FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

TECHNICAL MEMORANDUM NO. 28 OF 1965

THE PETROGRAPHIC COMPOSITION OF SOME COALS COMMERCIALLY AVAILABLE IN SOUTH AFRICA - (FIRST PROGRESS REPORT)

By
B. Moodie.

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

TECHNICAL MEMORANDUM NO. 28 OF 1965.

THE PETROGRAPHIC COMPOSITION OF SOME COALS COMMERCIALLY AVAILABLE IN SOUTH AFRICA - (FIRST PROGRESS REPORT.)

INTRODUCTION:

During the past few years a survey was undertaken of the petrographic composition and characteristics of various coals sizes produced by collieries in South Africa. This report deals with the smaller coal sizes, mainly nuts, peas and duff produced at eight collieries in the Transvaal and seven in Natal.

PRESENTATION OF RESULTS:

The average results based on a number of samples taken over the period appear in Table 1. Tables 2 to 11 give the comparative values of vitrite, vitrinertite, vitrinite, transition material and the ratio of active constituents to inert constituents found in the various products. Table 12 gives the average petrographic analysis of the Transvaal and Natal coals, calculated from Table 1.

A table containing analytical details of the samples investigated will be included in the final report of this series.

DISCUSSION OF RESULTS:

With the exception of Consolidated Colliery which is situated in the Ermelo-Breyten Coalfield, the other seven collieries in the Transvaal form more or less a block in the Witbank-Middelburg coalfield. The Natal collieries are geographically more widely dispersed. Four of them are situated in the Klip River coalfield two in the Vryheid coalfield and one in the Utrecht district.

All/........

All the collieries from the Transvaal exploit mainly the No. 2 Seam and produce steam coal but Springbok also produces a blend coking coal and gas coal from the No. 5 Seam. At least five collieries in Natal produce coking coal in varying quantities, the only exceptions being Ingagane and Utrecht Collieries which produce steam coal exclusively.

Since the Witbank-Middelburg Collieries under discussion are situated more or less in a block it is reasonable to expect that the different products made by them will vary little in petrographic composition, except perhaps the No. 5 Seam products from Springbok Colliery.

In general these coals are fairly dull in appearance (except the coal from the No. 5 Seam which is predominantly a bright coal) and are petrographically characterised by their relatively low vitrite contents, very high amounts of vitrinertite and low amounts of transition materials. The high amounts of vitrinertite consisting of microscopic mixtures of vitrinite and inertinite lend these coals their dull lustrous appearance. The Ermelo coals, being of a brighter appearance than the Witbank-Middelburg coals contain more vitrite, less vitrinertite and more transition material. From Tables 2, 3 and 5 it can be seen that the Ermelo coal (Consolidated) contains roughly 10% more vitrite, 20% less vitrinertite and 15% more vitrinite than the Witbank-Middelburg coals.

Corresponding products made by the Witbank-Middelburg Collieries show very little variation in petrographic composition. This is particularly evident when the vitrinite and vitrinertite contents are studied in Tables 5 and 3 respectively.

It is somewhat surprising that the duff coals of the Witbank-Middelburg collieries do not show any appreciable increase in active constituents as in the case of most of the Natal coals. The constant balance between the active and inert constituents is evident in

Table/........

Table 6; this is probably due to the high vitrinertite content of these coals where the intimate microscopic mixture of vitrinite and inertinite causes a definite degree of resistance to breakage.

Another remarkable feature about the Witbank-Middelburg coals is the similarity in petrographic constitution between the different products from the same colliery. This can clearly be seen in Table 3 where the vitrinertite content remains practically constant irrespective of the size of the coal. The same applies more or less to the transition material content (Table 4) and the vitrinite content (Table 5).

One is led to the conclusion that progressive crushing and screening as embodied by the Bürstlein process will have very little effect on the final product and that the washing characteristics of the coals from these collieries will also be more or less the same.

The products from the Natal Collieries show a much greater variation in petrographic composition. In general the vitrite (Table 7) vitrinite (Table 10) and transition material(Table 9) are higher and the vitrinertite (Table 8) lower than in the case of the Transvaal coals.

Since these coals are brighter in appearance this can be expected and it can be observed in Table 11 that the ratios of active to inert constituents are appreciably higher than in the Transvaal coals. In fact, with a few exceptions the active constituents are dominant even in the steam coals produced by Ingagane and Utrecht Collieries. There is also a distinct tendency for the smaller sizes to contain higher amounts of vitrite (Table 7) and vitrinite (Table 10) which is an indication that these coals may be more amenable to enrichment of active constituents by progressive crushing and screening.

The coals of interest to the carbonization industries contain considerably higher amounts of

vitrite/.......

vitrite (Table 2 and Table 7) than the non-coking coals and consequently also higher amounts of vitrinite (Table 5 and Table 10).

There is relatively little difference in transition material between Transvaal and Natal coals (Table 4 and 9) and in most cases it remains practically constant with the different product sizes which leads one to conclude that the vitrite content is the most important factor in a coking coal and that the transition material (in contrast to European coking coals) plays practically no part in the ability of the coal to yield a coke.

In conclusion it can be said that the Transvaal coals (with the exception of coals from Soutpansberg and Waterberg which were not considered in this report) contain less vitrite than the Natal coals, that the former are characterised by their high vitrinertite contents and that for carbonization purposes the Natal coals are petrographically superior to the Transvaal coals, as reflected in Table 12.

(Signed) B. MOODIE.
Principal Technical Officer.

PRETORIA,

6th July, 1965.

/LNS

TABLE 1.

THE AVERAGE PETROGRAPHIC ANALYSIS OF PRODUCTS FROM SOME SOUTH AFRICAN COLLIERIES.

TRANSVAAL COLLIERIES.

Sample No.	Microlithotype Analysis						Maceral Analysis				Ratio: Active/ Inert	No. of Samples Analysed
							Active		Inert			
	Vt %	Cl %	V.I. %	T.M. %	Fu %	C.S. %	Vn %	Ex. %	In. %	V.M. %		
Landau Colliery.												
Nuts	8.0	0.3	80.1	6.7	3.1	1.8	31.6	1.7	62.9	3.8	0.5:1	3
Peas	10.2	0.2	77.5	4.7	5.2	2.2	33.3	1.3	61.6	3.8	0.5:1	3
Duff	12.5	0.0	74.6	4.0	3.1	5.8	29.9	1.3	60.9	7.9	0.5:1	4
Van Dyksdrift Colliery.												
Nuts	16.1	0.6	66.9	7.1	5.1	4.2	40.6	1.8	51.7	5.9	0.7:1	3
Mixed Smalls	19.5	0.6	64.8	7.0	4.4	3.7	44.7	1.6	48.6	5.1	0.9:1	3
Springbok Colliery.												
Nuts	11.7	0.6	73.3	7.4	4.2	2.8	40.2	2.4	52.8	4.6	0.7:1	4
Mixed Smalls	16.8	0.2	69.4	7.0	4.2	2.4	43.6	2.2	50.9	3.3	0.8:1	3
*Coking Blend	44.2	1.9	34.6	13.8	3.3	2.2	69.7	3.1	24.6	2.6	2.7:1	3
*Gas coal	28.5	2.4	41.2	22.5	3.2	2.2	64.7	5.1	25.6	4.6	2.3:1	3
Douglas Colliery.												
Nuts	12.3	0.8	72.6	6.7	5.6	2.0	34.5	1.9	59.2	4.4	0.6:1	3
Peas	14.2	0.6	70.5	7.8	4.8	2.1	36.4	2.6	57.3	3.7	0.6:1	3
Duff	20.7	0.8	67.0	5.1	5.0	1.4	41.6	1.9	53.1	3.4	0.8:1	4

*No. 5 Seam.

TABLE 1 (Continued).

TRANSVAAL COLLIERIES (Continued).

Sample No.	Microlithotype Analysis						Maceral Analysis				Ratio: Active/ Inert	No. of Samples Analysed
							Active		Inert			
	Vt %	Cl %	V.I. %	T.M. %	Fu %	C.S. %	Vn %	Ex. %	In. %	V.M. %		
Albion Colliery.												
Nuts	11.7	0.4	73.4	6.8	4.0	3.7	35.8	1.9	57.9	4.4	0.6:1	3
Peas	12.5	0.1	74.1	6.5	4.1	2.7	36.1	1.6	56.4	5.9	0.6:1	3
Duff	18.0	0.3	67.3	3.9	5.6	4.9	37.4	1.1	56.6	4.9	0.6:1	3
Mixed Smalls	11.4	0.5	74.3	5.6	3.8	4.4	34.1	1.6	59.1	5.2	0.6:1	4
Transvaal Navigation Colliery.												
Nuts	13.5	0.6	71.4	8.2	5.2	1.1	37.4	2.9	55.9	3.8	0.7:1	4
Peas	10.1	0.6	75.8	6.2	5.3	2.0	34.2	1.6	60.1	4.1	0.6:1	3
Duff	14.3	0.5	73.5	4.9	3.8	3.0	40.5	1.4	53.2	4.9	0.7:1	4
Mixed Smalls	15.5	0.5	71.8	4.1	6.1	2.0	38.1	2.2	53.6	6.1	0.7:1	3
New Clydesdale Colliery.												
Nuts	14.9	0.4	69.3	7.1	5.4	2.9	38.0	1.8	55.9	4.3	0.7:1	3
Mixed Smalls	14.9	0.7	69.4	6.0	5.6	3.4	41.9	1.6	51.9	4.6	0.8:1	3
Consolidated Colliery.												
Nuts	25.5	1.2	50.9	13.9	4.5	4.0	53.2	3.3	37.3	6.2	1.3:1	3
Peas	27.0	1.1	51.6	8.9	6.8	4.6	55.6	1.8	36.6	6.0	1.3:1	3
Duff	29.2	0.3	50.5	8.1	5.6	6.3	51.8	1.8	39.0	7.4	1.2:1	3

NATAL COLLIERIES. TABLE 1 (Continued).

Sample No.	Microlithotype Analysis						Maceral Analysis				Ratio: Active/ Inert	No. of Samples Analysed
							Active		Inert			
	Vt %	Cl %	V.I. %	T.M. %	Fu %	C.S. %	Vn %	Ex. %	In. %	V.M. %		
Hlobane Colliery.												
Nuts	14.3	0.0	62.9	14.4	3.0	5.4	43.0	1.9	47.3	7.8	0.8:1	3
Peas	17.9	0.0	63.0	12.5	3.1	3.5	42.6	1.5	50.5	5.4	0.8:1	3
Duff	24.3	0.3	52.4	13.8	3.0	6.2	47.2	2.4	42.5	7.9	1.0:1	3
Mixed Smalls	24.4	0.4	54.0	12.5	3.3	5.4	48.7	1.5	44.5	5.3	1.0:1	2
Coking Coal	34.7	0.3	44.5	14.0	3.0	3.5	56.6	2.0	37.7	3.7	1.4:1	2
Ingagane Colliery.												
Nuts	15.2	0.5	63.1	12.4	3.4	5.4	43.9	1.9	48.2	6.0	0.8:1	2
Peas	19.7	0.6	59.3	13.1	3.2	4.1	47.1	2.2	44.6	6.1	1.0:1	2
Duff	24.4	0.4	51.0	9.4	2.6	12.2	50.8	1.8	35.0	12.4	1.1:1	2
Mixed Smalls	21.4	0.6	53.5	11.2	2.6	10.7	45.1	2.0	40.8	12.1	0.9:1	2
N.C.E.C. Colliery.												
Nuts	34.4	2.2	37.5	17.1	3.0	5.8	55.0	3.4	34.6	7.0	1.4:1	3
Peas	33.2	3.3	38.3	17.0	1.7	6.5	57.6	3.3	28.5	10.6	1.6:1	2
Duff	43.2	1.9	39.3	8.1	2.2	5.3	66.1	2.0	25.6	6.3	2.1:1	2
Mixed Smalls	34.8	2.4	43.4	10.4	3.5	5.5	56.7	2.3	33.8	7.2	1.4:1	2
Gas Coal	32.5	1.6	41.3	16.9	2.3	5.4	59.2	3.5	30.8	6.5	1.7:1	2
Coking Blend	43.9	1.6	37.4	8.7	2.7	5.7	62.4	2.5	26.6	8.5	1.8:1	2

TABLE 1 (Continued).

NATAL COLLIERIES (Continued).

Sample No.	Microlithotype Analysis						Maceral Analysis				Ratio: Active/ Inert	No. of Samples Analysed
							Active		Inert			
	Vt %	Cl %	V.I. %	T.M. %	Fu %	C.S. %	Vn %	Ex. %	In. %	V.M. %		
Enyati Colliery.												
Nuts	14.6	0.2	53.7	28.2	1.1	2.2	42.3	2.9	50.9	3.9	0.8:1	2
Peas	15.1	0.1	55.0	26.1	1.3	2.4	47.3	2.4	44.7	5.6	1.0:1	2
Duff	28.2	0.0	47.5	19.7	0.9	3.7	49.5	2.3	40.8	7.4	1.1:1	2
Mixed Smalls	24.5	0.0	46.0	23.6	1.5	4.4	54.2	3.1	35.3	7.4	1.3:1	2
Coking Blend	34.6	0.5	42.4	18.1	3.1	1.3	60.4	2.3	34.8	2.5	1.7:1	2
Durban Navigation Colliery.												
Coking Coal	29.9	1.2	47.2	17.3	3.2	1.2	62.7	2.7	32.0	2.6	1.9:1	2
Natal Navigation Colliery.												
Mixed Smalls	44.5	0.0	35.9	14.0	2.3	3.3	71.3	1.4	23.2	4.1	2.7:1	2
Coking Coal	58.3	0.7	33.2	4.8	1.5	1.5	69.9	1.1	25.7	3.3	2.4:1	2
Utrecht Colliery.												
Cobbles	23.1	1.7	51.4	12.7	3.0	8.1	48.3	2.3	39.5	9.9	1.0:1	2
Nuts	28.3	1.4	44.1	11.6	3.1	11.5	49.7	2.2	35.5	12.6	1.1:1	2
Peas	21.0	1.6	53.4	13.3	4.3	6.4	49.6	3.2	40.4	6.8	1.1:1	2
Duff	28.6	0.8	43.7	12.9	3.9	10.1	52.8	2.3	34.5	10.4	1.2:1	2
Mixed Smalls	18.1	0.9	55.4	13.0	3.4	9.2	45.6	2.3	40.9	11.2	0.9:1	2

TABLE 2.

A COMPARISON OF THE VITRITE CONTENT (PER CENT) OF THE DIFFERENT PRODUCTS FROM THE TRANSVAAL COLLIERIES.

Colliery	PRODUCT					
	Nuts	Peas	Duff	M.S.	Gas*	Coking* Blend.
Landau	8.0	10.2	12.5	-		
Van Dyksdrift	16.1	-	-	19.5		
Springbok	11.7	-	-	16.8	28.5	44.2
Douglas	12.3	14.2	20.7			
Albion	11.7	12.5	18.0	11.4		
T.N.C.	13.5	10.1	14.3	15.5		
New Clydesdale	14.9	-	-	14.9		
Consolidated	25.5	27.0	29.2	-		

* No. 5 Seam.

TABLE 3.

A COMPARISON OF THE VITRINERTITE CONTENT (PER CENT) OF THE DIFFERENT PRODUCTS FROM THE TRANSVAAL COLLIERIES.

Colliery	PRODUCT					
	Nuts	Peas	Duff	M.S.	Gas*	Coking* Blend
Landau	80.1	77.5	74.6	-		
Van Dyksdrift	66.9	-	-	64.8		
Springbok	73.3			69.4	41.2	34.6
Douglas	72.6	70.5	67.0	-		
Albion	73.4	74.1	67.3	74.3		
T.N.C.	71.4	75.8	73.5	71.8		
New Clydesdale	69.3	-	-	69.4		
Consolidated	50.9	51.6	50.5	-		

* No. 5 Seam.

Table 4/.......

TABLE 4.

A COMPARISON OF THE TRANSITION MATERIAL CONTENT (PER CENT) OF THE DIFFERENT PRODUCTS OF THE TRANSVAAL COLLIERIES.

Colliery	PRODUCT					
	Nuts	Peas	Duff	M.S.	Gas*	Coking* Blend.
Landau	6.7	4.7	4.0	-	-	-
Van Dyksdrift	7.1	-	-	7.0	-	-
Springbok	7.4	-	-	7.0	22.5	13.8
Douglas	6.7	7.8	5.1	-	-	-
Albion	6.8	6.5	3.9	5.6	-	-
T.N.C.	8.2	6.2	4.9	4.1	-	-
New Clydesdale	7.1			6.0	-	-
Consolidated	13.9	8.9	8.1	-	-	-

* No. 5 Seam.

TABLE 5.

A COMPARISON OF THE VITRINITE CONTENT (PER CENT) OF THE DIFFERENT PRODUCTS FROM THE TRANSVAAL COLLIERIES.

Colliery	PRODUCT					
	Nuts	Peas	Duff	M.S.	Gas*	Coking* Blend
Landau	31.6	33.3	29.9			
Van Dyksdrift	40.6	-	-	44.7		
Springbok	40.2	-	-	43.6	64.7	69.7
Douglas	34.5	36.4	41.6	-		
Albion	35.8	36.1	37.4	34.1		
T.N.C.	37.4	34.2	40.5	38.1		
New Clydesdale	38.0	-	-	41.9		
Consolidated	53.2	55.6	51.8			

* No. 5 Seam.

Table 6/......

TABLE 6.

A COMPARISON OF THE RATIO OF ACTIVE:
INERT CONSTITUENTS IN THE DIFFERENT PRODUCTS FROM
THE TRANSVAAL COLLIERIES.

Colliery	PRODUCT					
	Nuts	Peas	Duff	M.S.	Gas*	Coking* Blend
Landau	0.5	0.5	0.5			
Van Dyksdrift *	0.7	-	-	0.9		
Springbok	0.7	-	-	0.8	2.3	2.7
Douglas	0.6	0.6	0.8	-		
Albion	0.6	0.6	0.6	0.6		
T.N.C.	0.7	0.6	0.7	0.7		
New Clydesdale	0.7	-	-	0.8		
Consolidated	1.3	1.3	1.2	-		

* No. 5 Seam.

TABLE 7.

A COMPARISON OF THE VITRITE CONTENT (PER CENT)
OF THE DIFFERENT PRODUCTS FROM
THE NATAL COLLIERIES.

Colliery	PRODUCT					
	Nuts	Peas	Duff	M.S.	Gas Coal	Coking
Hlobane	14.3	17.9	24.3	24.4	-	34.7
D.N.C.	-	-	-	-	-	29.9
Northfield				44.5		58.3
Enyati	14.6	15.1	28.2	24.5	-	34.6
N.C.E.C.	34.4	33.2	43.2	34.8	32.5	43.9
Ingagane	15.2	19.7	24.4	21.4	-	-
Utrecht	28.3	21.0	28.6	18.1	-	-

Table 8/.....

TABLE 8.

A COMPARISON OF THE VITRINERTITE CONTENT (PER CENT) OF THE DIFFERENT PRODUCTS FROM THE NATAL COLLIERIES.

Colliery	PRODUCT					
	Nuts	Peas	Duff	M.S.	Gas Coal	Coking
Hlobane	62.9	63.0	52.4	54.0	–	44.5
D.N.C.	–	–	–	–	–	47.2
Northfield	–	–	–	35.9	–	33.2
Enyati	53.7	55.0	47.5	46.0		42.4
N.C.E.C.	37.5	38.3	39.3	43.4	41.3	37.4
Ingagane	63.1	59.3	51.0	53.5	–	–
Utrecht	44.1	53.4	43.7	55.4	–	–

TABLE 9.

A COMPARISON OF THE TRANSITION MATERIAL CONTENT (PER CENT) OF THE DIFFERENT PRODUCTS OF THE NATAL COLLIERIES.

Colliery	PRODUCT					
	Nuts	Peas	Duff	M.S.	Gas Coal	Coking
Hlobane	14.4	12.5	13.8	12.5	–	14.0
D.N.C.	–	–	–	–	–	17.3
Northfield				14.0	–	4.8
Enyati	28.2	26.1	19.7	23.6	–	18.1
N.C.E.C.	17.1	17.0	8.1	10.4	16.9	8.7
Ingagane	12.4	13.1	9.4	11.2		
Utrecht	11.6	13.3	12.9	13.0		

Table 10/.....

TABLE 10.

A COMPARISON OF THE VITRINITE CONTENT (PER CENT) OF THE DIFFERENT PRODUCTS FROM THE NATAL COLLIERY

Colliery	PRODUCT					
	Nuts	Peas	Duff	M.S.	Gas	Coking
Hlobane	43.0	42.6	47.2	48.7	-	56.6
D.N.C.	-	-	-	-	-	62.7
Northfield	-	-	-	71.3	-	69.9
Enyati	42.3	47.3	49.5	54.2		60.4
N.C.E.C.	55.0	57.6	66.1	56.7	59.2	62.4
Ingagane	43.9	47.1	50.8	45.1	-	-
Utrecht	49.7	49.6	52.8	45.6	-	-

TABLE 11.

A COMPARISON OF THE RATIO OF ACTIVE: INERT CONSTITUENTS IN THE DIFFERENT PRODUCTS FROM THE NATAL COLLIERIES.

Colliery	PRODUCT					
	Nuts	Peas	Duff	M.S.	Gas	Coking
Hlobane	0.8	0.8	1.0	1.0	-	1.4
D.N.C.	-	-	-	-	-	1.9
Northfield	-	-	-	2.7	-	2.4
Enyati	0.8	1.0	1.1	1.3	-	1.7
N.C.E.C.	1.4	1.6	2.1	1.4	1.7	1.8
Ingagane	0.8	1.0	1.1	0.9	-	-
Utrecht	1.1	1.1	1.2	0.9	-	-

Table 12/....

TABLE 12.

THE AVERAGE PETROGRAPHIC ANALYSIS
OF THE TRANSVAAL AND NATAL COAL.

Origin	Transvaal	Natal
Vitrite (%)	17.3	28.5
Clarite (%)	0.6	0.9
Vitrinertite (%)	66.7	48.1
Transition Material (%)	7.6	14.3
Fusite (%)	4.7	2.7
Carbonaceous shale (%)	3.1	5.5
Vitrinite (%)	41.8	53.6
Exinite (%)	2.1	2.3
Inertinite (%)	51.3	37.0
Visible Minerals (%)	4.8	7.1
Ratio of Active: Inert Constituents	0.8:1	1.3:1