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FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA

TEGNIESE MEMORANDUM
TECHNICAL

NO. 17 OF 1971

PREPARATION OF AND CARBONISATION TESTS ON LOW ASH BLEND COKING COALS FROM THE WITBANK NO. 2 SEAM

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INTRODUCTION

At a meeting held on 24th March, 1970, it was decided to form a co-ordinating group consisting of members of the staffs of Iscor, T.C.O.A., and the F.R.I. to study the production and utilisation of low ash blend coking coals from the No. 2 seam in the Witbank coal-field.

It was decided that:

1. The T.C.O.A. would be responsible for the taking and delivery at the F.R.I. pilot plant in Pretoria of bulk samples of about 100 tons each of $1\frac{1}{4}$" x 0 r.o.m. coal from eight selected collieries in the Witbank coal-field.
2. The F.R.I. would prepare these samples to the required specifications in the pilot plant.
3. Iscor and F.R.I. jointly would be responsible for carbonisation tests and coke testing.

Part A of this report, compiled by S.F. Streicher, deals with the preparation of the samples, while Part B, written by W.J. Sander, comprises the results of the carbonisation tests and coke testing.

PART A: PREPARATION OF LOW ASH BLEND COKING COALS

A.1 Coals Treated

The eight coals initially selected for the test programme were:

Greenside	Landau
Douglas	Van Dyksdrift
Koornfontein	Springbok
T.N.C.	Tweefontein

At the request of Iscor two consignments of coal from Phoenix colliery were also included. Two samples of Springbok

/coal .....

coal were washed due to the fact that the first consignment of this coal was not tested in the Iscor ovens. Washing results on a sample of New Clydesdale coal are also included in this report although this coal was intended to be part of a subsequent investigation of coals for formcoke production. Duplicate tests were also carried out on samples from Greenside colliery. Table A1 gives a list of the coals treated in chronological order.

A.2 Washing Procedure

In general, the preparation of the 1¼" x 0 r.o.m. coal consisted of:

1. Producing a 1¼" x 0.5 mm low ash coal with a maximum ash content of 7% and a minimum swelling index of 2½-3.
2. Rewashing the discard from the primary separation to produce a middlings product suitable for power station consumption, and a discard product.
3. Discard all the -0.5 mm material.

The required cutpoints to produce acceptable products for the operations above were supplied by the T.C.O.A. from washability tests carried out by the Association. In some cases the low ash products had to be washed to ash contents lower than 7% in order to achieve the required swelling index.

In view of the fact that the cyclone washer in the pilot plant can only handle coal to a top size of ½", the following procedure had to be adopted in treating the samples:

1. Screen the coal as received at ½" square aperture.
2. Wash the 1¼" x ½" size fraction in the Drewboy washer at about S.G. 1.35.
3. Rewash the discard from the primary Drewboy washer at about S.G. 1.60 to produce a middlings product and a discard.
4. Wash the ½" x 0.5 mm size fraction of the r.o.m. coal in the cyclone at a low specific gravity.
5. Rewash the discard from the cyclone primary wash at a high specific gravity to product a middlings product and a discard.

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6. Discard all -0.5 mm material.

7. Blend the two primary low ash products for carbonisation tests and the two middlings products for power station tests.

8. Despatch both blends.

On account of the fact that washing operations cannot be carried out simultaneously in the pilot plant, the above operations resulted in excessive handling of the coal.

All the samples were tested in the manner described above except that:

a) In the case of the Phoenix coal, Iscor indicated that they were not interested in the production of a middlings product and that all the coal could be crushed to -½", and washed in the cyclone only. As will be noted in most of the tables, the Phoenix coal was received and dealt with in two batches.

b) The T.N.C. sample contained a very small proportion of +½" material and permission was obtained to crush the +½" size fraction to -½" before washing in the cyclone washer.

All the different products from the individual washing operations, except the -0.5 mm material, were weighed before despatch. Owing to the difficulty of recovering all the -0.5 mm material from the system after each operation, this figure had to be arrived at by difference. The figures reported for the percentage of -0.5 mm material may therefore be slightly high because they include any possible small losses of coal, together with degradation products from the excessive handling operations described above.

Initially, some difficulties were encountered when washing in the Drewboy at low specific gravities, due to instability of the medium. This however could be rectified by occasional additions of superfine magnetite.

A.3 Washing Results

Washing results obtained in all the different individual operations, together with cutpoints and efficiencies are

/reported .....

reported in Table A2. Table A3 gives the yields of the combined final products as percentages of the raw coal received, and Table A4 represents the analyses of the different individual products and the calculated analyses of the blends.

PART B. CARBONISATION TESTS ON LOW ASH BLEND COKING COALS

B.1 Introduction

The investigation regarding the carbonisation of the T.C.O.A. low ash coals had to be run concurrently with an investigation on behalf of the Natal Associated Collieries. The approval of the N.A.C. had to be obtained to run the investigations concurrently because this organisation had been informed that the Institute would regard its programme of investigation as being of national importance and would give it priority.

B.2 Execution of the Programme

The programme was carried out in the following way, viz.: dry charges consisting of 100 per cent by weight of low ash Witbank coal as well as blends of 75 per cent by weight of this low ash coal and 25 per cent by weight of D.N.C. coal were carbonised, both in the narrow and the wide oven of the Institute's experimental coke ovens at a flue temperature of 1150°C.

Of the coals mentioned in paragraph A.1, charges of 100 per cent coal were carbonised in all cases except Greenside coal which was left out because of a misunderstanding, and New Clydesdale coal, which was intended for formcoke investigations.

Blend coking tests were carried out on all low ash coals except Greenside, New Clydesdale, Phoenix, and a wide oven test using T.N.C. The reason for the latter two coals not being tested was that there was insufficient coal for the charges required.

B.3 Experimental Results

All relevant available data pertaining to the coking investigation are summarized in Tables B1 to B5.

Table B1 contains the analytical details of the coals used in the charges. In Table B2 details are given of the

/unblended .....

unblended charges (i.e. 100 per cent coal) and the carbonisation conditions. Table B3 comprises details of the blends charged and the carbonisation conditions. The characteristics of cokes made from unblended charges are presented in Table B4, and the characteristics of cokes produced from blends in Table B5.

B.4 Discussion of the Results

A detailed discussion of the results obtained is not possible at this stage because all the data on the laboratory coking properties and the microscopic analyses are not yet available. Consequently only a few general observations are recorded.

B.4.1 Unblended charges

Promising results were obtained with Landau, Springbok No. 2 (first batch), and Douglas coals. Referring to Table B4 it appears as if Landau, Springbok No. 2 and possibly Douglas coals may be used as such to produce an acceptable coke. A further observation is that the quality of the cokes produced from the two different batches of Springbok No. 2 seam coal differs more than could be reasonably expected. It is not possible to explain this difference as there is not enough information available on the two batches.

B.4.2 Blends

It seems as if most of the low ash coals investigated would be suitable as blend coking coals when blended with D.N.C. coking coal. The order of merit of the quality of cokes made from the different unblended coals is also followed in the case of the blends. When Table B5 is consulted it can be seen that the most promising results were obtained with Landau coal. The first batch of Springbok No. 2 seam coal and Tweefontein coal also produced good cokes and the coke obtained from the Douglas coal blend appears to be acceptable. The other coals did not give such good coke; T.N.C. coal gave the poorest coke.

B. 5 Conclusion

In conclusion it may be stated that the preliminary results have indicated that

i) some of the low ash coals may be utilised as such to

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produce an acceptable coke, and

ii) most of the low ash coals may be good blend coking coals.

It has to be borne in mind that these conclusions are arrived at by means of the results obtained at pilot plant coke ovens. The ultimate test for deciding whether a coke is acceptable is its behaviour in the blast furnace. The results of this Transvaal low ash coal investigation nevertheless give a fairly reliable indication that some of the coals investigated may be used for coke manufacture. In this respect the investigation thus far has proved to be of considerable value.

(SIGNED) S.F. STREICHER
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PRETORIA.
2nd April, 1971.
/TW

TABLE A1

LIST OF COALS TREATED (CHRONOLOGICAL ORDER)

Colliery	Date received	Tonnage
Greenside	19.3.70	40
Landau	15.4.70	126
Douglas	23.4.70	106
Van Dyksdrift	19.5.70	132
Phoenix	29.6.70	150
Koornfontein	15.6.70	101
Phoenix	1.7.70	200
T.N.C.	20.7.70	128
Springbok	3.8.70	117
Greenside	24.8.70	130
New Clydesdale	15.9.70	142
Tweefontein	6.10.70	120
Springbok	16.10.70	120

/TABLE A2 .....

TABLE A2

INDIVIDUAL WASHING RESULTS

Coal	Washing operation	Size fraction	Test No.	Clean coal, yield		Discard, yield		Cutpoint	E.P.
				Tons	%	Tons	%		
Greenside	Primary	1¼" x ½"	497	4.8	25.0	14.3	75.0	1.35	0.002
	Primary	½" x 0,5 mm	499	4.3	30.2	9.9	69.8	1.38	0.013
	Secondary	1¼" x ½"	498	9.0	74.0	3.2	26.0	1.61	0.013
	Secondary	½" x 0,5 mm	500	6.7	72.9	2,5	27.1	1.63	0.017
Landau	Primary	1¼" x ½"	502	5.1	28.1	13.2	71.9	1.37	0.010
	Primary	½" x 0,5 mm	504	30.0	34.9	56.2	65.1	1.39	0.010
	Secondary	1¼" x ½"	503	7.3	55.3	5.9	44.7	1.57	0.014
	Secondary	½" x 0.5 mm	505	35.8	63.7	20.4	36.3	1.57	0.013
Douglas	Primary	1¼" x ½"	507	15.5	42.0	21.5	58.0	1.37	0.008
	Primary	½" x 0,5 mm	508	22.6	41.6	31.8	58.4	1.38	0.014
	Secondary	1¼" x ½"	509	14.6	80.6	3.5	19.4	1.60	0.013
	Secondary	½" x 0.5 mm	510	25.3	79.3	6.6	20.7	1,59	0.017
Van Dyksdrift	Primary	1¼" x ½"	512	14.1	23.1	47.1	76.9	1.35	0.008
	Primary	½" x 0.5 mm	513	16.4	30.8	36.6	69.2	1.37	0.012
	Secondary	1¼" x ½"	514	36.8	92.8	2.8	7.2	1.64	0.019
	Secondary	½" x 0.5 mm	515	38.5	88.1	5.7	11.9	1.61	0.019
Phoenix	Primary	½" x 0,5 mm	521	38.6	31.1	85.5	68.9	1.36	0.013
Koornfontein	Primary	1¼" x ½"	517	12.9	50.1	12.9	49.9	1.36	0.011
	Primary	½" x 0,5 mm	518	25.2	51.9	23.4	48.1	1.36	0.012
	Secondary	1¼" x ½"	519	12.2	94.5	0.7	5.5	1.69	0.012
	Secondary	½" x 0.5 mm	520	24.9	91.7		8.3	1.64	0.022
Phoenix	Primary	½" x 0.5 mm	524	72.4	41.6	101.6	58.4	1.37	0.012
T.N.C.	Primary	½" x 0.5 mm	528	33.0	34.3	62.2	65.7	1.38	0.012
	Secondary	½" x 0.5 mm	529	43.8	74.8	18.4	25.2	1.58	0.015
Springbok	Primary	1¼" x ½"	530	14.3	32.2	30.3	67.8	1.36	0.008
	Primary	½" x 0.5 mm	531	24.5	40.9	35.6	59.1	1.38	0.013
	Secondary	1¼" x ½"	532	25.2	90.5	2.6	9.5	1.60	0.027
	Secondary	½" x 0.5 mm	533	33.8	87.6	4.7	12.4	1.59	0.023
Greenside	Primary	1¼" x ½"	534	26.0	38.1	42.2	61.9	1.38	0.008
	Primary	½" x 0,5 mm	535	19.6	38.1	31.8	61.9	1.38	0.013
	Secondary	1¼" x ½"	536	24.7	68.4	12.4	31,6	1.58	0.012
	Secondary	½" x 0.5 mm	537	22.8	66.8	12.3	33.2	1.58	0.014
New Clydesdale	Primary	1¼" x ½"	542	9,8	26,1	27,7	72.9	1.37	0.005
	Primary	½" x 0.5 mm	543	35.0	49,8	35.1	50.2	1.35	0.010
	Secondary	1¼" x ½"	544	20.3	86.7	3.2	13.3	1.63	0.033
	Secondary	½" x 0.5 mm	545	46.3	85.5	7.8	14.5	1.58	0.016
Tweefontein	Primary	1¼" x ½"	556	9.7	19.9	39.1	80.1	1.35	0.009
	Primary	½" x 0,5 mm	557	12,0	18.9	51.7	81.1	1.35	0.011
	Secondary	1¼" x ½"	558	24.8	77.3	7.3	22.7	1.67	0.018
	Secondary	½" x 0.5 mm	559	39.9	75.1	12.9	24.9	1.65	0.017
Springbok	Primary	1¼" x ½"	561	15,2	32.7	24.4	67.3	1.36	0.008
	Primary	½" x 0,5 mm	562	27,3	41.9	40.3	58.1	1.38	0.013
	Secondary	1¼" x ½"	563	21.4	88.0	3.0	12.0	1.67	0.039
	Secondary	½" x 0.5 mm	564	35.3	87.8	4.2	12.2	1.66	0.022

/TABLE A3

TABLE A3

PRODUCT YIELDS

Colliery	Low ash, %	Middlings, %	Discard, %	-0.5 mm, %
Greenside	22.4	44.1	15.8	17.7
Landau	28.0	34.2	20.9	16.9
Douglas	35.9	37.7	9.5	16.9
Van Dyksdrift	22.9	56.7	6.5	13.9
Phoenix	25.7	-	57.0	17.3
Koornfontein	37.8	36.5	2.9	22.8
Phoenix	36.2	-	50.8	13.0
T.N.C.	25.7	34.1	14.3	25.9
Springbok	33.0	50.1	6.2	10.7
Greenside	35.2	36.5	19.1	9.2
New Clydesdale	31.0	47.1	7.7	14.2
Tweefontein	18.1	53.0	16.9	12.0
Springbok	35.3	47.2	6.6	10.9

/TABLE A4 .....

TABLE A4

ANALYSIS OF PRODUCTS

Colliery	Size fraction	Low ash coal					Middlings				Discard
		Moisture, %	Ash, %	Vol. mat., %	Sw. No.	S, %	Cal. val., lb/lb	Moisture, %	Ash, %	Vol. mat., %	Ash, %
Greenside	1¼" x ½"	1.9	7.0	35.2	5	0.69	12.06	2.1	15.1	25.5	40.9
	½" x 0.5 mm	2.1	6.6	35.5	4½	0.57	11.98	2.2	16.2	22.6	45.3
	1¼" x 0.5 mm	2.0	6.8	35.3	4½	0.63	12.03	2.1	15.5	24.3	42.7
Landau	1¼" x ½"	1.8	7.0	34.2	3½	0.65	12.34	2.3	14.1	23.1	42.8
	½" x 0.5 mm	2.0	6.6	33.5	2½	0.43	12.29	2.5	14.6	21.4	39.8
	1¼" x 0.5 mm	2.0	6.7	33.6	3	0.46	12.30	2.5	14.5	21.7	40.5
Douglas	1¼" x ½"	1.9	6.8	31.6	2	0.44	12.54	2.7	13.9	24.4	41.7
	½" x 0.5 mm	2.0	6.5	33.4	2½	0.43	12.44	2.7	14.3	23.7	45.3
	1¼" x 0.5 mm	2.0	6.6	32.7	2½	0.44	12.48	2.7	14.2	24.0	44.1
Van Dyksdrift	1¼" x ½"	2.3	5.8	32.6	1½	0.59	12.66	2.2	12.5	25.3	52.2
	½" x 0.5 mm	2.4	5.6	32.4	2	0.45	12.46	2.4	13.1	23.3	46.1
	1¼" x 0.5 mm	2.4	5.7	32.5	1½	0.52	12.56	2.3	12.8	24.3	48.1
Phoenix	½" x 0.5 mm	2.8	5.5	34.6	2½	0.55	-	-	-	-	21.7
Koornfontein	1¼" x ½"	2.6	5.8	34.3	2½	0.58	12.54	2.4	12.4	27.5	45.2
	½" x 0.5 mm	2.6	5.4	34.1	2½	0.59	12.55	2.6	12.0	27.2	45.4
	1¼" x 0.5 mm	2.6	5.5	34.2	2½	0.59	12.55	2.5	12.1	27.3	45.4
T.N.C.	½" x 0.5 mm	2.7	6.8	30.9	1	0.33	12.09	2.9	14.3	22.7	40.0
Springbok	1¼" x ½"	2.1	6.2	33.0	2½	0.67	12.47	2.2	13.1	23.0	43.7
	½" x 0.5 mm	2.1	6.3	31.8	2½	0.43	12.52	2.2	13.1	23.5	44.4
	1¼" x 0.5 mm	2.1	6.3	32.2	2½	0.52	12.50	2.2	13.1	23.3	44.2
New Clydesdale	1¼" x ½"	2.7	6.8	31.8	1½	0.54	12.39	2.6	13.0	24.9	44.8
	½" x 0.5 mm	2.5	5.6	33.7	2½	0.53	12.58	2.5	12.0	25.0	39.5
	1¼" x 0.5 mm	2.5	5.8	33.3	2	0.53	12.52	2.5	12.3	25.0	41.0
Tweefontein	1¼" x ½"	2.5	7.3	36.5	2½	0.61	11.73	2.7	16.8	24.9	47.0
	½" x 0.5 mm	2.6	5.8	36.1	2½	0.57	11.73	2.7	16.4	23.5	44.6
	1¼" x 0.5 mm	2.6	6.5	36.3	2½	0.59	11.73	2.7	16.6	24.0	45.5
Springbok	1¼" x ½"	2.2	6.8	32.8	2½	0.54	12.58	2.3	13.7	25.2	50.7
	½" x 0.5 mm	1.9	6.7	31.8	2	0.48	12.39	2.2	14.5	23.4	48.1
	1¼" x 0.5 mm	2.0	6.7	32.2	2	0.50	12.46	2.2	14.2	24.1	49.1

/TABLE B1 .....

TABLE B1

EXPERIMENTAL COKE OVEN TESTS

ANALYTICAL DETAILS OF COMPONENTS USED IN CHARGES

Sample No.		70/324	70/388	70/531	70/579	70/607	70/678	70/741	70/969	70/978	69/796	70/447	70/606
Identification		Landau	Douglas	Van Dyks-drift	Koorn-fontein	Phoenix	T.N.C.	Spring-bok (2)	Twee-fontein	Spring-bok (2) (2nd batch)	D.N.C.	D.N.C.	D.N.C.
Proximate analysis, % (air-dry)	H_2O	2.0	2.5	2.4	2.7	3.1	3.0	2.2	2.6	2.2	1.3	1.1	1.3
	Ash	7.1	6.5	5.6	5.5	5.8	6.7	6.3	6.5	7.0	13.3	12.7	11.4
	V.M.	32.3	32.5	33.6	34.4	34.5	31.1	33.8	36.3	31.6	30.3	26.7	30.1
	F.C.	58.6	58.5	58.4	57.4	56.6	59.2	57.7	54.6	59.2	55.1	59.5	57.2
Swelling No.		3	2½	2½-3	2½-3	2	1	2-2½	2½	1-1½	5½	4½	5
V.M., % (d.a.f.)		35.5	35.7	36.5	37.5	37.9	34.4	36.9	39.9	34.8	35.5	31.0	34.5
Total sulphur, %		0.57	0.41	0.41	0.64	0.46	0.38	0.59	0.59	0.49	1.39	1.29	1.24
Phosphorus (P in coal), %		0.044	0.042	0.112	0.117	0.015	0.008	0.105	Not done	0.149	0.023	0.023	0.025

/TABLE B2 .....

TABLE B2

EXPERIMENTAL COKE OVEN TESTS

DETAILS OF UNBLENDED CHARGES AND OF CARBONISING CONDITIONS

Flue Temperature: 1150°C

	Test No.*	ND1054	WD777	ND1057	WD781	ND1067	WD792	ND1075	WD801	ND1083	WD809	ND1099	WD819	ND1106	WD823
Coal charged	Composition of charge, 100%	Landau		Douglas		Van Dyksdrift		Koornfontein		Phoenix		T.N.C.		Springbok (2) (70/741)	
	Proximate analysis, % (air-dry) H_2O	2.0	2.0	2.1	2.2	2.1	2.1	2.3	2.3	2.9	2.9	2.6	2.7	2.0	2.0
	Proximate analysis, % (air-dry) Ash	6.7	6.8	6.3	6.4	6.7	6.6	6.2	5.7	5.6	5.7	6.5	6.5	6.5	6.6
	Proximate analysis, % (air-dry) V.M.	32.0	32.1	32.1	31.4	31.9	32.8	32.9	32.8	35.1	35.1	30.8	31.2	32.2	33.0
	Proximate analysis, % (air-dry) F.C.	59.3	59.1	59.5	60.0	59.3	58.5	58.6	59.2	56.4	56.3	60.1	59.6	59.3	58.4
	Swelling No.	3	2½-3	1½-2	2½	2-2½	2	2½	1½-2	2½-3	2½	1-1½	1-1½	2½	2
	Size analysis, % (+⅛"	11.5	8.4	11.2	10.7	14.0	13.1	13.2	14.8	17.9	14.0	13.4	16.7	9.1	13.3
	Size analysis, % ⅛" x 1/16"	32.2	36.7	30.4	31.4	34.8	32.3	31.7	32.9	33.4	28.4	30.8	33.8	31.5	32.0
	Size analysis, % 1/16" x 22 m	30.3	32.3	30.6	27.0	30.0	26.6	27.4	26.8	26.8	26.4	28.5	28.9	28.7	25.8
	Size analysis, % 22 m x 100 m	22.1	20.4	23.7	26.2	18.7	24.3	18.6	21.6	18.6	25.4	22.4	17.7	26.6	24.2
	Size analysis, % (-100 m	3.9	2.2	4.1	4.7	2.5	3.7	9.1	3.9	3.3	5.8	4.9	2.9	4.1	4.7
Carbonisation details	Moisture as charged, %	2.4	2.4	2.4	2.6	2.6	2.4	2.6	2.8	2.8	3.0	2.6	3.0	2.8	2.4
	Wt. charged (moist), lb	702	874	699	869	699	865	678	865	692	883	709	891	685	883
	B.D. (dry), lb/ft³**	49.0	48.3	48.7	48.0	48.7	47.8	47.3	47.6	48.1	48.5	49.4	49.0	47.6	48.8
	Min. coking period (M.C.P.), hr	13.2	17.7	13.0	17.9	12.7	17.7	13.2	17.6	13.2	18.1	14.5	18.9	13.0	18.0
	Total coking time (T.C.T.), hr	15.6	19.9	15.5	20.2	15.6	20.1	15.2	19.7	15.6	20.4	16.6	20.9	15.5	20.0
	Total coke yield (dry weights), %	71.4	71.2	71.0	71.4	70.7	71.2	67.7	69.2	67.8	72.5	70.9	72.0	70.9	71.3

*N: In the narrow oven
W: In the wide oven
D: Dry charging

**Based on volume of coal space of oven.

NOTE: For analytical details of components used in charges see Table B1.

/TABLE B1 continued .....

TABLE B2 (continued)

Test No.*			ND1159	WD870	ND1162	WD872
Coal charged	Composition of charge, 100%		Tweefontein		Springbok (2) (second batch) (70/978)	
	Proximate analysis, % (air-dry)	H_2O	2.4	2.3	1.8	1.8
		Ash	7.0	6.4	6.7	6.7
		V.M.	35.6	35.2	31.9	32.5
		F.C.	55.0	56.1	59.6	59.0
		Swelling No.	2½	2½	2	1½
	Size analysis, %	+⅛"	19.5	14.2	14.1	16.5
		⅛" x 1/16"	32.1	29.8	30.9	35.1
		1/16" x 22 m	24.9	27.7	27.2	26.1
		22 m x 100 m	20.2	23.8	23.9	19.4
		-100 m	3.3	4.5	3.9	2.9
Carbonisation details	Moisture as charged, %		2.6	2.6	2.0	2.0
	Wt. charged (moist), lb		709	883	702	883
	B.D. (dry), lb/ft^3**		49.4	48.7	49.3	49.0
	Min. coking period (M.C.P.), hr		12.7	18.5	12.6	17.7
	Total coking time (T.C.T.), hr		15.6	21.0	15.6	20.0
	Total coke yield (dry weights), %		68.3	68.8	70.8	71.9

/TABLE B3 .....

TABLE B3

EXPERIMENTAL COKE OVEN TESTS

DETAILS OF BLENDS CHARGED AND OF CARBONISING CONDITIONS

Flue temperature: 1150°C

	Test No.*	ND1055	WD778	ND1058	WD782	ND1068	WD793	ND1076	WD802		ND1100		ND1107	WD824
Coal charged	Composition of charge 75%	Landau		Douglas		Van Dyksdrift		Koornfontein		Phoenix	T.N.C.		Springbok (2) (70/741)	
	25%	D.N.C. (69/796)		D.N.C. (69/796)		D.N.C. (70/447)		D.N.C. (70/447)		D.N.C.	D.N.C. (70/606)		D.N.C. (70/606)	
	Proximate analysis, % (air-dry) H_2O	2.4	2.4	2.0	1.9	1.9	1.9	2.1	2.1	Insufficient coal for charges	2.1	Insufficient coal for charge	2.0	1.8
	Ash	8.1	8.4	8.3	8.3	7.3	7.9	6.9	7.1		7.5		7.7	8.3
	V.M.	30.6	30.5	30.7	31.2	31.8	30.5	32.5	32.4		30.5		32.0	32.0
	F.C.	58.9	58.7	59.0	58.6	59.0	59.7	58.5	58.4		59.9		58.3	57.9
	Swelling No.	4	3-3½	2½	2½-3	2½	2	2½-3	2-2½		1½		2-2½	2
	Size analysis, % +⅛"	16.9	14.5	12.9	13.2	13.4	19.4	10.9	16.5		13.4		11.7	11.9
	⅛" x 1/16"	35.9	37.8	35.7	31.9	35.0	39.7	36.3	32.1		34.2		28.8	34.0
	1/16" x 22 m	27.1	27.1	24.7	25.9	25.9	25.6	26.6	26.3		29.6		28.0	28.3
	22 m x 100 m	16.9	17.8	20.7	22.6	19.9	13.1	21.9	20.4		18.3		25.4	20.5
	-100 m	3.2	2.8	6.0	6.4	5.8	2.2	4.3	4.7		4.5		6.1	5.3
Carbonisation details	Moisture as charged, %	2.4	2.4	2.4	2.6	2.8	2.4	2.6	2.4		2.6		2.0	2.2
	Wt. charged (moist), lb	723	896	730	918	730	918	709	909		727		713	918
	B.D. (dry), lb/ft³**	50.5	49.5	51.2	50.7	50.8	50.7	49.4	50.3		50.6		50.0	50.9
	Min. coking period (M.C.P.), hr	13.2	17.8	14.1	19.2	14.0	19.3	13.3	18.7		14.3		13.1	17.5
	Total coking time (T.C.T.), hr	15.4	19.9	16.3	21.3	16.1	21.4	15.5	20.9		16.3		15.3	19.5
	Total coke yield (dry weights), %	72.2	72.8	71.6	75.4	72.3	72.7	71.5	71.4		72.0		67.5	68.4

*) **) See Table B2

/TABLE B3 continued .....

TABLE B3 (continued)

Test No.*			ND1160	WD871	ND1171	WD874
Coal charged	Composition of charge	75%	Tweefontein		Springbok (2) (second batch) (70/978)	
		25%	D.N.C. (70/606)		D.N.C. (70/606)	
	Proximate analysis, % (air-dry)	H_2O	2.0	2.2	1.9	2.0
		Ash	7.7	7.5	7.7	7.8
		V.M.	34.7	33.5	31.1	31.9
		F.C.	55.6	56.8	59.3	58.3
		Swelling No.	3	2	2	1½-2
	Size analysis, %	+⅛"	14.1	16.6	22.7	19.9
		⅛" x 1/16"	32.8	35.0	38.3	35.5
		1/16" x 22 m	25.4	25.4	22.9	23.8
		22 m x 100 m	23.2	19.3	13.3	17.0
		-100 m	4.5	3.7	2.7	3.7
Carbonisation details	Moisture as charged, %		2.0	2.2	2.2	2.4
	Wt. charged (moist), lb		713	905	747	931
	B.D. (dry), lb/ft^3**		50.0	50.1	52.3	51.5
	Min. coking period (M.P.C.), hr		13.1	18.3	13.1	18.1
	Total coking time (T.C.T.), hr		15.8	20.7	15.9	20.4
	Total coke yield (dry weights), %		69.4	70.6	70.5	67.8

/TABLE B4 .....

TABLE B4

EXPERIMENTAL COKE OVEN TESTS : UNBLENDED CHARGES

CHARACTERISTICS OF COKES

Test No.*			ND1054	WD777	ND1057	WD781	ND1067	WD792	ND1075	WD801	ND1083	WD809	ND1099	WD819	ND1106	WD823
Composition of charge, 100%			Landau (70/324)		Douglas (70/388)		Van Dyksdrift (70/531)		Koornfontein (70/579)		Phoenix (70/607)		T.N.C. (70/678)		Springbok (2) (70/741)	
Characteristics of cokes	Bulk density (dry basis)	kg/m3	Not available		Not available		479	479	426	423	416	434	445	469	453	431
		lb/ft3					29.9	29.9	26.6	26.4	26.0	27.1	27.8	29.3	28.3	26.9
	mm, round holes: Size analysis, % on mm round	125	17.5	14.0	12.5	16.6	14.6	16.9	6.8	15.7	3.2	9.6	6.6	12.6	12.6	16.1
		80	59.4	58.6	53.5	57.1	56.0	61.2	47.1	52.7	43.4	43.4	38.1	41.0	52.7	59.0
		60	78.2	77.6	73.8	75.1	74.9	74.0	69.1	69.3	62.8	64.8	56.8	52.7	74.3	75.8
		25	92.6	91.6	89.9	88.7	90.4	87.5	88.2	85.8	88.2	85.3	71.6	65.1	91.8	90.4
		10	94.5	93.3	92.0	90.6	92.6	89.9	90.6	88.4	90.9	88.5	76.2	69.7	93.9	92.5
		Mean size, mm	88.0	85.8	81.1	84.6	85.5	86.2	74.3	78.9	71.2	73.2	63.8	63.5	82.3	85.7
	Modified micum test on +25 mm coke	M'_{40}	72.6	69.7	67.9	66.2	64.9	63.0	61.4	61.1	63.7	58.5	48.3	46.8	69.5	67.2
		M_{20m}	85.2	81.6	79.3	76.9	79.2	75.5	76.6	73.7	77.8	74.2	55.3	53.2	81.9	79.0
		M_{10m}	12.9	15.7	17.8	20.4	17.3	21.5	19.8	22.8	17.2	20.7	42.0	44.5	15.3	17.8
		$MMSS_m$	53.0	51.0	51.1	48.9	48.6	44.8	48.6	44.9	52.3	48.1	38.0	35.0	52.2	49.6
		$CMTV_m$	63.0	59.0	55.8	52.7	53.7	49.4	49.2	47.2	52.7	46.4	28.0	26.0	58.8	55.3
	B.S. shatter index	1½"	-	88.8	-	88.5	-	88.3	-	86.4	-	83.6	-	ø	-	88.6
		½"	-	96.4	-	95.0	-	94.4	-	93.9	-	93.9	-	ø	-	95.9
	B.S. abr. index		-	67.7	-	60.4	-	58.7	-	56.1	-	56.5	-	39.9	-	62.4
	S.A.S.S. value		-	35.0	-	32.1	-	29.2	-	25.6	-	24.8	-	-	-	32.3
Quality** assigned using the index		M'_{40}	G	G	F	F	F	P	P	P	P	P	VP	VP	G	F
		M_{10m}	VG	G	F	F	F	P	P	P	F	P	VP	VP	G	F

*N: In the narrow oven
W: In the wide oven
D: Dry charging

**F.R.I. Inf. Circ. No. 10 (Reprint from J.S.A. Inst. of Min. & Metal. Oct. 1969, 65-67).

NOTE: For details of charges and carbonizing conditions see Table B2.

ø Excess breeze, no shatter test possible.

/TABLE B4 continued .....

TABLE B4 (continued)

Test No.*				ND1159	WD870	ND1162	WD872
Composition of charge, 100%				Tweefontein (70/969)		Springbok (2) (second batch) (70/978)	
Characteristics of cokes	Bulk density (dry basis)		kg/m^3	421	437	449	465
			lb/ft^3	26.3	27.3	28.0	29.0
	mm, round holes	Size analysis, % on mm round	125	6.4	15.5	16.4	21.6
			80	42.9	52.8	60.3	58.1
			60	68.0	72.5	77.8	73.8
			25	90.9	88.7	89.8	87.1
			10	93.5	91.2	92.0	89.6
		Mean size, mm		73.4	81.7	86.7	86.6
		Modified micum test on +25 mm coke	M'_{40}	63.8	62.3	65.7	65.8
			M_{20m}	81.5	76.9	76.1	74.9
			M_{10m}	14.0	18.6	20.8	22.0
			$MMSS_m$	52.6	46.0	47.5	46.3
			$CMTV_m$	54.8	50.7	52.0	51.3
	B.S. shatter index		1½"	-	86.0	-	89.2
			½"	-	95.0	-	95.1
	B.S. abr. index			-	61.9	-	57.5
	S.A.S.S. value			-	28.0	-	28.5
Quality** assigned using the index			M'_{40}	P	P	F	F
			M_{10m}	G	F	P	P

/TABLE B5 .....

TABLE B5

EXPERIMENTAL COKE OVEN TESTS : BLENDED CHARGES

CHARACTERISTICS OF COKES

Test No.*			ND1055	WD778	ND1058	WD782	ND1068	WD793	ND1076	WD802		ND1100	-	ND1107	WD824
Composition of charge		75%	Landau		Douglas		Van Dyksdrift		Koornfontein		Phoenix	T.N.C.		Springbok (2) (70/741)	
		25%	D.N.C. (69/796)		D.N.C. (69/796)		D.N.C. (70/447)		D.N.C. (70/447)		D.N.C.	D.N.C. (70/606)		D.N.C. (70/606)	
Characteristics of cokes	Bulk density (dry basis)	kg/m³	477	477	Not available		477	479	445	420	Insufficient coal for blend charges	453	In-sufficient coal for wide oven charge	449	449
		lb/ft³	29.8	29.8			29.8	29.9	27.8	26.2		28.3		28.0	28.0
	mm, round holes: Size analysis, % on mm round	125	14.4	16.6	12.0	27.2	12.3	18.5	13.5	16.3		17.8		13.6	16.7
		80	55.4	57.7	58.3	65.3	47.3	60.0	53.3	59.0		60.0		51.9	55.6
		60	75.5	78.3	77.9	80.8	72.5	76.6	74.5	76.7		76.5		74.7	76.6
		25	93.6	92.8	92.9	92.6	90.7	89.7	91.2	89.7		89.0		93.1	92.8
		10	95.5	94.6	94.7	94.1	92.7	91.4	93.3	91.4		91.0		95.0	94.4
		Mean size, mm	84.9	88.1	85.8	97.1	79.5	88.0	82.0	86.4		86.5		82.3	85.3
	Modified micum test on +25 mm coke	M'_{40}	77.2	74.3	71.0	71.8	72.5	69.6	70.8	67.9		67.5		74.7	71.9
		M_{20m}	87.3	85.4	83.7	82.6	82.9	79.0	81.8	78.9		75.9		85.9	83.8
		M_{10m}	10.7	12.6	14.2	15.2	15.0	18.7	15.4	18.7		22.4		11.7	14.2
		$MMSS_m$	58.5	54.3	53.1	49.9	56.1	49.8	52.2	49.8		48.5		58.8	53.7
		$CMTV_m$	68.9	65.0	60.9	60.8	61.6	56.5	59.9	55.2		52.4		65.9	61.7
	B.S. shatter index	1½"	-	92.1	-	91.4	-	89.7	-	86.8		-		-	90.1
		½"	-	97.4	-	96.8	-	95.6	-	94.6		-		-	97.1
	B.S. abr. index		-	71.7	-	63.3	-	54.8	-	63.3		-		-	68.2
	S.A.S.S. value		-	39.4	-	33.4	-	26.8	-	29.8		-		-	36.1
Quality** assigned using the index		M'_{40}	VG	VG	G	G	G	G	G	F		F		G	G
		M_{10m}	Ex	VG	G	G	G	F	G	F		P		VG	VG

*) **) See Table B4

NOTE: For details of blends and carbonising conditions see Table B3.

/TABLE B5 continued .....

TABLE B5 (continued)

Test No.*			ND1160	WD871	ND1171	WD874
Composition of charge		75%	Tweefontein		Springbok (2) (second batch)	
		25%	D.N.C. (70/606)		D.N.C. (70/606)	
Characteristics of cokes	Bulk density (dry basis)	kg/m³	444	442	450	458
		lb/ft³	27.7	27.6	28.1	28.6
	mm, round holes — Size analysis, % on mm round	125	7.0	16.8	14.5	26.7
		80	43.5	57.8	57.2	64.3
		60	69.8	77.6	76.3	79.4
		25	93.3	92.2	92.6	90.5
		10	95.3	93.9	94.5	92.3
		Mean size, mm	75.6	87.7	85.4	93.1
	Modified micum test on +25 mm coke	M'_{40}	72.4	73.2	73.6	71.6
		M_{20m}	85.6	83.1	84.2	80.3
		M_{10m}	11.5	14.2	13.5	17.3
		$MMSS_m$	58.3	50.9	54.3	48.4
		$CMTV_m$	64.1	62.8	63.6	59.2
	B.S. shatter index	1½"	-	89.6	-	90.6
		½"	-	96.4	-	95.8
	B.S. abr. index		-	67.3	-	62.8
	S.A.S.S. value		-	34.8	-	31.8
Quality** assigned using the index		M'_{40}	G	G	G	G
		M_{10m}	VG	VG	VG	G