked coking qualities no carbonisation tests beyond the routine B.S.I. Crucible Swelling Test were considered necessary.

Tables of analytical results, incorporating fractional screen analyses of the commercial products, follow.

Figures for ash fusion point, total sulphur, ash content and calorific value of composite samples of rounds and cobbles, nuts, peas and duff, prepared by combining equal quantities of individual grades, are also included.

Descriptions.../

DESCRIPTIONS OF UNDERGROUND FACE SAMPLES IN NO.2 SEAM
AT TRANSVAAL NAVIGATION COLLIERY.

Sample Position.	F.R.I. Sample Number.	Width Sampled (ins.)	Description of subsection.
<u>Place 1</u> Main haulage road 380ft from bottom of incline.	S.160 G	11½	Mainly dull, homogeneous coal lustrous, friable and well-cleated.
	F	16½	Mainly dull coal, thinly streaked with bright coal. Isolated small pyritic nodules.
	E	26½	Mainly dull coal streaked with bright coal in top 5 in. and middle 6 in. Very blocky.
	D	22	Mixed coal, calcitic. Well-defined 4 in. dull band at base.
	C	16½	Mainly mixed coal with isolated nodules and lenses of pyrite in bottom 6 in.
	B	7	Mainly dull shaly coal; pyritic.
	A	15	Mainly bright coal with 2 in. layer of dull inferior coal at base. Isolated pyritic nodules.
	A - F	103½	Seam as mined.
<u>Place 2.</u> 120 ft. west of main haulage road.	S.161 G	20	Dull, lustrous, well-cleated coal; soft and friable. Vertical shale inclusions.
	F	19½	Dull homogeneous coal containing 2 in. shaly coal at base. Moderate lustre. Isolated pyritic nodules.
	E	30	Mainly dull, lustrous coal, streaked with bright coal throughout. 1 inch dull shaly band 19 in. from top.
	D	21	Similar to E but containing more bright coal.
	C	11	Mixed coal; isolated pyritic nodules.
	B	6	Mainly dull coal; highly pyritic.
	A	14½	Mainly bright coal with a 1 in. inferior layer at base.
	A - F	102	Seam as mined.

DESCRIPTION OF UNDERGROUND FACE SAMPLES IN NO. 2 SEAM contd.

Sample Position.	F.R.I. Sample Number.	Width Sampled (ins.)	Description of Subsection.
Place 3 80 ft. east of main haul- age road.	S.162 G	18	Friable, dull pyritic coal. Mainly dull coal with isolated pyritic nodules. Lower 1½ in. shaly.
	F	16½	
	E	21½	Mainly dull lustrous coal streaked throughout with bright coal. Distinctive 3 in. dull band at base.
	D	20½	Mixed coal with dull coal pre-dominating.
	C	15	Mixed coal; isolated pyritic nodules.
	B A	8 14½	Dull, shaly pyritic coal. Mainly bright coal, vitrainous in lower half. Isolated pyritic lenticles. Shaly in bottom 2 in.
A - F		96	Seam as mined.
<u>ROOF:</u> Dull, shaly coal. <u>Not sampled.</u>			
<u>FLOOR:</u> 18 in. Hard dark grey shale with No.1 seam below.			

Analyses of Underground Face Samples...

ANALYSES OF UNDERGROUND FACE SAMPLES.

Sub-Section.	Width ins.	Prox. Analysis (% on air-dried coal)				Cal. Val. lbs/lb.	Crucible Swelling Index.*
		H ₂ O %	Ash %	Vol. Matter %	Fix. Carbon %		
S.160 G	11½	2.7	16.0	21.2	60.1	11.8	P
F	16½	2.9	12.7	23.8	60.6	12.4	P
E	26½	2.5	8.4	29.3	59.8	13.2	1Ag
D	22	2.3	7.9	31.0	58.8	13.5	1Ag
C	16½	2.1	11.0	30.5	56.4	13.2	1½Ag
B	7	1.3	33.9	36.9	27.9	7.4	F
A	15	2.0	11.2	35.1	51.7	13.1	2
A to F (calc'd.)	103½	2.3	11.6	30.3	55.8	12.7	-
A to G (calc'd.)	115	2.3	12.0	29.4	56.3	12.6	-
S.161 G	20	2.5	25.1	17.8	54.6	10.0	P
F	19½	2.6	13.3	24.5	59.6	12.4	P
E	30	2.5	8.5	28.0	61.0	13.3	1Ag
D	21	2.4	7.6	30.1	59.9	13.6	1Ag
C	11	2.4	7.8	31.9	57.9	13.6	2½
B	6	2.1	14.3	30.0	53.6	12.6	1Ag
A	14½	2.2	9.4	35.4	53.0	13.5	3½
A to F (calc'd.)	102	2.4	9.6	29.4	58.6	13.2	-
A to G (calc'd.)	122	2.4	12.2	27.5	57.9	12.7	-
S.162 G	18	2.5	17.8	23.6	56.1	11.6	P
F	16½	2.7	11.7	24.7	60.9	12.7	P
E	21½	2.5	8.3	27.9	61.3	13.3	1Ag
D	20½	2.4	7.8	29.8	60.0	13.5	1Ag
C	15	2.3	10.9	30.6	57.1	13.2	1Ag
B	8	2.0	19.7	33.5	44.8	11.5	1½Ag
A	14½	2.0	13.1	35.1	49.8	12.9	2½
A to F (calc'd.)	96	2.4	10.9	29.5	57.2	13.0	-
A to G (calc'd.)	114	2.4	11.9	28.7	57.0	12.8	-

* An index of 1Ag denotes a residue of definite coke structure but no swelling. F denotes a residue readily friable and possessed of no coking structure. P denotes a residue in powder form. An index of 3 or more indicates definite coking propensities.

The average figures for different heights of seam are calculated according to the thicknesses of individual layers.

ANALYSES OF COMPOSITE SAMPLE OF COMPLETE SEAM (F.R.I. SAMPLE S.183)

S.183 Represents proportionately, according to thickness, a composite sample of the complete seam at each sampling point made up from individual subsections A to G in the proportion of layer widths.

Fractional Washing Test (Minus 16 B.S. mesh coal)

Cumulative Floats at :	Yield (per cent)	Ash content (per cent)
Sp. Gr. 1.30	9.4	2.9
Sp. Gr. 1.35	32.2	3.8
Sp. Gr. 1.40	52.8	4.9
Sp. Gr. 1.45	73.7	6.1
Sp. Gr. 1.50	81.5	7.0
Sp. Gr. 1.58	87.2	8.1
Sinks at Sp.Gr. 1.58	12.8	41.8

Proximate Analysis, Sulphur and Calorific Value.

(Per cent on air-dried coal)

	Original Coal.	Float Coal (-16 B.S.mesh) at S.G. 1.58.
Moisture	1.9	2.3
Ash	12.4	8.1
Vol. Matter(less moisture)	28.8	29.4
Fixed Carbon	56.9	60.2
Total Sulphur	1.83	0.58
Organic Sulphur	0.50	not determined.
Mineral Sulphur	1.33	not determined.
Calorific Value lbs/lb.	12.7	13.5

FUSION POINT OF ASH.

Initial Deformation Temperature	°C	1300	1320
Fusion Temperature	°C	1310	1335
Fluid Temperature	°C	1325	1360

ULTIMATE ANALYSIS.

(Per cent on coal floated at S. G. 1.58)

	Air-dried coal.	Calculated dry, ash-free coal.
Moisture	2.3	-
Ash	8.1	-
Carbon	75.4	84.1
Hydrogen	4.4	4.9
Nitrogen	2.0	2.2
Total Sulphur	0.6	-
Organic Sulphur	-	0.6
Difference (oxygen & errors)	7.2	8.2
	100.0	

PROXIMATE ANALYSES.... / 8

PROXIMATE ANALYSES, CALORIFIC VALUES AND SCREENING

TESTS ON COMMERCIAL GRADES.

*
Samples taken 30/3/49

Air-dried coal %	Rds. & Cobbles	Nuts	Peas	Duff	Size (In.sq.mesh)	Nuts	Peas	Duff
Moisture	1.5	2.1	2.2	2.3	+ 1 1/4	8.8	-	-
Ash	9.9	11.0	10.0	10.7	1 1/4 - 3/4	65.0	-	-
Vol.Matter (less H ₂ O)	31.4	31.5	31.6	32.4	3/4 - 1/2	18.9	42.6	-
Fix.Carb.	57.2	55.4	56.2	54.6	1/2 - 1/4	2.7	47.7	8.3
					1/4 - 1/8	0.7	2.8	40.4
					- 1/8	3.9	6.9	51.3
Cal.Value lbs/lb.	13.2	13.0	13.2	12.9	Total	100.0		

*
Samples taken 5/4/49

Air-dried coal %	Rds. & Cobbles	Nuts	Peas	Duff	Size (In.sq.mesh)	Nuts	Peas	Duff
Moisture	1.7	1.8	2.4	2.4	+ 1 1/4	-	-	-
Ash	8.9	11.2	8.9	10.1	1 1/4 - 3/4	-	-	-
Vol.Mat. (less H ₂ O)	31.3	31.5	30.1	31.3	3/4 - 1/2	Insufficient sample	13.8	-
Fix.Carb.	58.1	55.5	58.6	56.2	1/2 - 1/4		49.8	16.5
					1/4 - 1/8		13.2	37.1
					- 1/8		23.2	46.4
Cal.Value lbs/lb.	13.4	13.0	13.3	13.0	Total	100.0		

*
Samples taken 12/4/49

Air-dried coal %	Rds. & Cobbles	Nuts	Peas	Duff	Size (In.sq.mesh)	Nuts	Peas	Duff
Moisture	2.4	2.5	2.4	2.4	+ 1 1/4	-	-	-
Ash	9.2	10.1	9.2	9.8	1 1/4 - 3/4	67.7	-	-
Vol.Matter (less H ₂ O)	31.4	30.5	30.8	31.8	3/4 - 1/2	23.3	25.6	0.7
Fix. Carb.	57.0	56.9	57.6	56.0	1/2 - 1/4	3.9	59.0	19.3
					1/4 - 1/8	1.1	4.8	29.8
					- 1/8	4.0	10.6	50.2
Cal.Value lbs/lb.	13.3	13.2	13.3	13.1	Total	100.0		

* Sampled according to S.A. Standard Specification - S.A.No.13 of 1937. "Standard Methods on the Sampling of Coal in South Africa".

ANALYSES OF COMPOSITE COMMERCIAL SAMPLES PREPARED BY
COMBINING EQUAL AMOUNTS OF INDIVIDUAL GRADES.

		Rounds and Cobbles.	Nuts.	Peas.	Duff.
Ash (calc'd)	per cent	9.3	10.8	9.4	10.2
Total Sulphur	per cent	1.44	2.28	1.64	1.61
Calorific value (calc'd)	lbs/lb.	13.3	13.1	13.3	13.0
Fusion point of Ash	°C	1300	1300	1300	1320

CONCLUSIONS: Reference has already been made to the uniformity in structure exhibited by the No. 2 seam throughout the mining area already developed and, to a large extent, this uniformity is also reflected in the analyses of the various layers composing the seam.

The best quality coal is concentrated in the middle mixed bright and dull portions represented by subsections C and D. Throughout the area sampled this part varies by as little as 0.2 lbs. per lb. in calorific value and 1.5 per cent in ash content, the average figures being 13.5 lbs. per lb. and 8.6 per cent respectively.

Subsection A, the bottom bright coal is not so consistent in analysis as the upper parts of the seam, due mainly to the influence of a variable, shaly layer adjacent to the floor. It is the only horizon, however, to possess well-defined coking properties.

A band of dull, often shaly, coal separates subsection A from the mixed bright and dull horizon in the middle of the seam. This band is peculiar in that it exhibits a marked variation in ash content from 14.3% in the No. 2 sample to 33.9 in the No. 1 sample, taken in the most northerly part of the mine. Where the ash content is high, the volatile content is also high and investigation has shown that this is due to contamination with dolomitic material containing the carbonates of calcium, magnesium and iron from which carbon dioxide is evolved on heating.

The tables of analytical results indicate that the deterioration of subsection B northwards i.e. in the direction of the main haulage, is also accompanied by a general decrease in quality of the seam. At the same time there is also revealed a tendency to improvement westwards, i.e. in the direction of the No. 2 sampling point. Good agreement exists between the analyses of the seam 'in situ' and those obtained for the samples of the commercial grades. All confirm the excellent quality of the No.2 seam in this area, but it should be emphasised that, if development of the mine is concentrated solely in a northerly direction, in time it may prove difficult to maintain first grade quality coal/
coal/

coal without some form of processing.

It is of interest to note the inferiority of the "nut" grade compared with the peas and duff; this feature, expressed in higher ash and sulphur contents and lower calorific value, may be observed throughout the three series of samples taken during the period 31/3/49 to 12/4/49. It would appear from the results that there is a preferential breakdown into the nut size range of the bulk of the impurities present, especially pyrites.

The smaller screened sizes, including duff, should prove very acceptable fuels for steam-raising but it is recommended that some attention be paid to screening. At present there is an undesirable and large variation in the screen analyses of these grades. Attention is specially directed to the screening of the nuts - in order to comply with the regulations governing the issue of a grading certificate for this class of coal, the undersize, i.e. $\frac{3}{4}$ in., must be reduced to below 20 per cent in the sample taken. (See regulations published in Government Gazette No. 4157, Friday 6th. May, 1949). At present the amount of undersize is approximately 30 per cent or more.

PRETORIA.

1st. June, 1949.

No 2 SEAM — TRANSWAAL NAVIGATION COLLIERY

Diagrammatic Representation.

