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FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

REPORT NO. 3 OF 1965.

FURTHER COKING INVESTIGATIONS TO DETERMINE THE EFFECT OF PREDRYING THE CHARGE.

BY:

C.C. LA GRANGE.

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Introduction.

In a previous report* the advantages and disadvantages of predrying and preheating coke oven charges were briefly dealt with and some literature references on the subject were cited. The results obtained from a series of full scale coking investigations, having the object of studying the effect of predrying the charge from the normal moisture content of about 7-8 per cent to the approximately air-dry state (ca. 2 per cent moisture), and carried out as part of the Iscor F.R.I. joint Research Project, were presented.

The present report covers further investigations along similar lines, while the data are amplified by some results obtained in parallel experiments in the Institute's pilot coke ovens on portions of the same blends kindly made available by Iscor.

Remarks on Methods of drying the Coal.

In the previous experiments* the coal was predried in a revolving drum type of drier normally used for drying road metal but modified for the purpose of drying coal. In the present series this drier was again used with some experiments but in most instances a pilot scale fluidized bed drier, specially installed by Iscor for the purpose of the investigation, was used.

For convenience, products dried in the drum drier or the fluidized bed drier (or tests with such products) are indicated in the report by the letters DD or FD, respectively.

Originally the temperature of the fluidizing gas was controlled by diluting the too hot combustion gas with large volumes of cold air. The excess air in such instances

resulted ...../

*Fuel Research Institute of South Africa. Report No. 5 of 1964.

resulted in a fluidizing gas with an oxygen content approximating that of air. Such tests are indicated by adding the letter E, i.e. the designation becomes FDE.

At a later stage Iscor modified the installation by recirculating exit gases from the drier, thus restricting air dilution and reducing the oxygen content of the fluidizing gas to about 15 per cent. Such tests are designated FDR.

Finally Iscor applied maximum recirculation of the exit gases, reducing the oxygen content to about 3-4 per cent. These tests are designated FDM.

With all DD tests the coal (or coal mixture) was first predried and then crushed in the hammer mill for charging. With the FD tests the moist blend was first crushed in the normal way in the hammer mill and then predried, applying one of the fluidized bed procedures.

Coals used and some of the variables investigated.

The coals used in the investigation are those regularly used by Iscor for coke production. The following is a list of the collieries from which they originated, together with the abbreviations used in the tables for their identification:-

Nav - Navigation Coll. (S.A.C.E.).
S - Springbok Coll. (No. 5 Seam).
DNC - Durban Navigation Coll.
N - Natal Navigation Coll. (Northfield).
B - Blesbok Coll. (No. 5 Seam).
Ind - Indumeni Coll. (Coking Product).

The modified micum indices reported in the tables and the methods followed for determining bulk density of charge, heat penetration, minimum coking period and soaking time have been explained in recent publications.* The theoretical throughput (appearing in Tables 6-10) is a measure of the relative productivity of a coke oven. It is defined as follows:-

$$\text{Theoretical throughput} = \frac{\text{Bulk dens. (dry basis) of charge (lb/ft}^3\text{)}}{\text{minimum coking period (hr)}}$$

In this sense the theoretical throughput indicates the weight (lb) of dry coal, whether charged in the moist or predried state, coked per cubic foot of oven space per hour, no allowance being made for a soaking period.

It ...../

*Fuel Research Institute of South Africa. Bulletins No. 64 and No. 60.

It should be pointed out that the value of the tests run in the Institute's pilot coke ovens may have been impaired to some extent in that the quantities of prepared charges obtained therefor were probably not always accurately representative of the charges as coked in Iscor's ovens. This was not realized until appreciable discrepancies in the size analyses of test blends as charged by Iscor and by the Institute were detected. The reason for this is that size segregation (or unmixing of sizes) can assume rather serious proportions when handling dry coal in the size range normal for coking charges. It is to be expected that size segragation will be accompanied by the segregation of petrographic components having different coking properties. This will affect the characteristics and uniformity of resulting cokes. It is also possible that the accuracy of samples taken for analysis throughout the investigation may have suffered to some extent when predried charges were involved. Measures taken to counteract the difficulty alleviated matters but did not fully rectify them. (See Appendix 1 for further remarks on the problem.)

Regarding the results of pilot oven tests it can be stated that they generally confirm the trends of and conclusions that may be drawn from the results of the full scale investigations. The results reported for the pilot scale experiments (Tables 6-10) are therefore limited to moisture content as charged, bulk density, heat penetration and theoretical throughput.

<u>Discussion of results</u>.

Condensed results of the full scale investigations are given in Tables 1 to 5. Tables 1 to 3 and Table 4 contain the results of the experiments in which predrying was carried out in the fluidized bed (FDE, FDR and FDM) and the revolving drum (DD), respectively. Table 5 was compiled to enable an easy comparison to be made between fluidized bed (FD) and drum (DD) results for those blends where both methods of predrying were applied.

Generally speaking, there is relatively little difference between the size analysis, mean size and shatter index (on $1\frac{1}{2}$in) of coke from moist and corresponding predried charges. An important difference is, however, a reduction of about 3 per cent in the breeze content (material smaller than $\frac{1}{4}$in) resulting from predrying charges. The

B.S. ...../

B.S. abrasion index and all the micum indices are appreciably improved by predrying. Thus the reduction in breeze content mentioned above would be more pronounced if both types of coke were sampled after handling instead of at the coke ovens as was done during the investigation.

South African cokes generally compare rather unfavourably with overseas cokes when considering resistance to abrasion, for example as depicted by the micum index on 10mm. It is therefore fortunate that especially this characteristic is appreciably improved by predrying the charge. It also appears to be quite reasonable in South Africa to judge the effect or benefit of predrying simply by the degree of improvement imparted to the micum index M_{10m}. This was done graphically in Figure 1 by plotting points representing M_{10m} micum index values of cokes resulting from conventional moist charging (moisture content of blends about 7-8 per cent) on the y-axis, and on the x-axis the improvement in these values brought about by predrying the charge. The DD results which appeared in the previous report were also included in Figure 1.

The plotted points obtained lie in a band which suggests a linear relationship between the two variables. The interpretation is that the weaker the coke yielded by a blend when charged in the moist state the greater the improvement in the M_{10m} value obtained after predrying the charge.

Two straight lines, representing the best fits of the FDE and the DD results, (13 and 19 points, respectively), were drawn in the figure. The lines are given by the following equations:-

For FDE results:- $x' = 0.838y - 8.68$
For DD results:- $x'' = 0.745y - 6.25$

From the two straight lines it appears that a larger improvement in M_{10m} results when predrying is carried out in the drum drier. This is confirmed by the results in Table 5. The FDR and FDM results are represented by only 5 and 3 points, respectively, in Figure 1. It is thus not possible to draw firm conclusions regarding the relative merits of these two modifications of fluidized bed predrying. There is no indication that maximum recirculation of exit gases (FDM results) is any better than limited recirculation (FDR results), and it is probable that neither method is

better ...../

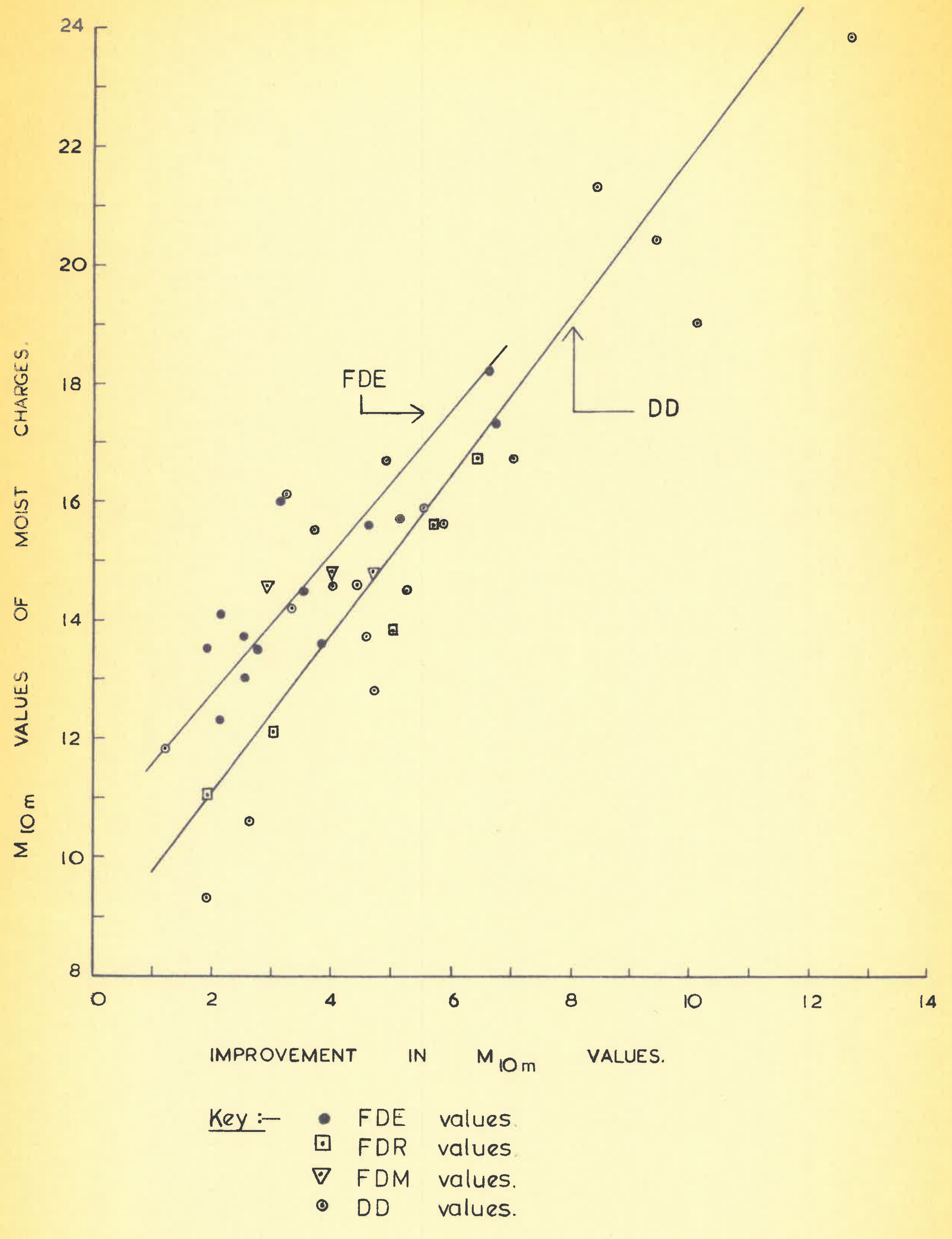

Fig. 1. RELATION BETWEEN M_{10m} VALUES (of moist charges) AND THEIR IMPROVEMENT THROUGH PREDRYING THE CHARGE.

better than predrying in the drum.

It is unfortunate that no results are available for predrying by means of an inert or preferably slightly reducing fluidizing gas. Of course, any additional benefit from such a predrying procedure would probably only be realized if total exclusion of oxidizing gases could subsequently be applied until the time of charging the coal. It is not known whether the additional trouble and expense of such a refinement would in fact yield any additional benefits.

The tests carried out in the Institute's pilot coke ovens yielded some additional results which could not readily be obtained with full scale investigations, namely in respect of heat penetration at constant flue temperatures and, in conjuction with the bulk density figures, the theoretical throughput values. These data have been evaluated separately for the narrow and the wide experimental ovens, the results appearing in Tables 6-9. These results have been summarized in Table 10. They are very similar for the two ovens and may be briefly stated as follows:- Predrying the coking charges so as to render them approximately air-dry before charging (i.e. reducing their moisture content from about 7.3 to about 2.2 per cent) results in an increase in the bulk density (dry basis) of 12½ per cent, a reduction in the heat penetration of 3½ per cent and an increase in the theoretical throughput of 10 per cent.

<u>Conclusion</u>.

A battery of coke ovens has already been operating in France on predried charges for several years now. No reports have been received that the results achieved are not satisfactory, but neither have reports been received of further batteries being converted to or being designed for dry charging. It is thus not possible without further information to gauge the future of this technique in the only other country known to have applied it, viz. France.

The technical feasibility of dry charging, under at least some South African conditions, has now been established beyond any doubt. It is clear that appreciable improvement in coke quality may be achieved in this way.

It is undoubtedly no simple task to arrive at a quantitative economic evaluation of the advantages and disadvantages of adopting dry charging at existing coke ovens, as numerous less well defined aspects are involved.

The disadvantages include such factors as the conversion of a complete and established system, primarily designed for moist charging, and subsequent adaptation to the new circumstances. The dust nuisance and explosion risk cannot be overlooked either. The problem of size segregation has already been mentioned. An already complicated and expensive industrial process is rendered more so by the change over.

On the credit side there is, inter alia, the better yield of furnace coke of improved quality from more productive coke ovens. With the better coke more iron at a lower coke rate and with smoother operation can be produced in the same time in the same blast furnaces; or larger blast furnaces and other techniques can be employed to improve efficiency and reduce costs even further.

There is, however, another factor which may assume great importance in South Africa. Dry charging may constitute a further positive contribution to the conservation of coking coal, because it may be possible to use a higher percentage of weakly (or conversely the same percentage of a weaker) coking coal in blends. From the national point of view this is an important consideration.

It will indeed be interesting to follow developments in the technique of dry charging of coke ovens in South Africa in the future.

Acknowledgment.

The Institute is indebted to Iscor for enabling participation in the investigation and for allowing the Institute to procure quantities of the coals for additional experiments and samples of the cokes for testing.

SIGNED C.C. LA GRANGE
CHIEF OF DIVISION.

PRETORIA.
1st March, 1965.

APPENDIX 1.

Remarks on Size Segregation.

The rather serious problem of unwanted segregation or unmixing of different sizes will undoubtedly present itself when handling dry crushed coal. The phenomenon is very well described and illustrated in a recent publication by Williams.* He also proposes some precautions which may be taken to counteract unmixing.

A blender for flowable solids, employing pneumatic recycling and claimed to prevent unmixing of sizes, is described in other literature.** As the blender also acts as storage bunker it may provide the answer to some of the practical difficulties expected when introducing predrying of coking coal charges industrially.

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*Williams, J.C. "The flow of materials in hoppers." The S.A. Industrial Chemist, 18, No. 9, p.p. 102-6 (Sept. 1964).

**Anon. "Gravity unit efficiently blends solids." Chemical Engineering, July 6, 1964, p.p. 98/9.

TABLE 2.

RESULTS OF FULL SCALE INVESTIGATIONS TO STUDY THE EFFECT OF PREDRYING THE CHARGE.

METHOD OF PREDRYING : FLUIDIZED BED WITH RESTRICTED AMOUNT OF AIR IN FLUIDIZING GAS (FDR).

Test No.	Details of Coal Charged: Composition of Charge,* %	Details of Coal Charged: Condition	Details of Coal Charged: Moist. as Charged %	Size Anal., % on 3"	2"	1"	½"	Mean Size In.	Shat. Ind. on 1½"	B.S. Abr. Ind.	Modified Micum Results: M'_{40}	M_{20m}	M_{10m}	$CMTV_m$
Is 249	55 B, 16 S,)	Moist	8.3	42	76	91	93	2.81	88	70	63	81	16.7	53
Is 250	22 DNC, 7 N)	Dried	2.0	35	77	94	97	2.74	86	79	66	87	10.3	59
		Diff.	-6.3	-7	1	3	4	-0.07	-2	9	3	6	-6.4	6
Is 252	19 B, 15 S, 48)	Moist	6.8	43	77	95	96	2.82	88	73	69	86	12.1	60
Is 253	Ind, 12 DNC, 6 N)	Dried	1.5	38	74	96	97	2.75	87	79	70	89	9.1	63
		Diff.	-5.3	-5	-3	1	1	-0.07	-1	6	1	3	-3.0	3
Is 254	34 S, 48 Ind,)	Moist	6.0	38	76	95	96	2.71	89	76	72	88	11.0	64
Is 255	12 DNC, 6 N)	Dried	1.5	32	73	95	97	2.64	86	80	70	89	9.1	63
		Diff.	-4.5	-6	-3	0	1	-0.07	-3	4	-2	1	-1.9	-1
Is 256	36 B, 29 S,)	Moist	8.0	45	77	92	93	2.80	88	72	66	82	15.6	55
Is 257	24 DNC, 11 N)	Dried	2.0	42	74	95	96	2.80	88	78	68	88	9.9	61
		Diff.	-6.0	-3	-3	3	3	0	0	6	2	6	-5.7	6
Is 258	45 Nav, 25 S,)	Moist	7.3	38	72	90	92	2.67	85	73	64	84	13.8	55
Is 259	22 DNC, 8 N)	Dried	1.8	37	74	95	97	2.76	86	80	71	90	8.8	65
		Diff.	-5.5	-1	2	5	5	0.09	1	7	7	6	-5.0	10
Mean Difference			-5.5	-4	-1	2	3	-0.02	-1	8	2	4	-4.0	5

*For abbreviations used see text.

TABLE 3.

RESULTS OF FULL SCALE INVESTIGATIONS TO STUDY THE EFFECT OF PREDRYING THE CHARGE.

METHOD OF PREDRYING : FLUIDIZED BED WITH MAXIMUM RECIRCULATION OF EXIT GASES (FDM).

Test No.	Details of Coal Charged			Characteristics of Cokes Obtained										
	Composition of Charge,* %	Condi-tion	Moist. as Charged %	Size Anal., % on				Mean Size In.	Shat. Ind. on 1½"	B.S. Abr. Ind.	Modified Micum Results			
				3"	2"	1"	½"				M'_{40}	M_{20m}	M_{10m}	$CMTV_m$
Is 260	45 Nav, 25 S,)	Moist	6.5	46	74	91	93	2.81	86	72	62	83	14.8	53
Is 261	22 DNC, 8 N)	Dried	1.8	36	75	95	96	2.69	87	79	71	88	10.1	64
		Diff.	-4.7	-10	1	4	3	-0.12	1	7	9	5	-4.7	11
Is 262	45 Nav, 25 S,)	Moist	7.3	45	76	92	94	2.85	88	72	65	83	14.8	55
Is 263	22 DNC, 8 N)	Dried	2.2	41	78	95	97	2.86	87	79	67	87	10.8	60
		Diff.	-5.1	-4	2	3	3	0.01	-1	7	2	4	-4.0	5
Is 264	45 Nav, 25 S,)	Moist	6.1	42	76	92	94	2.79	88	72	65	82	14.6	55
Is 265	22 DNC, 8 N)	Dried	2.0	46	83	95	97	2.92	89	77	67	86	11.7	59
		Diff.	-4.1	4	7	3	3	0.13	1	5	2	4	-2.9	4
	Mean Difference		-4.6	-3	3	3	3	0.01	0	7	4	4	-3.9	7

*For abbreviations used see text.

TABLE 4.

RESULTS OF FULL SCALE INVESTIGATIONS TO STUDY THE EFFECT OF PREDRYING THE CHARGE.

METHOD OF PREDRYING : REVOLVING DRUM (DD).

Test No.	Details of Coal Charged			Characteristics of Cokes Obtained										
	Composition of Charge,* %	Condi- tion	Moist. as Charged %	Size Anal., % on				Mean Size In.	Shat. Ind. on 1½"	B.S. Abr. Ind.	Modified Micum Results			
				3"	2"	1"	½"				M'40	M_{20m}	M_{10m}	$CMTV_m$
Is 232	45 Nav, 25 S,	Moist	7.5	51	78	92	94	3.01	86	72	64	83	13.7	55
Is 233	22 DNC, 8 N	Dried	2.0	37	76	96	97	2.78	86	80	69	88	9.1	62
		Diff.	-5.5	-14	-2	4	3	-0.23	0	8	5	5	-4.6	7
Is 243	44 Nav, 25 S,	Moist	7.0	52	79	92	94	2.99	86	73	65	83	14.5	56
Is 245	23 DNC, 8 N	Dried	2.3	42	75	96	97	2.82	89	79	68	89	9.3	61
		Diff.	-4.7	-10	-4	4	3	-0.17	3	6	3	6	-5.2	5
Is 246	44 Nav, 25 S,	Moist	7.0	41	72	89	92	2.74	89	71	63	82	15.6	53
Is 247	23 DNC, 8 N	Dried	2.0	38	74	94	96	2.69	84	80	66	88	9.8	60
		Diff.	-5.0	-3	2	5	4	-0.05	-5	9	3	6	-5.8	7
Is 249	55 B, 16 S,	Moist	8.3	42	76	91	93	2.81	88	70	63	81	16.7	53
Is 251	22 DNC, 7 N	Dried	2.3	39	75	94	96	2.75	88	79	73	88	9.7	63
		Diff.	-6.0	-3	-1	3	3	-0.06	0	9	10	7	-7.0	10
Is 264	45 Nav, 25 S,	Moist	6.1	42	76	92	94	2.79	88	72	65	82	14.6	55
Is 266	22 DNC, 8 N	Dried	2.1	47	80	96	97	2.99	89	77	67	87	10.6	60
		Diff.	-4.0	5	4	4	3	0.20	1	5	2	5	-4.0	5
Mean Difference			-5.0	-5	0	4	3	-0.06	0	7	5	6	-5.3	7

*For abbreviations used see text.

TABLE 5.

RESULTS OF FULL SCALE INVESTIGATIONS TO STUDY THE EFFECT OF PREDRYING THE CHARGE.

METHOD OF PREDRYING : FLUIDIZED BED (FD) OR REVOLVING DRUM (DD).

Test No.	Details of Coal Charged			Characteristics of Cokes Obtained										
	Composition of Charge,* %	Condi-tion	Moist. as Charged %	Size Anal., % on				Mean Size In.	Shat. Ind. on 1½"	B.S. Abr. Ind.	Modified Micum Results			
				3"	2"	1"	½"				M'_{40}	M_{20m}	M_{10m}	$CMTV_m$
Is 234 Is 233	45 Nav, 25 S,) 22 DNC, 8 N)	FDE DD Diff.	1.2 2.0 0.8	50 37 -13	83 76 -7	95 96 1	97 97 0	3.13 2.78 -0.35	86 86 0	78 80 2	66 69 3	85 88 3	11.2 9.1 -2.1	58 62 4
Is 244 Is 245	44 Nav, 25 S,) 23 DNC, 8 N)	FDE DD Diff.	1.9 2.3 0.4	43 42 -1	77 75 -2	95 96 1	97 97 0	2.87 2.82 -0.05	86 89 3	78 79 1	66 68 2	86 89 3	11.0 9.3 -1.7	59 61 2
Is 248 Is 247	44 Nav, 25 S,) 23 DNC, 8 N)	FDE DD Diff.	1.9 2.0 0.1	43 38 -5	79 74 -5	95 94 -1	97 96 -1	2.85 2.69 -0.16	87 84 -3	78 80 2	67 66 -1	86 88 2	11.0 9.8 -1.2	60 60 0
Is 250 Is 251	55 B, 16 S,) 22 DNC, 7 N)	FDR DD Diff.	2.0 2.3 0.3	35 39 4	77 75 -2	94 94 0	97 96 -1	2.74 2.75 0.01	86 88 2	79 79 0	66 73 7	87 88 1	10.3 9.7 -0.6	59 63 4
Is 265 Is 266	45 Nav, 25 S,) 22 DNC, 8 N)	FDM DD Diff.	2.0 2.1 0.1	46 47 1	83 80 -3	95 96 1	97 97 0	2.92 2.99 0.07	89 89 0	77 77 0	67 67 0	86 87 1	11.7 10.6 -1.1	59 60 1
Mean Difference			0.3	-3	-3	0	0	-0.10	0	1	2	2	-1.3	2

*For abbreviations used see text.

TABLE 7.

DATA OBTAINED FROM PILOT SCALE OVEN TESTS. (FLUE TEMPERATURES : 1150°C).

(COAL PREDRIED IN ISCOR'S FLUIDIZED BED DRIER WITH RESTRICTED AMOUNT OF AIR IN FLUIDIZING GAS (FDR)).

Iscor Test No.	Condition Charge	Tests in Narrow (15.0") Oven					Tests in Wide (18.9") Oven				
		Test No. N	Carbonising Conditions				Test No. W	Carbonising Conditions			
			Moist. as Charged %	B. Dens. (dry b.) lb/ft^3	Heat Penetr. in/hr	Theor. Through-put		Moist. as Charged %	B. Dens. (dry b.) lb/ft^3	Heat Penetr. in/hr	Theor. Through-put
Is 249	Moist	542	8.8	47.9	1.06	3.4	382	9.0	47.9	0.93	2.3
Is 250	Dried	543	2.2	52.8	1.06	3.7	383	2.2	53.3	0.92	2.6
	Diff.		-6.6	4.9	0.00	0.3		-6.8	5.4	-0.01	0.3
Is 252	Moist	545	7.4	48.2	1.06	3.4	385	7.0	48.4	0.95	2.4
Is 253	Dried	547	1.8	53.8	1.00	3.6	387	2.0	53.7	0.94	2.7
	Diff.		-5.6	5.6	-0.06	0.2		-5.0	5.3	-0.01	0.3
Is 254	Moist	546	7.0	47.0	1.08	3.4	386	7.0	46.5	0.96	2.4
Is 255	Dried	548	1.6	53.1	1.01	3.6	388	1.8	53.5	0.95	2.7
	Diff.		-5.4	6.1	-0.07	0.2		-5.2	7.0	-0.01	0.3
Is 256	Moist	549	7.6	47.8	1.06	3.4	389	7.8	46.3	0.96	2.4
Is 257	Dried	550	1.8	54.0	1.07	3.9	390	2.8	52.0	0.98	2.7
	Diff.		-5.8	6.2	0.01	0.5		-5.0	5.7	0.02	0.3
Is 258	Moist	551	6.8	44.7	1.11	3.3	391	7.0	43.9	0.96	2.2
Is 259	Dried	552	2.0	52.7	1.07	3.8	392	2.0	52.7	0.90	2.5
	Diff.		-4.8	8.0	-0.04	0.5		-5.0	8.8	-0.06	0.3
Mean Difference			-5.6	6.2	-0.03	0.3		-5.4	6.4	-0.01	0.3

TABLE 8.

DATA OBTAINED FROM PILOT SCALE OVEN TESTS. (FLUE TEMPERATURES : 1150°C).

(COAL PREDRIED IN ISCOR'S FLUIDIZED BED DRIER WITH MAXIMUM RECIRCULATION OF EXIT GASES (FDM)).

Iscor Test No.	Condition Charge	Tests in Narrow (15.0") Oven					Tests in Wide (18.9") Oven				
		Test No. N	Carbonising Conditions				Test No. W	Carbonising Conditions			
			Moist. as Charged %	B. Dens. (dry b.) lb/ft³	Heat Penetr. in/hr	Theor. Through-put		Moist. as Charged %	B. Dens. (dry b.) lb/ft³	Heat Penetr. in/hr	Theor. Through-put
Is 260	Moist	553	6.4	46.3	1.09	3.4	393	6.8	45.2	0.99	2.4
Is 261	Dried	554	2.0	53.4	1.05	3.7	394	2.2	53.3	0.97	2.7
	Diff.		-4.4	7.1	-0.04	0.3		-4.6	8.1	-0.02	0.3
Is 262	Moist	555	7.8	49.3	1.06	3.5	395	7.8	48.4	0.98	2.5
Is 263	Dried	556	2.0	53.9	1.08	3.9	396	2.4	54.2	0.99	2.8
	Diff.		-5.8	4.6	0.02	0.4		-5.4	5.8	0.01	0.3
Is 264	Moist	557	7.0	49.5	1.09	3.6	397	7.0	49.8	0.98	2.6
Is 265	Dried	558	2.0	53.9	1.08	3.9	398	2.4	54.4	0.97	2.7
	Diff.		-5.0	4.4	-0.01	0.3		-4.6	4.6	0.02	0.1
Mean Difference			-5.1	5.4	-0.01	0.3		-4.9	6.2	0.0	0.2

TABLE 9.

DATA OBTAINED FROM PILOT SCALE OVEN TESTS. (FLUE TEMPERATURES : 1150°C).

(COAL PREDRIED IN ISCOR'S REVOLVING DRUM DRIER AND CRUSHED IN ISCOR'S HAMMER MILL (DD)).

Iscor Test No.	Condi-tion Charge	Tests in Narrow (15.0") Oven					Tests in Wide (18.9") Oven				
		Test No. N	Carbonising Conditions				Test No. W	Carbonising Conditions			
			Moist. as Charged %	B. Dens. (dry b.) lb/ft³	Heat Penetr. in/hr	Theor. Through-put		Moist. as Charged %	B. Dens. (dry b.) lb/ft³	Heat Penetr. in/hr	Theor. Through-put
Is 232	Moist	525	7.2	47.8	1.08	3.4	365	7.4	50.7	0.98	2.6
Is 233	Dried	526	2.6	54.3	1.01	3.6	366	2.4	54.9	0.90	2.6
	Diff.		-4.6	6.5	-0.07	0.2		-5.0	4.2	-0.08	0.0
Is 243	Moist	536	7.4	48.6	1.06	3.4	376	7.0	47.0	0.95	2.3
Is 245	Dried	538	2.2	54.5	1.00	3.6	378	2.2	53.8	0.90	2.6
	Diff.		-5.2	5.9	-0.06	0.2		-4.8	6.8	-0.05	0.3
Is 246	Moist	539	7.4	48.6	1.04	3.4	379	7.2	48.3	0.95	2.4
Is 247	Dried	540	2.0	54.6	1.03	3.7	380	2.0	54.2	0.91	2.6
	Diff.		-5.4	6.0	-0.01	0.3		-5.2	5.9	-0.04	0.2
Is 249	Moist	542	8.8	47.9	1.06	3.4	382	9.0	47.9	0.93	2.3
Is 251	Dried	544	2.4	53.4	1.01	3.6	384	2.4	53.9	0.90	2.6
	Diff.		-6.4	5.5	-0.05	0.2		-6.6	6.0	-0.03	0.3
Is 264	Moist	557	7.0	49.5	1.09	3.6	397	7.0	49.8	0.98	2.6
Is 266	Dried	559	2.4	55.1	1.00	3.7	399	2.6	54.8	0.94	2.7
	Diff.		-4.6	5.6	-0.09	0.1		-4.4	5.0	-0.04	0.1
Mean Difference			-5.2	5.9	-0.06	0.2		-5.2	5.6	-0.05	0.2

TABLE 10.

SUMMARY OF DATA OBTAINED FROM PILOT SCALE OVEN TESTS IN PREDRYING EXPERIMENTS
(FLUE TEMPERATURES : 1150°C)
(ALL METHODS OF PREDRYING TAKEN TOGETHER).

Oven Width (in)		15.0	18.9
Moisture as Charged	(Average % (Decrease in* % (units)	7.2 5.1	7.4 5.1
Bulk Density of Charge (dry basis)	(Average,* lb/ft^3 (Increase) lb/ft^3 (in**) %	47.9 5.9 12	47.8 6.0 13
Heat Penetration	(Average,* in/hr (Decrease) in/hr (in**) %	1.07 0.04 4	0.96 0.03 3
Theoretical Throughput	(Average,* lb/ft^3hr (Increase) lb/ft^3hr (in**) %	3.4 0.3 10	2.4 0.2 10

*Referring to moist charges.
**As a result of predrying the charge.

MR. SAVAGE

CORRESPONDENCE FOR ATTENTION

DATE: 8th October, 1964.

REF. NO.	NAME OF SENDER.	SUBJECT	OFFICER
21/374	Pretoria Technical College	M. Stenvert - non-attendance at class	
17/2	Vaalbank Coal & Anthracite	Cheque R63-45 - levy	
17/2	Brockwell Anthracite	Cheque R111-06 - levy	
35/39	Federale Mynbou	Sample reports and core descriptions	✓

M 20m

M 10m

M 1/40

sheep
goats

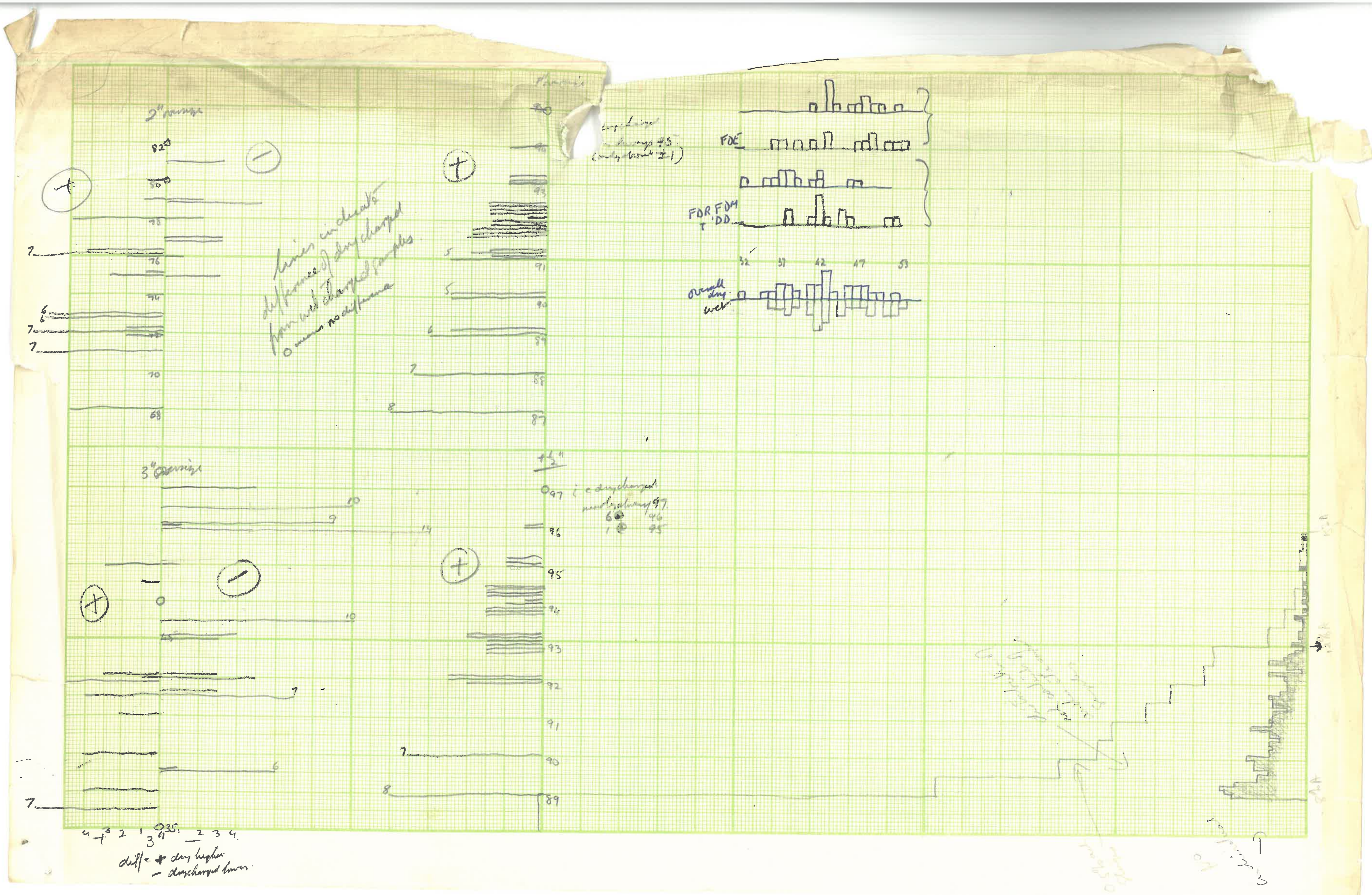
goats
sheep

sheep
goats

Shatter breaks 89, quite often, mainly wet.
lowest @ 84 dry
@ 83 wet.
Very little range
+ very little difference overall between dry & wet

Differences
wet higher
+ dry higher

19 15
overall -4 on 26 comparisons
is negligible



2" (size)
3" (size)
lines indicate difference of drycharged from wet charged samples
0 means no difference
diff = + dry higher
− drycharged lower
FDE
FDR FDM
T DD
overall
dry
wet
32
37
42
47
53

TABLE 1.

RESULTS OF FULL SCALE INVESTIGATIONS TO STUDY THE EFFECT OF PREDRYING THE CHARGE.

METHOD OF PREDRYING : FLUIDIZED BED WITH EXCESS AIR IN THE FLUIDIZING GAS (FDE).

Test No.	Details of Coal Charged: Composition of Charge,* %	Condition	Moist. as Charged %	Characteristics of Cokes Obtained: Size Anal., % on 3"	2"	1"	½"	Mean Size In.	Shat. Ind. on 1½"	B.S. Abr. Ind.	Modified Micum Results: M'_{40}	M_{20m}	M_{10m}	$CMTV_m$
Is 220	45 Nav, 25 S,	Moist	5.9	48	80	93	95	3.00	87	74	65	85	12.3	57
Is 221	22 DNC, 8 N	Dried	2.7	49	80	95	97	3.01	85	77	67	87	10.2	60
		Diff.	-3.2	1	0	2	2	0.01	-2	3	2	2	-2.1	3
Is 222	45 Nav, 25 S,	Moist	6.6	49	82	93	97	2.99	87	74	63	82	14.1	54
Is 223	22 DNC, 8 N	Dried	2.3	52	82	95	97	3.04	87	76	66	84	12.0	58
		Diff.	-4.3	3	0	2	0	0.05	0	2	3	2	-2.1	4
Is 224	45 Nav, 25 S,	Moist	6.9	43	75	92	94	2.81	85	76	63	84	13.0	55
Is 225	22 DNC, 8 N	Dried	2.7	44	78	95	96	2.85	87	78	66	87	10.5	59
		Diff.	-4.2	1	3	3	2	0.04	2	2	3	3	-2.5	4
Is 226	45 Nav, 25 S,	Moist	7.2	49	80	94	95	2.95	89	74	67	84	13.5	58
Is 227	22 DNC, 8 N	Dried	2.2	48	81	96	97	2.98	88	77	67	86	11.6	59
		Diff.	-5.0	-1	1	2	2	0.03	-1	3	0	2	-1.9	1
Is 228	45 Nav, 25 S,	Moist	6.5	37	68	90	93	2.60	83	76	62	85	13.6	54
Is 229	22 DNC, 8 N**	Dried	1.7	41	73	95	96	2.77	86	80	68	88	9.8	61
		Diff.	-4.8	4	5	5	3	0.17	3	4	6	3	-3.8	7
Is 230	45 Nav, 25 S,	Moist	6.8	53	81	92	94	3.06	87	71	63	80	16.0	53
Is 231	22 DNC, 8 N***	Dried	2.0	48	78	93	95	2.92	86	76	64	83	12.9	55
		Diff.	-4.8	-5	-3	1	1	-0.14	-1	5	1	3	-3.1	2
Is 232	45 Nav, 25 S,	Moist	7.5	51	78	92	94	3.01	86	72	64	83	13.7	55
Is 234	22 DNC, 8 N	Dried	1.2	50	83	95	97	3.13	86	78	66	85	11.2	58
		Diff.	-6.3	-1	5	3	3	0.12	0	6	2	2	-2.5	3
Is 235	60 Nav, 30 S,	Moist	6.3	36	73	88	90	2.63	85	69	59	80	17.3	49
Is 236	10 DNC	Dried	1.9	43	79	95	97	2.81	87	77	63	86	10.6	56
		Diff.	-4.4	7	6	7	7	0.18	2	8	4	6	-6.7	7
Is 237	60 Nav, 30 S,	Moist	7.3	39	71	87	89	2.65	87	68	60	79	18.2	49
Is 238	10 DNC	Dried	1.9	43	78	95	97	2.84	88	77	66	86	11.6	58
		Diff.	-5.4	4	7	8	8	0.19	1	9	6	7	-6.6	9
Is 239	40 Nav, 20 S,	Moist	6.8	47	79	93	95	3.00	88	73	65	83	13.5	56
Is 240	40 DNC	Dried	1.6	47	80	95	97	2.95	87	77	63	86	10.8	56
		Diff.	-5.2	0	1	2	2	-0.05	-1	4	-2	3	-2.7	0
Is 241	40 Nav, 20 S,	Moist	6.4	43	73	91	93	2.71	89	70	67	83	15.7	56
Is 242	40 DNC	Dried	1.6	46	79	96	97	3.00	89	79	72	88	10.6	64
		Diff.	-4.8	3	6	5	4	0.29	0	9	5	5	-5.1	8
Is 243	44 Nav, 25 S,	Moist	7.0	52	79	92	94	2.99	86	73	65	83	14.5	56
Is 244	23 DNC, 8 N	Dried	1.9	43	77	95	97	2.87	86	78	66	86	11.0	59
		Diff.	-5.1	-9	-2	3	3	-0.12	0	5	1	3	-3.5	3
Is 246	44 Nav, 25 S,	Moist	7.0	41	72	89	92	2.74	89	71	63	82	15.6	53
Is 248	23 DNC, 8 N	Dried	1.9	43	79	95	97	2.85	87	78	67	86	11.0	60
		Diff.	-5.1	2	7	6	5	0.11	-2	7	4	4	-4.6	7
Mean Difference			-4.8	1	3	4	3	0.07	0	5	3	4	-3.6	5

*For abbreviations used see text.
**Blend crushed extra fine.
***Blend crushed extra coarse.

TABLE 6.

DATA OBTAINED FROM PILOT SCALE OVEN TESTS. (FLUE TEMPERATURES : 1150°C).

(COAL PREDRIED IN ISCOR'S FLUIDIZED BED DRIER WITH EXCESS AIR IN FLUIDIZING GAS (FDE)).

Iscor Test No.	Condition Charge	Tests in Narrow (15.0") Oven					Tests in Wide (18.9") Oven				
		Test No. N	Carbonising Conditions				Test No. W	Carbonising Conditions			
			Moist. as Charged %	B. Dens. (dry b.) lb/ft³	Heat Penetr. in/hr	Theor. Through-put		Moist. as Charged %	B. Dens. (dry b.) lb/ft³	Heat Penetr. in/hr	Theor. Through-put
Is 220	Moist	512	6.2	46.2	1.09	3.4	-	-	-	-	-
Is 221	Dried	514	2.6	52.1	1.03	3.6	-	-	-	-	-
	Diff.		-3.6	5.9	-0.06	0.2	-	-	-	-	-
Is 222	Moist	515	6.8	50.1	1.09	3.6	355	7.2	49.7	0.98	2.6
Is 223	Dried	516	2.6	54.5	0.99	3.6	356	2.6	56.0	0.90	2.7
	Diff.		-4.2	4.4	-0.10	0.0		-4.6	6.3	-0.08	0.1
Is 224	Moist	517	7.6	47.6	1.09	3.5	357	7.6	46.2	0.99	2.4
Is 225	Dried	518	2.6	53.8	1.04	3.7	358	2.6	55.3	0.95	2.8
	Diff.		-5.0	6.2	-0.05	0.2		-5.0	9.1	-0.04	0.4
Is 226	Moist	519	7.4	49.1	1.08	3.5	359	7.8	48.4	0.96	2.5
Is 227	Dried	520	2.0	54.4	1.04	3.8	360	2.2	55.3	0.95	2.8
	Diff.		-5.4	5.3	-0.04	0.3		-5.6	6.9	-0.01	0.3
Is 228	Moist	521	6.6	44.1	1.09	3.2	361	6.8	44.5	1.00	2.4
Is 229	Dried	522	2.0	52.4	1.05	3.7	362	3.0	51.9	0.92	2.5
	Diff.		-4.6	8.3	-0.04	0.5		-3.8	7.4	-0.08	0.1
Is 230	Moist	523	7.2	49.4	1.03	3.4	363	7.4	48.6	0.96	2.5
Is 231	Dried	524	1.8	53.8	1.06	3.8	364	2.2	54.3	0.93	2.7
	Diff.		-5.4	4.4	0.03	0.4		-5.2	5.7	-0.03	0.2
Is 232	Moist	525	7.2	47.8	1.08	3.4	365	7.4	50.7	0.98	2.6
Is 234	Dried	527	2.0	53.9	1.06	3.8	367	2.4	54.4	0.95	2.7
	Diff.		-5.2	6.1	-0.02	0.4		-5.0	3.7	-0.03	0.1
Is 235	Moist	528	6.6	46.2	1.07	3.3	368	6.8	46.1	0.91	2.2
Is 236	Dried	529	2.2	53.6	1.06	3.8	369	2.0	52.2	0.95	2.6
	Diff.		-4.4	7.4	-0.01	0.5		-4.8	6.1	0.04	0.4
Is 237	Moist	530	7.4	47.5	1.05	3.3	370	7.4	48.9	0.96	2.5
Is 238	Dried	531	2.2	53.1	1.01	3.6	371	2.2	53.6	0.94	2.7
	Diff.		-5.2	5.6	-0.04	0.3		-5.2	4.7	-0.02	0.2
Is 239	Moist	532	7.0	49.5	1.08	3.6	372	7.8	49.3	0.96	2.5
Is 240	Dried	533	2.0	53.9	1.06	3.8	373	2.2	50.6	0.95	2.5
	Diff.		-5.0	4.4	-0.02	0.2		-5.6	1.3	-0.01	0.0
Is 241	Moist	534	7.0	47.4	1.09	3.5	374	6.8	45.9	0.97	2.4
Is 242	Dried	535	2.0	53.9	1.00	3.6	375	1.8	53.5	0.90	2.5
	Diff.		-5.0	6.5	-0.09	0.1		-5.0	7.6	-0.07	0.1
Is 243	Moist	536	7.4	48.6	1.06	3.4	376	7.0	47.0	0.95	2.3
Is 244	Dried	537	2.0	54.6	1.01	3.7	377	2.2	54.3	0.94	2.7
	Diff.		-5.4	6.0	-0.05	0.3		-4.8	7.3	-0.01	0.4
Is 246	Moist	539	7.4	48.6	1.04	3.4	379	7.2	48.3	0.95	2.4
Is 248	Dried	541	2.0	53.9	1.06	3.8	381	2.2	53.8	0.96	2.7
	Diff.		-5.4	5.3	0.02	0.4		-5.0	5.5	0.01	0.3
Mean Difference			-4.9	5.8	-0.04	0.3		-5.0	6.0	-0.03	0.2