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REPORT No. 24

OF 1950

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VAN 1950

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FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA.

BRANDSTOF-NAVORSINGS-INSTITUUT

VAN SUID-AFRIKA.

SUBJECT:
ONDERWERP: WASHABILITY AND OTHER CHARACTERISTICS OF NO. 5 SEAM COAL (RUN-OF-MINE) FROM NAVIGATION COLLIERY.

DIVISION:
AFDELING: CHEMISTRY.

NAME OF OFFICER:
NAAM VAN AMPTENAAR: C. C. LA GRANGE & J. J. WOLMARANS.

W.P.—69328—17/1/50

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

REPORT NO. 24 OF 1950.

WASHABILITY AND OTHER CHARACTERISTICS OF NO.5 SEAM COAL (RUN-OF-MINE) FROM NAVIGATION COLLIERY.

According to information given by the Manager at Navigation Colliery in May, 1950, the mining height in the No.5 Seam is about 6 feet, but about 2 feet at the top of this consists of inferior material and is loaded into separate, specially marked tubs underground and sent direct to the waste dump on arrival at the surface. The weight, per cent. thus dumped is not known.

The cutting machine is made to cut in high-ash coal and the cuttings, amounting to some 7 per cent. of the coal extracted, are also sent direct to the waste dump.

The run-of-mine coal (which does not include the two types of material directly dumped and described above) is separated in the plant into plus 1½ inch and minus 1½ inch (round holes) fractions. The proportion of the latter was not known but was estimated at about 10 per cent. of the run-of-mine coal. As sampling could not be done at a stage prior to this separation, the two size fractions had to be sampled separately.

A bulk sample of 15 tons of the plus 1½ inch material was obtained on 11/5/50 by taking approximately 200 lb. increments at intervals of about 1 minute. This sample was railed to the Institute at Pretoria where it was subdivided into 5 lots of three tons each. One 3-ton lot was crushed (by hand) to minus 4 inches (square holes) and subdivided into three lots of 1 ton each. Only 1 ton of this material (Sample No.T177) was used for the washability tests described below, the remainder of the bulk sample being used for preparing raw material for testing in the experimental coke oven, which tests will not be discussed in this report.

A sample/.....

A sample (No. T178) of the minus 1½ inch material described above was obtained by taking an ordinary spade-ful for each tub of run-of-mine coal arriving at the plant from underground over a period of approximately one hour. The total weight of this sample was 138 lb.

The procedure adopted in screening samples T177 and T178 (sample No. T177 was also subjected to crushing as shown,) and in numbering the various size fractions obtained is indicated in Diagrams Nos. 1 and 2. The yields of various grades will be found in Table 3.

All the size fractions, except those smaller than 1 mm., were saturated with moisture and washed in zinc chloride solutions at the following specific gravities:- 1.350, 1.400, 1.450, 1.500 and 1.600.

The yields and analytical data (air-dry state) of the fractions obtained appear in Table 1, while the cumulative results (calculated in most instances from the data of Table 1) are given in Table 2. From the combined results the ash contents of the various size fractions and the original bulk samples were calculated, the results appearing in Table 3.

Washability curves for the various size fractions appear in Figures 1 to 8. In each figure there are three curves, viz.:-

1. Cumulative yield against specific gravity.
2. Cumulative yield against cumulative ash content.
3. ±0.1 S.G. distribution (i.e. difference between yields)* against specific gravity.

The/.....

* The ±0.1 S.G. distribution is a quantitative indication of what is usually referred to as the 'near gravity material' at the particular specific gravity.

The usual correction applied for material with a specific gravity greater than 2.0 was neglected when calculating the distribution figures as a separation was not made at or near this gravity. The effect of not applying the correction is not likely to be appreciable.

The washability data of the samples at the four arbitrarily chosen specific gravities 1.55, 1.50, 1.45 and 1.40 have been summarised in Table 4.

Brief Remarks:

From Table 3 it is evident that there are only comparatively small differences between the ash contents of the various size grades in the natural arisings, (the A and D samples) with the exception of the -1 mm. material which has a remarkably high ash content. The swelling number of this 'dust' fraction was found to be only between 2½ and 3 so that it has in any case little value from the coking point of view. The concentration of the better quality coal in the smaller sizes of the natural arisings (disregarding the dust) which is usually found with the Witbank coals does therefore not take place in the case of this coal. No explanation for this can be given at this stage.

Judging by the ±0.1 S.G. distribution at specific gravity 1.55 (see washability curves and Table 4) reasonably satisfactory results might be expected if washing is effected at this gravity in a jig type of washer in the case of coal represented by all the samples, except that represented by sample A_1, for which results would probably not be very satisfactory. At s.g. 1.50 it would probably only be coal represented by sample A_3 that could reasonably satisfactorily be washed in a jig. For the rest, (especially at lower gravities), a type of washer more suitable for coping with difficult washing propositions would be required for efficient washing.

The swelling characteristics of the coal are on the whole good for this seam and fall within the range which has proved by experience to be associated with coals suitable for use in the carbonisation industries.

The ash/.....

The ash content of the run-of-mine coal is rather high (17.6%) and fairly drastic crushing and washing would be required to reduce it to a low value (say 10% or lower) which is so desirable with coal intended for conversion into metallurgical coke. The comparatively high volatile matter content of the prepared coal (about 35% air-dry state) and the resultant low yield of coke on carbonisation, is an important characteristic of this coal, setting a low ash requirement for the material to be carbonised. It is apparent from the data available that, provided a suitable washer is used, the best ash reduction will be achieved with material crushed to a comparatively small size (say below about 1 inch).

(Sgd.) C.C.LA GRANGE
SENIOR RESEARCH OFFICER.

and

J.J. WOLMARANS
TECHNICAL ASSISTANT.

PRETORIA.
6th September, 1950.

DIAGRAM NO. 1.

COLLIERY: Navigation. SEAM: No. 5. [+1½" coal(round holes)] SAMPLE NO: T177.

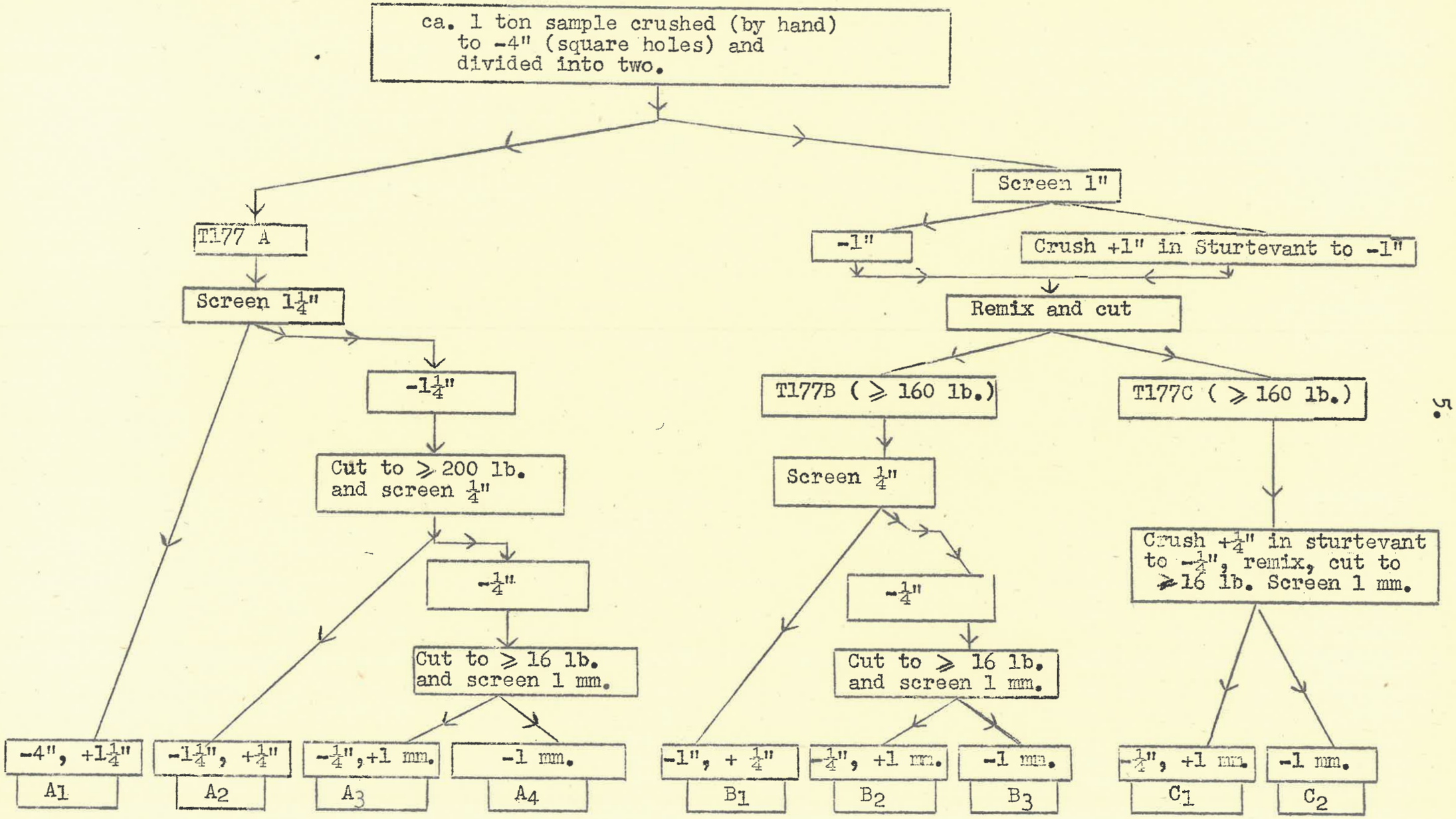


DIAGRAM NO. 2.

COLLIERY: Navigation. SEAM: No. 5 {-1½" coal (round holes)} SAMPLE NO: T178

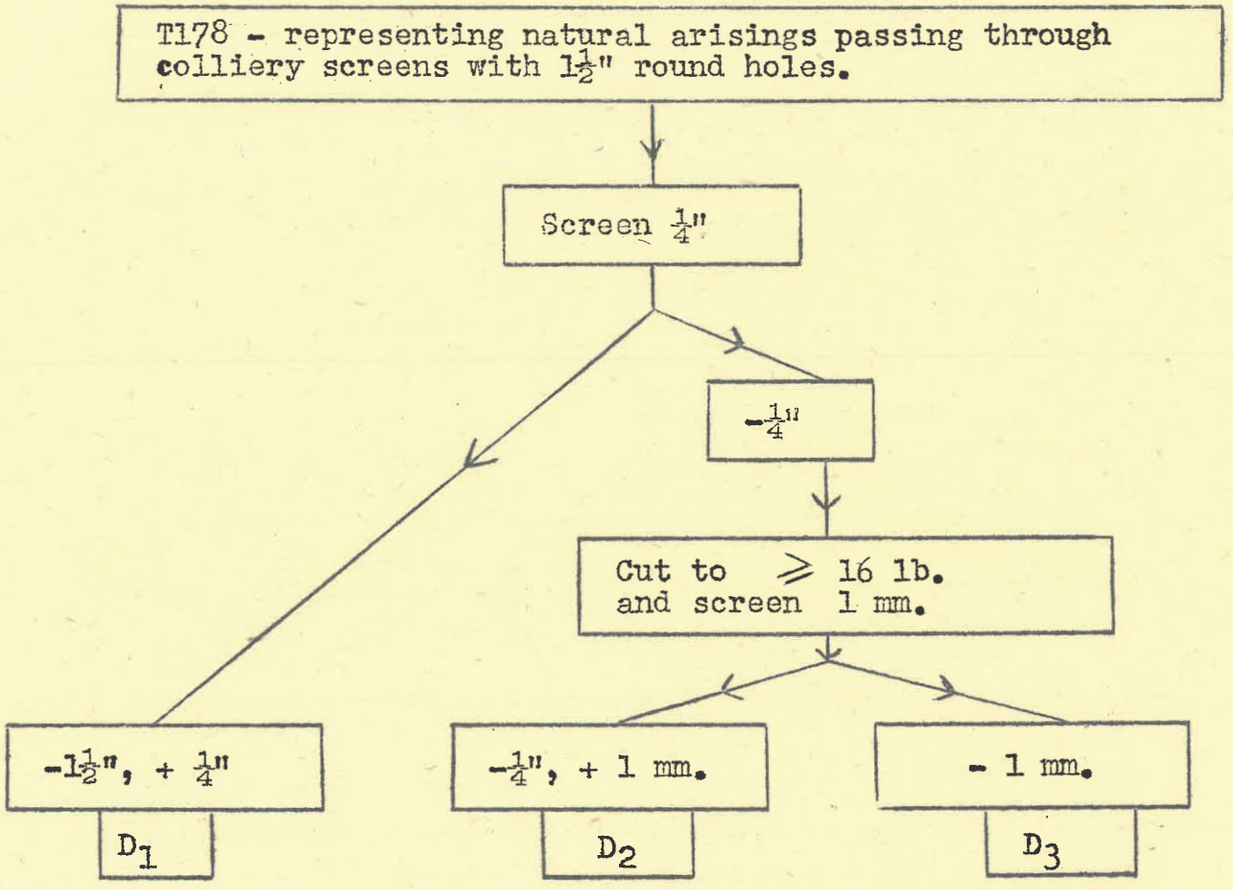


TABLE 1.

YIELDS AND ANALITICAL DATA OF SPECIFIC GRAVITY FRACTIONS.

Sample No.	S.G. Fraction.	Yield %.	C.V. lb/lb.	Moist. %.	Ash %.	Vol.Mat. %.	Fix.Carb. %.
T177A$_1$	Fl. 1.35	23.7	-	2.2	8.0	38.6	51.2
	Fr.1.35-1.40	26.9	-	2.2	11.9	33.2	52.7
	Fr.1.40-1.45	17.4	-	2.2	15.3	29.9	52.6
	Fr.1.45 -1.50	13.4	11.6	2.1	20.7	27.5	49.7
	Fr.1.50-1.60	9.5	10.7	2.0	26.2	25.6	46.2
	Sk. 1.60	9.1	-	-	44.7	-	-
T177A$_2$	Fl. 1.35	40.1	-	2.3	7.4	38.5	51.8
	Fr.1.35-1.40	20.3	-	2.2	11.4	32.9	53.5
	Fr.1.40-1.45	13.0	-	2.1	15.1	29.8	53.0
	Fr.1.45-1.50	6.3	11.8	2.0	19.6	27.5	50.9
	Fr.1.50-1.60	7.6	10.7	1.9	26.0	25.4	46.7
	Sk. 1.60	12.7	-	-	48.1	-	-
T177A$_3$	Fl. 1.35	55.6	-	2.4	5.3	37.4	54.9
	Fr.1.35-1.40	14.3	-	2.3	11.3	30.4	56.0
	Fr.1.40-1.45	7.0	-	2.1	14.4	29.5	54.0
	Fr.1.45-1.50	4.6	11.8	2.1	18.8	26.4	52.7
	Fr.1.50-1.60	4.6	10.5	2.0	25.8	24.4	47.8
	Sk. 1.60	13.9	-	-	64.6	-	-
T177B$_1$	Fl. 1.35	35.6	-	2.1	7.7	38.3	51.9
	Fr.1.35-1.40	23.2	-	2.0	11.9	33.1	53.0
	Fr.1.40-1.45	11.1	-	2.0	15.7	29.7	52.6
	Fr.1.45-1.50	7.6	11.7	2.0	19.8	27.5	50.7
	Fr.1.50-1.60	8.7	10.6	1.9	27.1	25.0	46.0
	Sk. 1.60	13.8	-	-	50.4	-	-
T177B$_2$	Fl. 1.35	47.6	-	2.3	6.2	37.5	54.0
	Fr.1.35-1.40	15.0	-	2.2	10.9	32.8	54.1
	Fr.1.40-1.45	9.7	-	2.0	15.5	29.9	52.6
	Fr.1.45-1.50	7.0	11.9	2.0	18.7	27.4	51.9
	Fr.1.50-1.60	6.2	10.7	2.0	25.6	24.5	47.9
	Sk. 1.60	14.5	-	-	55.2	-	-
T177C$_1$	Fl. 1.35	38.9	-	2.2	6.1	38.7	53.0
	Fr.1.35-1.40	19.5	-	2.0	11.3	32.9	53.8
	Fr.1.40-1.45	12.3	-	2.0	14.3	30.1	53.6
	Fr.1.45-1.50	7.2	11.7	1.9	19.6	27.8	50.7
	Fr.1.50-1.60	7.2	10.6	1.8	26.2	25.7	46.3
	Sk. 1.60	14.9	-	-	52.7	-	-
T178D$_1$	Fl. 1.35	43.6	-	2.4	6.7	38.4	52.5
	Fr.1.35-1.40	16.3	-	2.1	11.3	33.7	52.9
	Fr.1.40-1.45	13.7	-	2.1	14.3	30.0	53.6
	Fr.1.45-1.50	5.9	11.8	2.2	18.8	26.8	52.2
	Fr.1.50-1.60	7.3	10.6	2.1	26.2	24.2	47.5
	Sk. 1.60	13.2	-	-	50.4	-	-
T178D$_2$	Fl. 1.35	50.0	-	2.6	4.8	37.3	55.3
	Fr.1.35-1.40	11.1	-	2.2	12.7	32.1	52.0
	Fr.1.40-1.45	8.0	-	2.3	13.9	28.9	54.9
	Fr.1.45-1.50	6.9	11.9	2.3	18.2	25.9	53.6
	Fr.1.50-1.60	8.0	10.6	2.1	25.3	23.5	49.1
	Sk. 1.60	16.0	-	-	53.7	-	-

TABLE 2/.....

TABLE 2.

CUMULATIVE YIELDS AND ANALYTICAL DATA OF SPECIFIC GRAVITY SEPARATIONS.

Sample No.	S. G.	Float Yield %.	Cal.Val. lb/lb.	Moist. %.	Ash %.	Vol.Mat. %.	Fix.Carb. %.	Sw. No.
T177A$_1$	1.35	23.7	-	2.2	8.0	38.6	51.2	4
	1.40	50.6	-	2.2	10.1	35.7	52.0	4-4½
	1.45	68.0	13.2	2.2	11.4	34.2	52.2	4
	1.50	81.4	12.9	2.2	12.9	33.1	51.8	3½-4
	1.60	90.9	12.7	2.2	14.3	32.3	51.2	3½
	Unwashed	100	-	-	17.1	-	-	-
T177A$_2$	1.35	40.1	-	2.3	7.4	38.5	51.8	4½
	1.40	60.4	-	2.3	8.7	36.6	52.4	4-4½
	1.45	73.4	13.5	2.2	9.9	35.4	52.5	4
	1.50	79.7	13.4	2.2	10.6	34.8	52.4	4-4½
	1.60	87.3	13.1	2.2	12.0	34.0	51.9	4-4½
	Unwashed	100	-	-	16.6	-	-	-
T177A$_3$	1.35	55.6	-	2.4	5.3	37.4	54.9	3½-4
	1.40	69.9	-	2.4	6.6	36.0	55.0	5
	1.45	76.9	13.7	2.4	7.3	35.4	54.9	4½
	1.50	81.5	13.5	2.3	8.0	34.9	54.8	4½-5
	1.60	86.1	13.4	2.3	8.9	34.3	54.5	4½
	Unwashed	100	-	-	16.7	-	-	-
T177B$_1$	1.35	35.6	-	2.1	7.7	38.3	51.9	3½-4
	1.40	58.8	-	2.1	9.4	36.2	52.3	4½
	1.45	69.9	13.5	2.1	10.4	35.2	52.3	4½
	1.50	77.5	13.3	2.0	11.3	34.5	52.2	4
	1.60	86.2	13.0	2.0	12.9	33.5	51.6	3½
	Unwashed	100	-	-	18.1	-	-	-
T177B$_2$	1.35	47.6	-	2.3	6.2	37.5	54.0	4
	1.40	62.6	-	2.3	7.3	36.4	54.0	5
	1.45	72.3	13.8	2.2	8.4	35.5	53.9	5
	1.50	79.3	13.6	2.2	9.3	34.8	53.7	5
	1.60	85.5	13.4	2.2	10.5	34.0	53.3	4
	Unwashed	100	-	-	17.0	-	-	-
T177C$_1$	1.35	38.9	-	2.2	6.1	38.7	53.0	3
	1.40	58.4	-	2.1	7.8	36.8	53.3	3½
	1.45	70.7	13.5	2.1	9.0	35.6	53.3	2½-3
	1.50	77.9	13.3	2.1	9.9	34.9	53.1	3½
	1.60	85.1	13.1	2.1	11.3	34.1	52.5	4
	Unwashed	100	-	-	17.5	-	-	-
T178D$_1$	1.35	43.6	-	2.4	6.7	38.4	52.5	4-4½
	1.40	59.9	-	2.3	8.0	37.1	52.6	4
	1.45	73.6	13.6	2.3	9.1	35.8	52.8	4½
	1.50	79.5	13.5	2.3	9.9	35.1	52.7	4½-5
	1.60	86.8	13.2	2.3	11.2	34.2	52.3	3-3½
	Unwashed	100	-	-	16.4	-	-	-
T178D$_2$	1.35	50.0	-	2.6	4.8	37.3	55.3	4
	1.40	61.1	-	2.5	6.2	36.5	54.8	4½-5
	1.45	69.1	13.8	2.5	7.1	35.5	54.7	4
	1.50	76.0	13.6	2.5	8.1	34.6	54.8	4½
	1.60	84.0	13.3	2.4	9.8	33.6	54.2	4-4½
	Unwashed	100	-	-	16.8	-	-	-

TABLE 3/.....

TABLE 3.

ASH CONTENTS OF SIZE FRACTIONS AND ORIGINAL COAL CALCULATED FROM THE AVAILABLE DATA.

Sample No.	%	Ash %.	Sample No.	Ash %.	Sample No.	Ash %.
T177 A_1	57.6	17.1				
A_2	35.3	16.6	A	17.1		
A_3	5.1	16.7				
A_4	2.0	22.4*				
B_1	77.5	18.1				
B_2	16.5	17.0	B	18.1	T177	17.6
B_3	6.0	20.3*				
C_1	77.6	17.5	C	17.7		
C_2	22.4	18.5*				
T178 D_1	43.5	16.4				
D_2	42.5	16.8	D	17.5	T178	17.5
D_3	14.0	23.0*				

* Actually determined.

TABLE 4/.....

TABLE 4.

WASHABILITY DATA (CUMULATIVE) OF SAMPLES AT ARBITRARILY CHOSEN SPECIFIC GRAVITIES.

S. G.	1.55.				1.50				1.45				1.40		
Sample No.	Yield %.	Ash %.	+0.1 S.G. Distrib.	Sw. No.(x)	Yield %.	Ash %.	+0.1 S.G. Distrib.	Sw. No.	Yield %.	Ash %.	+0.1 S.G. Distrib.	Sw. No.	Yield %.	Ash %.	Sw. No.
T177 A_1	87.7	13.7	ca. 25	ca. $3\frac{1}{2}$	81.4	12.9	41	$3\frac{1}{2}$-4	68.0	11.4	63	4	50.6	10.1	4-$4\frac{1}{2}$
A_2	84.2	11.4	ca. 17	ca. 4-$4\frac{1}{2}$	79.7	10.6	27	4-$4\frac{1}{2}$	73.4	9.9	44	4	60.4	8.7	4-$4\frac{1}{2}$
A_3	84.5	8.5	ca. 13	ca. $4\frac{1}{2}$	81.5	8.0	16	$4\frac{1}{2}$-5	76.4	7.3	29	$4\frac{1}{2}$	69.9	6.6	5
$(A_1+A_2+A_3)^x$	86.3	12.6	-	-	80.8	11.8	-	-	70.4	10.6	-	-	55.1	9.4	-
$(A_1+A_2)^x$	86.4	12.8	-	-	80.8	12.0	-	-	70.1	10.8	-	-	54.3	9.6	-
~~$(A_2+A_3)^x$~~	84.2	11.0	-	-	79.9	10.3	-	-	73.8	9.6	-	-	61.6	8.4	-
T177 B_1	82.5	12.1	ca. 20	ca. $3\frac{1}{2}$-4	77.5	11.3	27	4	69.9	10.4	47	$4\frac{1}{2}$	58.8	9.4	$4\frac{1}{2}$
B_2	83.4	10.1	ca. 15	ca. $4\frac{1}{2}$	79.3	9.3	23	5	72.3	8.4	36	5	62.6	7.3	5
$(B_1+B_2)^x$	82.7	11.9	-	-	77.8	11.1	-	-	70.3	10.2	-	-	59.5	9.1	-
T177 C_1	82.7	10.7	ca. 18	ca. $3\frac{1}{2}$-4	77.9	9.9	27	$3\frac{1}{2}$	70.7	9.0	43	$2\frac{1}{2}$-3	58.4	7.8	$3\frac{1}{2}$
T178 D_1	83.2	10.5	ca. 20	ca. 4	79.5	9.9	27	$4\frac{1}{2}$-5	73.6	9.1	40	$4\frac{1}{2}$	59.9	8.0	4
D_2	80.6	9.0	ca. 17	ca. $4\frac{1}{2}$	76.0	8.1	23	$4\frac{1}{2}$	69.1	7.1	31	4	61.1	6.2	$4\frac{1}{2}$-5
$(D_1+D_2)^x$	81.9	9.8	-	-	77.8	9.0	-	-	71.4	8.1	-	-	60.5	7.1	-
91%$(A_1+A_2+A_3)^x$ +9%(D_1+D_2)	85.9	12.3	-	-	80.5	11.5	-	-	70.5	10.4	-	-	55.6	9.2	-

x Calculated Values.

(x) Estimated Values.

FIG. 1

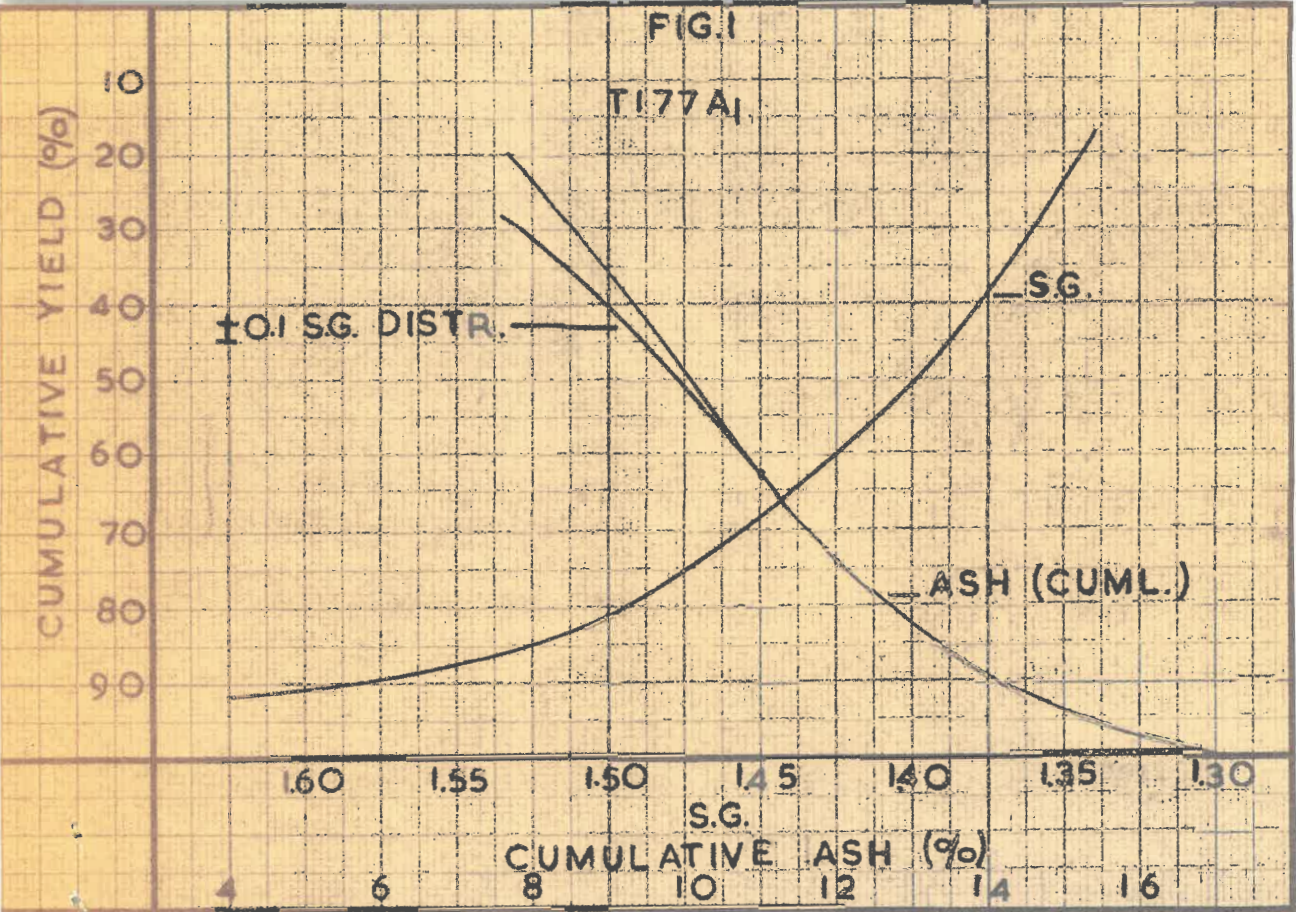

T 177 A1
CUMULATIVE YIELD (%)
10
20
30
40
50
60
70
80
90
± 0.1 S.G. DISTR.
S.G.
ASH (CUML.)
1.60
1.55
1.50
1.45
1.40
1.35
1.30
S.G.
CUMULATIVE ASH (%)
4
6
8
10
12
14
16

FIG. 2

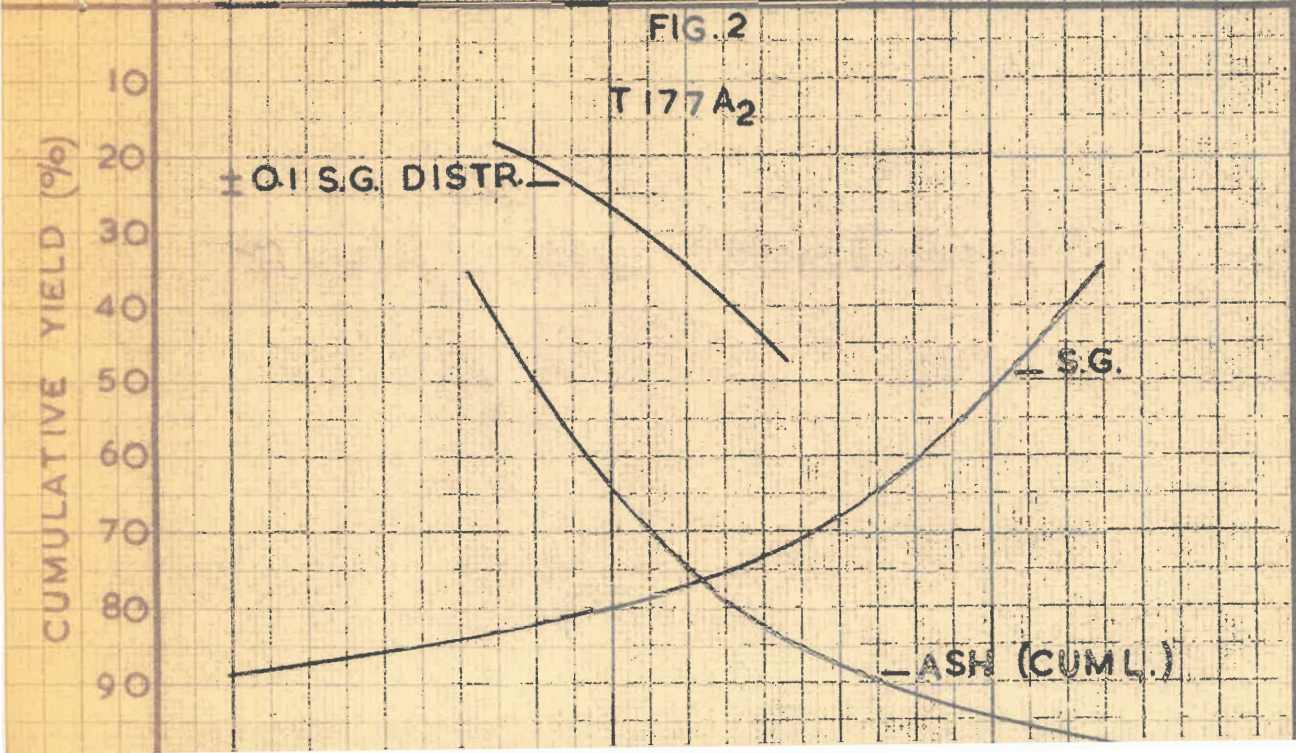

T 177 A2
CUMULATIVE YIELD (%)
10
20
30
40
50
60
70
80
90
± 0.1 S.G. DISTR.
S.G.
ASH (CUML.)

FIG 3

T177 A_3

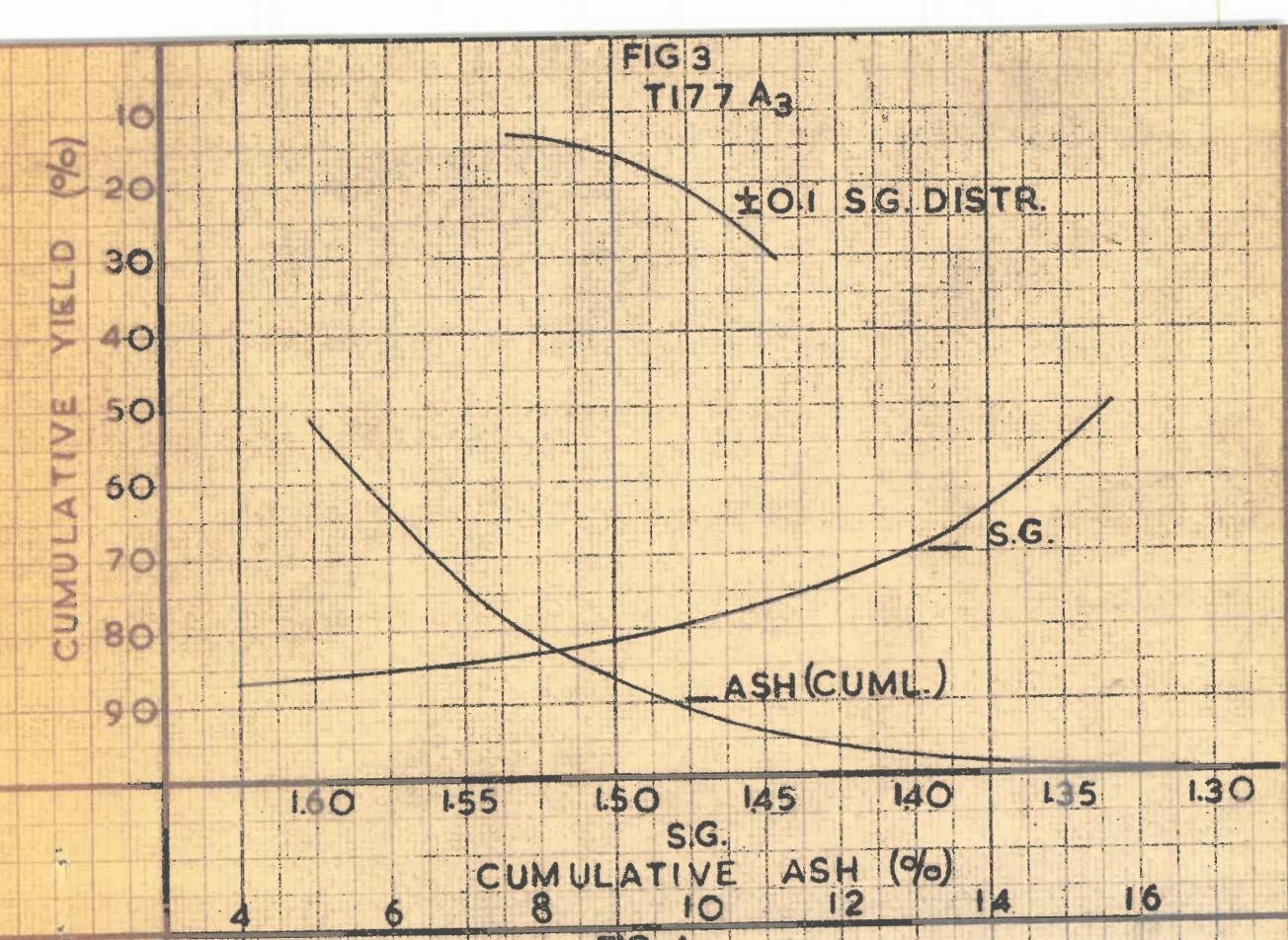


FIG. 4

T177 B_1

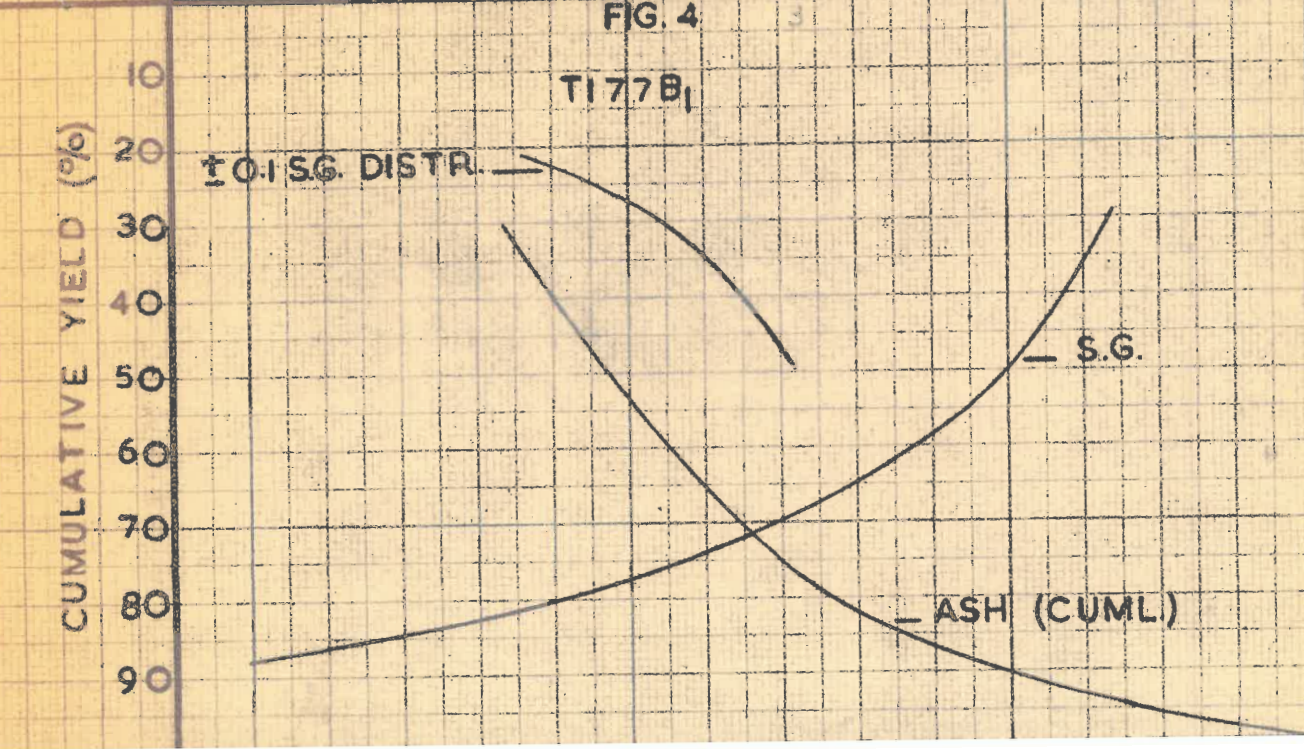


FIG. 5

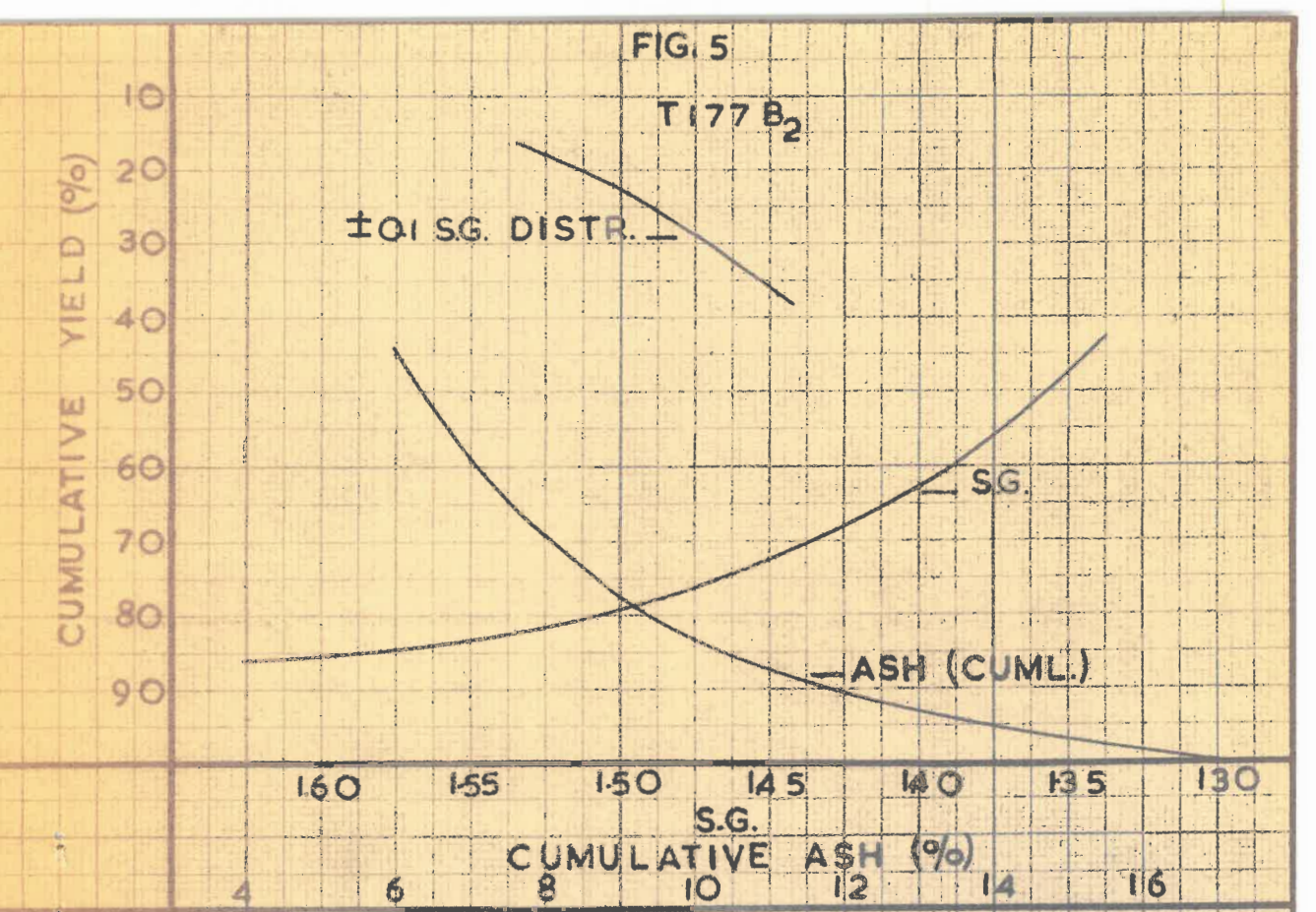

T177 B2
±0.1 S.G. DISTR.
S.G.
ASH (CUML.)
CUMULATIVE YIELD (%)
10
20
30
40
50
60
70
80
90
1.60
1.55
1.50
1.45
1.40
1.35
1.30
S.G.
CUMULATIVE ASH (%)
4
6
8
10
12
14
16

FIG. 6

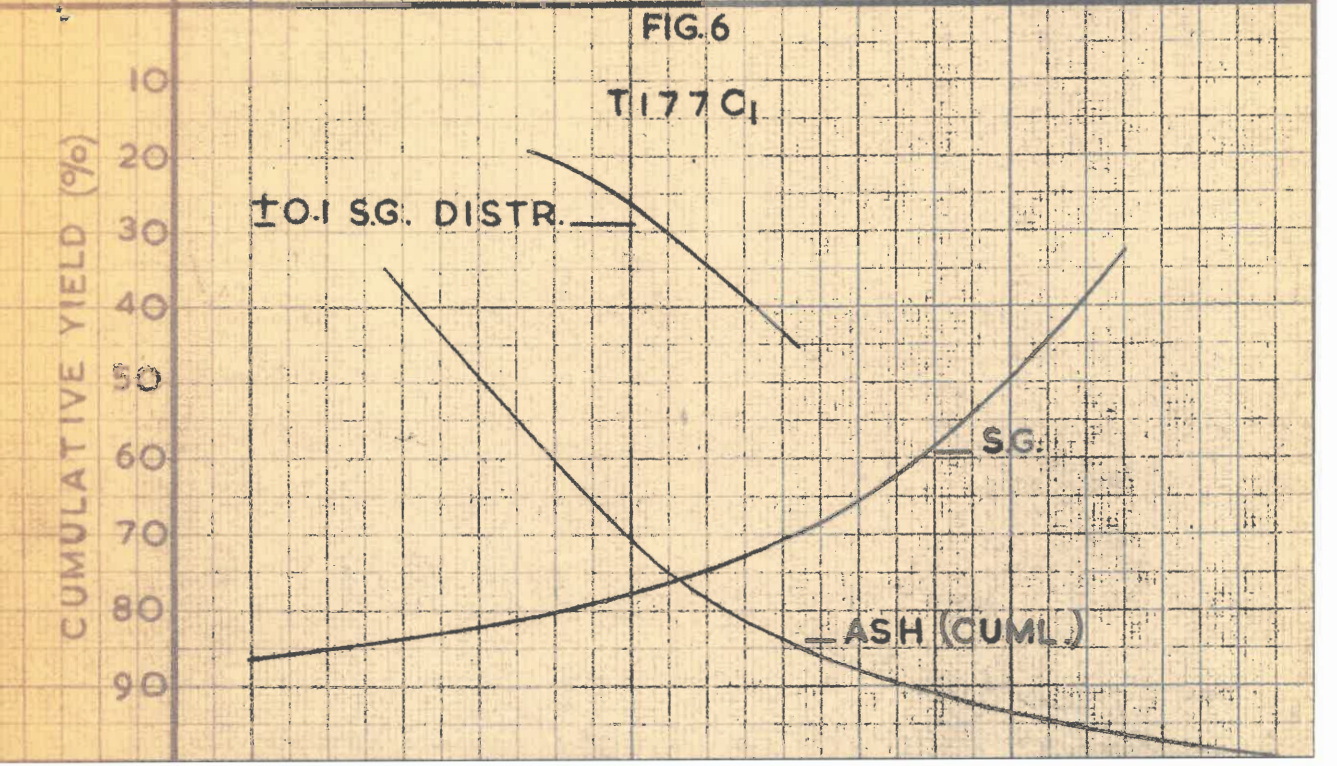

T177 C1
±0.1 S.G. DISTR.
S.G.
ASH (CUML.)
CUMULATIVE YIELD (%)
10
20
30
40
50
60
70
80
90

FIG. 7

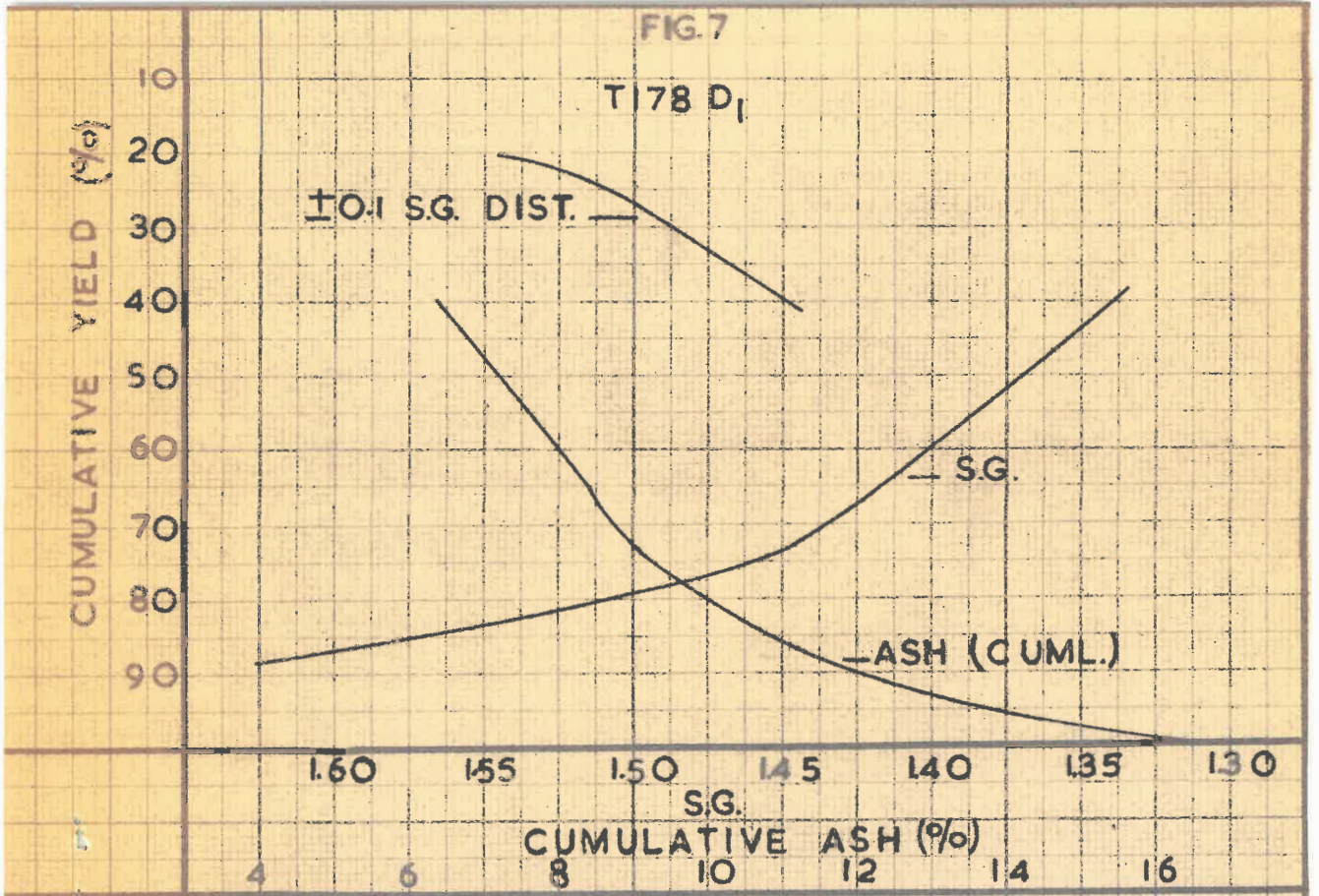
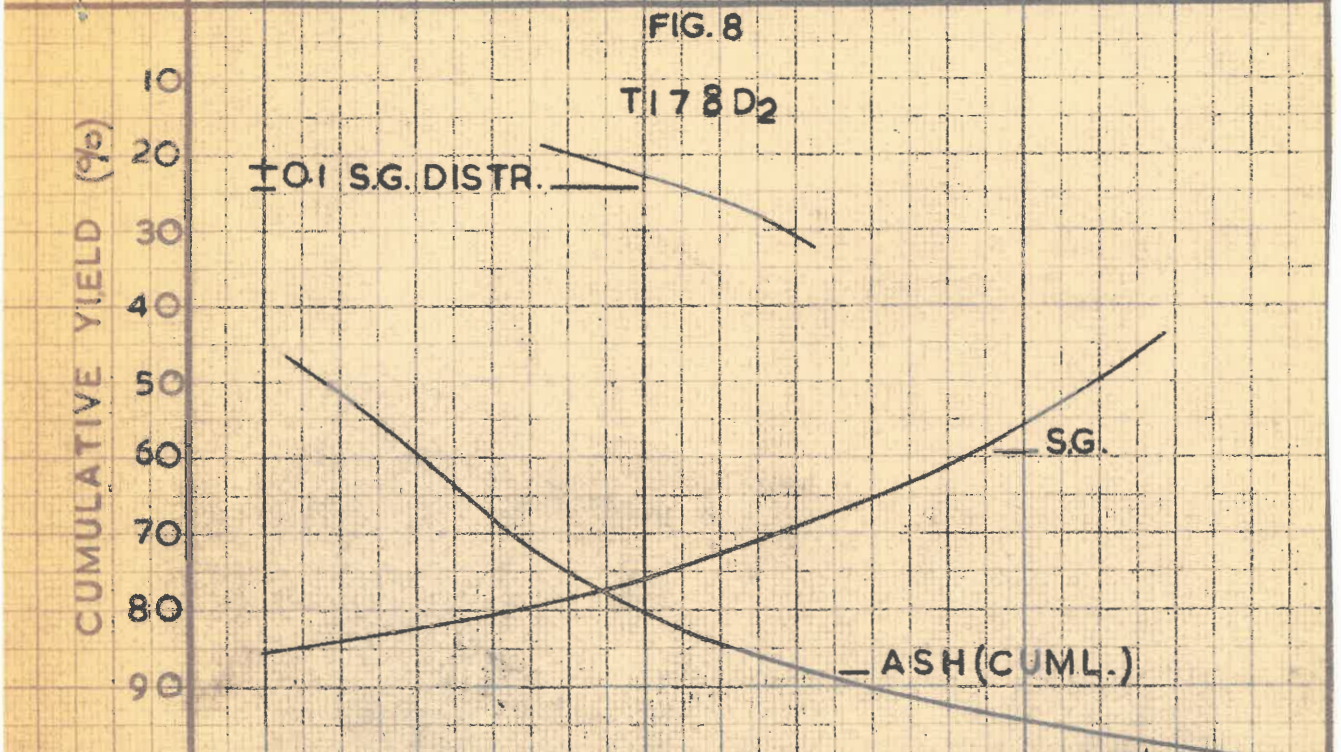

T178 D1
±0.1 S.G. DIST.
S.G.
ASH (CUML.)
CUMULATIVE YIELD (%)
10
20
30
40
50
60
70
80
90
1.60
1.55
1.50
1.45
1.40
1.35
1.30
S.G.
CUMULATIVE ASH (%)
4
6
8
10
12
14
16

FIG. 8


T178 D2
±0.1 S.G. DISTR.
S.G.
ASH (CUML.)
CUMULATIVE YIELD (%)
10
20
30
40
50
60
70
80
90