F.R.I. 47

VERSLAG NR. 54

REPORT NO. 1977

VAN

OF

FRI 54/1977

U1/E/5/2

BRANDSTOFNAVORSINGSINSTITUUT VAN SUID-AFRIKA

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

ONDERWERP: MINERAL MATTER FACTORS FOR FIFTY-SIX COAL PRODUCT SAMPLES
SUBJECT:

AFDELING: CHEMISTRY
DIVISION:

NAAM VAN AMPTENAAR: J L GAIGHER
NAME OF OFFICER:

Coetzee 7751—L48

PROJECT	:	INORGANIC CONSTITUENTS (INCLUDING MINERALS) IN COAL 2.8
AUTHOR	:	J L GAIGHER
LEADER OF PROJECT	:	J L GAIGHER
TITLE	:	MINERAL MATTER FACTORS FOR FIFTY-SIX COAL PRODUCT SAMPLES
ENQUIRIES TO	:	J L GAIGHER
SECTION	:	CHEMISTRY

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

REPORT NO. 54 OF 1977

MINERAL MATTER FACTORS FOR FIFTY-SIX COAL PRODUCT SAMPLES

SYNOPSIS

The regional variation of mineral matter to ash ratios for some coal product samples is discussed by means of frequency weighted histograms.

INTRODUCTION

Although an ash determination of coal is commonly taken to be a measure of its content of "inorganic" or non-combustible matter, this value rather underestimates the amount of non-coal material, or mineral matter, in coal.

This is due to the mineral matter also undergoing mass losses when coal is ashed in a standard ash determination at about 800^{o}C. For example, the clay minerals kaolinite and illite are dehydrated for mass losses of 14,0 per cent and 4,5 per cent respectively, the carbonates are decomposed: calcite being calcined to lime (mass loss 44 per cent) and iron sulphide or pyrite is oxidized to hematite with a loss in mass of 33 per cent. Quartz is relatively stable and does not undergo any change in mass.

The ratio of the mineral matter to ash content i.e. the mineral matter factor, is thus usually greater than 1, and by multiplying the ash content by the mineral matter factor, a more accurate measure of the amount of "inorganic" material in coal is obtained.

METHOD AND RESULTS

The mineral matter contents of the coal samples were determined by the method of radio-frequency oxidation (Gluskoter 1965) under the standard conditions given in FRI Report No. 66 of 1976, i.e. 200 watt power and 50 ml per minute oxygen flow rate. For all of the samples, the radio-

2/.....

frequency ashing was terminated when the mass loss per 24 hour period was less than 1,0 per cent. In order for the values to be directly comparable, the mineral matter contents of the coal samples were determined on the same basis as the ash contents i.e. air-dry.

Table 1 gives the ash content, mineral matter content and mineral matter factors of the coal product samples which are grouped according to the various coalfields. Data from Report No. 66 of 1976 are included. Average mineral matter factors weighted according to the relative coal production of the collieries are also given in the Table.

In Figure 1, histograms of mineral matter factors weighted for relative coal production are presented for all the collieries as a whole, and separately for the coal producing areas.

DISCUSSION AND CONCLUSIONS

The histogram for all the coal areas combined (Figure 1) appears to be polymodal with maxima at 1,16, 1,20 and 1,24 mineral matter to ash ratios. It is thus misleading to attempt to calculate an overall mineral matter factor for all the colliery products.

However, assuming that the rather limited data in some instances are representative of the area as a whole, certain mineral matter factors appear to be coupled to certain geographical areas or seams. For example, the No. 5 Seam of the Witbank area appears to have a lower average mineral matter factor at 1,13 than either the No. 2 or No.2 and No. 4 Seams combined, in which a number of maxima are represented (1,16, 1,20 and 1,23). Similarly mineral matter factors can be assigned to the main coal producers of the Ermelo and Utrecht areas (1,24) as well as the Vryheid area (1,14).

In the Klip River area a wide variation occurs with mineral matter factors ranging from 1,14 to 1,28 for a weighted average of 1,19.

For the South Rand and Orange Free State coalfields maxima occur at around 1,16 (Sigma and Vierfontein), 1,20 (Cornelia and Springfield) and 1,24 (Coalbrook) mineral matter factors.

3/.....

With reference to its utilization, the mineral matter factors of coal used for steel production show a number of maxima depending on whether the coal is derived from the Witbank No. 5 Seam or from the coalfields of Natal with a range of 1,13 to 1,22. Power station coal, however, has three maxima (at 1,16, 1,20 and 1,24 mineral matter to ash ratio) and coal mined for domestic and export purposes occupies the full range of 1,08 to 1,28.

In conclusion it may be stated that since a mineral matter to ash ratio depends on the identity and amount of the mineral matter from which the ash was derived, the wide variation of the mineral matter factors points to an equally wide variation in the mineral matter contents of South African coal products.

ACKNOWLEDGEMENTS

Although the author must bear responsibility for the views expressed in this Report, Mr W H D Savage is thanked for reading the manuscript and suggesting corrections and improvements.

J L GAIGHER
SENIOR RESEARCH OFFICER

PRETORIA
18/8/77
JLG/md

REFERENCES

Gaigher, J L (1976): Interim report on minerals in coal - The direct determination of the mineral matter content in some coal product samples - FRI Report No. 66 of 1976 12pp.

Gluskoter, H J (1965): Electronic low-temperature ashing of bituminous coal - Fuel 44 285 - 291.

TABLE 1

MINERAL MATTER FACTORS OF COAL PRODUCT SAMPLES

Colliery	Product	Sample No.	AIR-DRY BASIS		
			Ash %	MM %	MM / Ash [1]
WITBANK NO. 2 SEAM					
Albion	Pea	75/576B	16,8	20,5	1,22
Bank	Pea	76/71B	10,4	12,5	1,20
Delmas	Mixed small	75/38D	19,0	23,4	1,23
Douglas [2]	Pea	76/67B	15,3	18,0	1,18
Eikeboom	Pea	75/208D	9,6	11,4	1,18
Koornfontein	Mixed small	75/582A	12,4	15,7	1,26
New Clydesdale	Nut	75/414A	15,4	19,1	1,24
Optimum [2]	Chrushed	76/237A	33,1	38,3	1,16
Springbok	Nut	75/424A	13,7	16,3	1,19
Tavistock	Pea	75/136B	10,7	13,3	1,24
Transvaal Navigation	Pea	75/128B	11,8	14,3	1,21
Van Dyks Drift [2]	Mixed small	75/425B	14,3	17,6	1,23
Weighted [3] average					1,20
NO. 2 AND NO. 4 SEAMS					
Anglo Power (Kriel) [4]	Crushed	75/553A	20,4	25,3	1,24
Blinkpan [5]	Mixed small	75/144A	20,1	24,8	1,23
Greenside	Pea	76/62B	15,4	18,4	1,20
New Largo	Nut	75/427B	20,6	24,7	1,20
Phoenix	Pea	75/570B	14,8	17,9	1,21
South Witbank [4]	Pea	75/572D	20,2	24,3	1,20
Tweefontein	Pea	75/418B	13,4	15,3	1,14
Waterpan	Mixed small	75/428D	14,4	17,4	1,20
Witbank Consolidated [6]	Mixed small	75/574C	21,9	26,2	1,20
Wolvekrans [2]	Pea	75/589B	15,7	18,4	1,17
Weighted [3] average					1,20

6/.....

TABLE 1 (contd)

Colliery	Product	Sample No.	AIR-DRY BASIS		
			Ash %	MM %	MM[1)] / Ash
WITBANK (contd)					
NO. 5 SEAM					
Blesbok	Coking	76/965A	13,5	15,2	1,13
Greenside	Blend coking	75/408D	11,5	13,7	1,19
Kriel	Nut	75/555B	15,0	17,6	1,17
Navigation	Coking	75/569B	11,9	13,5	1,13
Springbok	Coking	76/246C	11,4	12,9	1,13
Springbok Hope	Coking	76/244A	10,6	12,2	1,15
Weighted[3)] average					1,14
EASTERN TRANSVAAL					
Spitzkop	Pea	75/586B	13,2	16,1	1,22
Union	Pea	75/124B	13,0	16,0	1,23
Usutu (South and East)	Crushed	76/234A	16,7	20,5	1,23
Usutu (West)	Crushed	76/233A	21,8	27,1	1,24
Weighted[3)] average					1,23
SOUTH RAND AND ORANGE FREE STATE					
Coalbrook No. 2	Mixed small	75/45A	24,6	30,6	1,24
Coalbrook No. 3	Crushed	75/559A	33,4	41,3	1,24
Cornelia Bertha I	Pea	75/393A	26,2	31,5	1,20
Cornelia Bertha II	Pea	75/394B	25,0	29,8	1,19
Sigma	13 x 0 mm	75/557B	30,2	34,9	1,15
Springfield (Grootvlei)	Crushed	75/562A	26,8	32,1	1,20
Vierfontein	Mixed small	75/202A	30,1	35,2	1,17
Weighted[3)] average					1,19

7/.....

TABLE 1 (contd)

Colliery	Product	Sample No.	AIR-DRY BASIS		
			Ash %	MM %	$\frac{MM}{Ash}$ [1]
NATAL					
KLIP RIVER					
Ballengeich	Pea	75/303B	16,1	18,9	1,17
Durban Navigation	Coking	76/680A	11,0	13,2	1,20
Indumeni	Coking	76/683A	10,4	12,7	1,22
Kilbarchan	Mixed small	75/55A	24,7	29,3	1,19
Natal Navigation	Coking	76/684A	13,6	15,9	1,17
Newcastle-Platberg	Pea	75/304B	23,2	26,5	1,14
Star	Nut	75/301B	13,4	17,2	1,28
Weighted[3] average					1,19
UTRECHT					
Balgray	Mixed small	76/40B	15,2	18,2	1,20
Utrecht	Pea	75/310B	13,5	16,7	1,23
Umgala	Small	76/933A	13,4	16,7	1,25
Zimbutu	Pea	76/934C	12,7	15,8	1,24
Weighted[3] average					1,24
PAULPIETERSBURG-VRYHEID					
Aloe Anthracite	Mixed duff	8434	11,8	12,7	1,08
Brockwell Anthracite	Mixed small	76/44D	13,6	15,5	1,14
Dumbe	Coking	76/223A	10,7	12,6	1,18
Hlobane	Coking	76/691A	12,9	14,7	1,14
Tendega	Coking	76/950A	12,1	13,9	1,15
Vryheid Coronation	Coking	76/946A	12,5	14,2	1,14
Weighted[3] average					1,14

1) Mineral matter factor.

2) Including No. 1 Seam.

3) Weighted for relative coal production.

4) No. 4 Seam only.

5) No. 4 Seam not always mined.

6) No. 2 Seam not always mined.

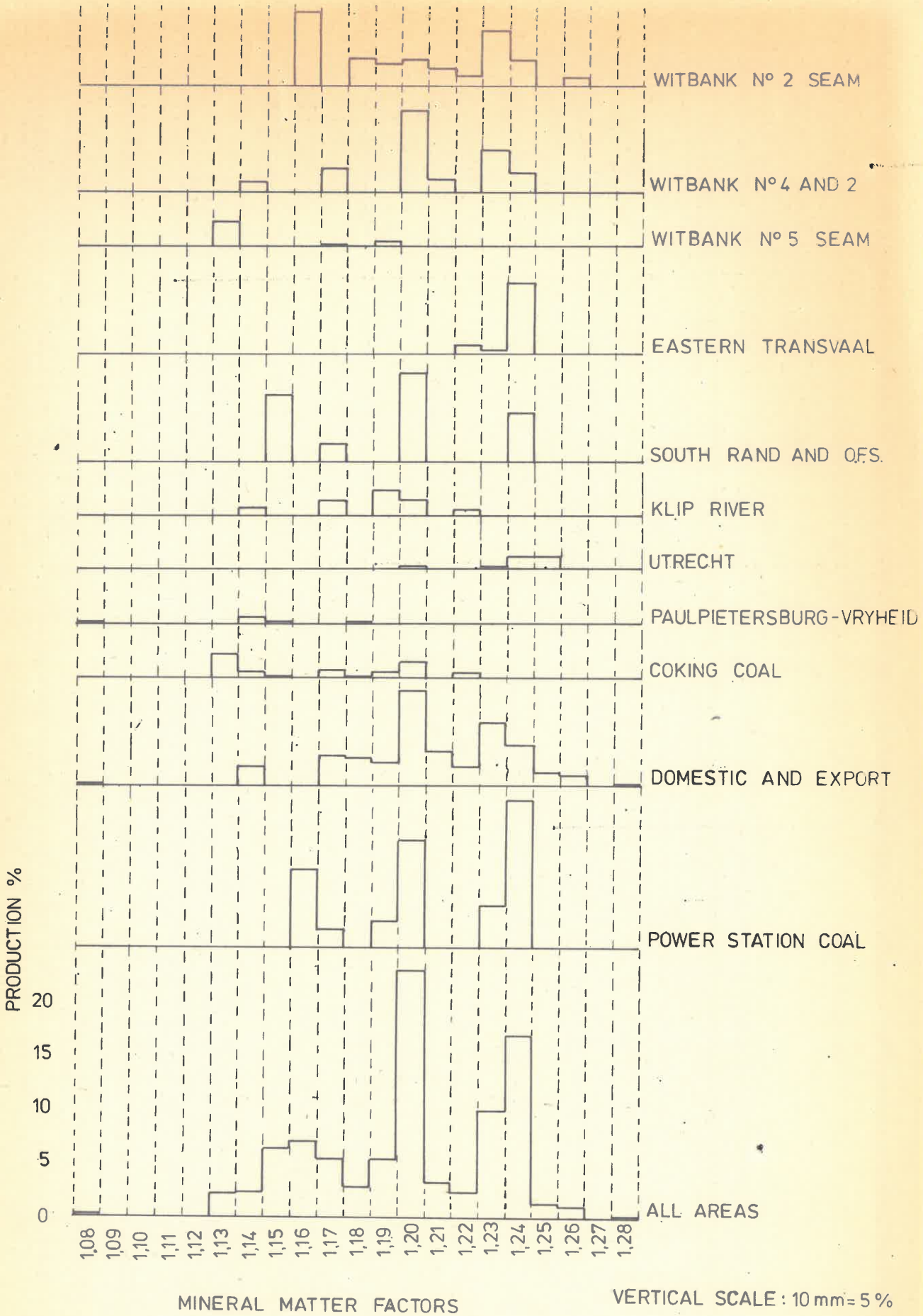

FIGURE 1 HISTOGRAMS OF MINERAL MATTER FACTORS WEIGHTED FOR COLLIERY COAL PRODUCTION.