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WASHABILITY ANALYSIS OF LIGNITE BOREHOLE SAMPLES
FROM THE WOOD MOUNTAIN AND SHAUNAVON
(CYPRESS) AREAS, SASKATCHEWAN

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by

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ABSTRACT

Individual borehole samples of lignite from the Wood Mountain and Shaunavon Areas of Saskatchewan were combined and each considered as a single borehole for analysis.

After air drying and crushing of the plus 1/4-inch material, subsamples obtained by coning and quartering were wet-screened to remove the fines and clayey materials. The remaining product was analysed by the float-sink method.

Screenability and washability data showed that a power plant product containing 15% ash could be obtained at 71% yield from the Wood Mountain lignite by desliming at 200 mesh and washing at >1.8 specific gravity using a process such as the Compound Water Cyclone. Ash content of the Shaunavon (Cypress) lignite could be reduced to approx 15% ash by removal of the 200 mesh fraction alone to give a yield of 76% on the as-mined basis. Sodium contents were 0.51% and 0.03% (coal basis) for Wood Mountain and Shaunavon samples respectively.

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INTRODUCTION

As a continuation in part of the program undertaken in 1974 for evaluating Saskatchewan high-ash lignites, 167 drums containing lignite borehole samples were received in the latter part of August and the first half of September 1975, at the Western Research Laboratory (WRL) from the Dept. of Mineral Resources, Regina, Saskatchewan. Eighty-seven (87) drums were marked "Wood Mountain 54R and eighty (80) drums from the Shaunavon area were designated as "Cypress 20R". The contents of each drum were packed in sealed plastic bags and tagged. The average weight was approx 150 lb (wet basis).

Samples from each area were combined to represent a single borehole as was done for the Willowbunch and Estevan area samples reported previously (1).

After air-drying, the bulk sample was screened at 1/4-inch, the oversize passed through a Sturtevant crusher, then recombined with the undersize. The subsample for analysis was obtained by coning and quartering.

Screen and float-sink analyses are presented separately for each area along with prediction of washing results.

The surplus material has been retained at WRL; approx 3800 lb (13 drums) for Wood Mountain and approx 5000 lb (15 drums) for Cypress, both air-dried basis.

I - WOOD MOUNTAIN 54R

The samples were very wet and contained little clayey material.

Preparation

All 87 samples were spread on the clean concrete floor of the pilot plant and turned over and mixed daily. A grab sample was taken from each bag as it was emptied to make up a subsample for determination of air-drying weight loss. This amounted to 43.87% during mixing of the bulk sample. The oven-dried moisture loss determined on a 1 lb air-dried

sample was 31.3%.

Analysis

Proximate analysis is given in Table I-1 and results of dry and wet screen analysis in Table I-2 which also shows ash contents and screenability data for the wet-screened fractions.

Results for the float-sink analysis are presented in Table I-3 for the plus 1/4-inch, 1/4 inch x 6 mesh, 6 x 48 mesh and 48 x 200 mesh fractions which together accounted for 84% of the total. Ash content of all sizes combined was 26.8% (as analysed). Calculated washability data for the plus 200 mesh fraction are shown in Table I-4. Total sodium content was 0.509% (dry coal basis).

Results and Conclusions

The material contained 15.8% minus 200 mesh with an ash content of 44.1%. According to Table I-3, removal of this fraction would result in only a slight reduction in ash content from 26.8 to 23.6% at a yield of approx 84%.

The washability data and curves for the plus 200 mesh fraction are presented in Table I-4 and Fig. I-1 respectively. The performance evaluation in Fig. I-2 shows that a clean coal ash content of 15% could be obtained at a yield of 84% using compound water cyclones having a probable error $(r) \approx 0.10$. The corresponding reject would have an ash content of 70%.

It is concluded that a 15% ash thermal coal could be obtained at a yield of approx 71% on the as-mined basis by desliming at 200 mesh and washing the oversize at >1.8 specific gravity in water - only cyclones.

TABLE I - 1: WOOD MOUNTAIN 54R: Proximate Analysis

	<u>As Received Basis</u>	<u>Dry Basis</u>
Moisture %	61.44	-
Ash %	11.44	29.66
Volatile Matter %	13.61	35.31
Fixed Carbon %	13.51	35.03

TABLE I - 2: WOOD MOUNTAIN 54R: Results of Dry and Wet Screening

Screen Size (Mesh)	Dry Screening		Wet Screening					
	Wt %	Cum Wt %	Wt %	Ash % (Dry Basis)	Oversize		Undersize	
					Cum Wt %	Cum Ash %	Cum Wt %	Cum Ash %
+ 1/2-inch	0.03	0.03	-	-	-	-	-	-
1/2 x 1/4-inch	1.69	1.72	1.35	14.33	1.35	14.33	100.00	28.15
1/4-inch x 6	16.39	18.11	11.87	25.17	13.22	24.06	98.65	28.34
6 x 48	65.81	83.92	58.56	22.06	71.78	22.43	86.78	28.77
48 x 200	11.04	94.96	12.43	40.94	84.21	25.16	28.22	42.71
200 x 325	1.89	96.85	2.14	37.63	86.35	25.47	15.79	44.10
- 325	3.15	100.00	13.65	45.12	100.00	28.15	13.65	45.12
Total	100.00		100.00					

1
3
1

TABLE I - 3: WOOD MOUNTAIN 54R: Float-sink Analysis on Plus 200 Mesh Fractions

(Ash contents on as analysed basis shown in brackets.)

Screen Size (mesh) \ Sp Gr										
	1.30	1.35	1.40	1.45	1.50	1.60	1.80	2.00		Total
1/2- 1/4-inch	0.30 (4.71)	0.22 (5.94)	0.28 (7.60)	0.21 (10.16)	0.12 (13.42)	0.08 (18.84)	0.05 (37.34)	— —	0.09 (73.04)	1.35 (13.73)
1/4-inch x 6	0.39 (4.76)	2.33 (5.41)	2.13 (7.95)	2.28 (11.03)	1.40 (14.62)	1.22 (19.88)	1.03 (31.14)	0.25 (56.37)	0.84 (80.61)	11.87 (18.12)
6 x 48	1.56 (4.60)	3.77 (5.54)	6.51 (7.44)	12.74 (11.63)	7.93 (12.80)	10.43 (16.86)	8.54 (27.29)	1.51 (45.09)	5.57 (80.62)	58.56 (21.38)
48 x 200	0.01 (5.18)	0.02 (5.80)	0.12 (7.02)	0.50 (7.62)	1.39 (10.69)	3.12 (14.43)	2.88 (24.05)	0.61 (42.63)	3.78 (89.58)	12.43 (40.11)
Total	2.26 (4.64)	6.34 (5.51)	9.04 (7.56)	15.73 (11.40)	10.84 (12.77)	14.85 (16.61)	12.50 (26.90)	2.37 (45.65)	10.28 (83.85)	84.21 (23.56)
200 - 325	This fraction forms 2.14% of the total sample and has an ash content of 37.63%.									
- 325	This fraction forms 13.65% of the total sample and has an ash content of 45.12%. Therefore the ash content in the total sample is 26.80%.									

TABLE I - 4: WOOD MOUNTAIN 54R: Washability Data for plus 200 mesh fraction (84.21% of total)

Sp Gr	wt %	Ash % (As analysed)	Floats		Sinks	
			cum wt %	cum ash %	cum wt%	cum ash %
- 1.3	2.68	4.64	2.68	4.64	100.00	23.56
1.3 - 1.35	7.53	5.51	10.21	5.28	97.32	24.09
1.35 - 1.40	10.74	7.56	20.95	6.45	89.79	25.65
1.40 - 1.45	18.68	11.40	39.63	8.78	79.05	28.10
1.45 - 1.50	12.87	12.77	52.50	9.76	60.37	33.27
1.50 - 1.60	17.64	16.61	70.14	11.48	47.50	38.83
1.60 - 1.80	14.84	26.90	84.98	14.18	29.86	51.95
1.80 - 2.0	2.81	45.65	87.79	15.18	15.02	76.70
+ 2.0	12.21	83.85	100.00	23.56	12.21	83.85
Total	100.00	23.56				

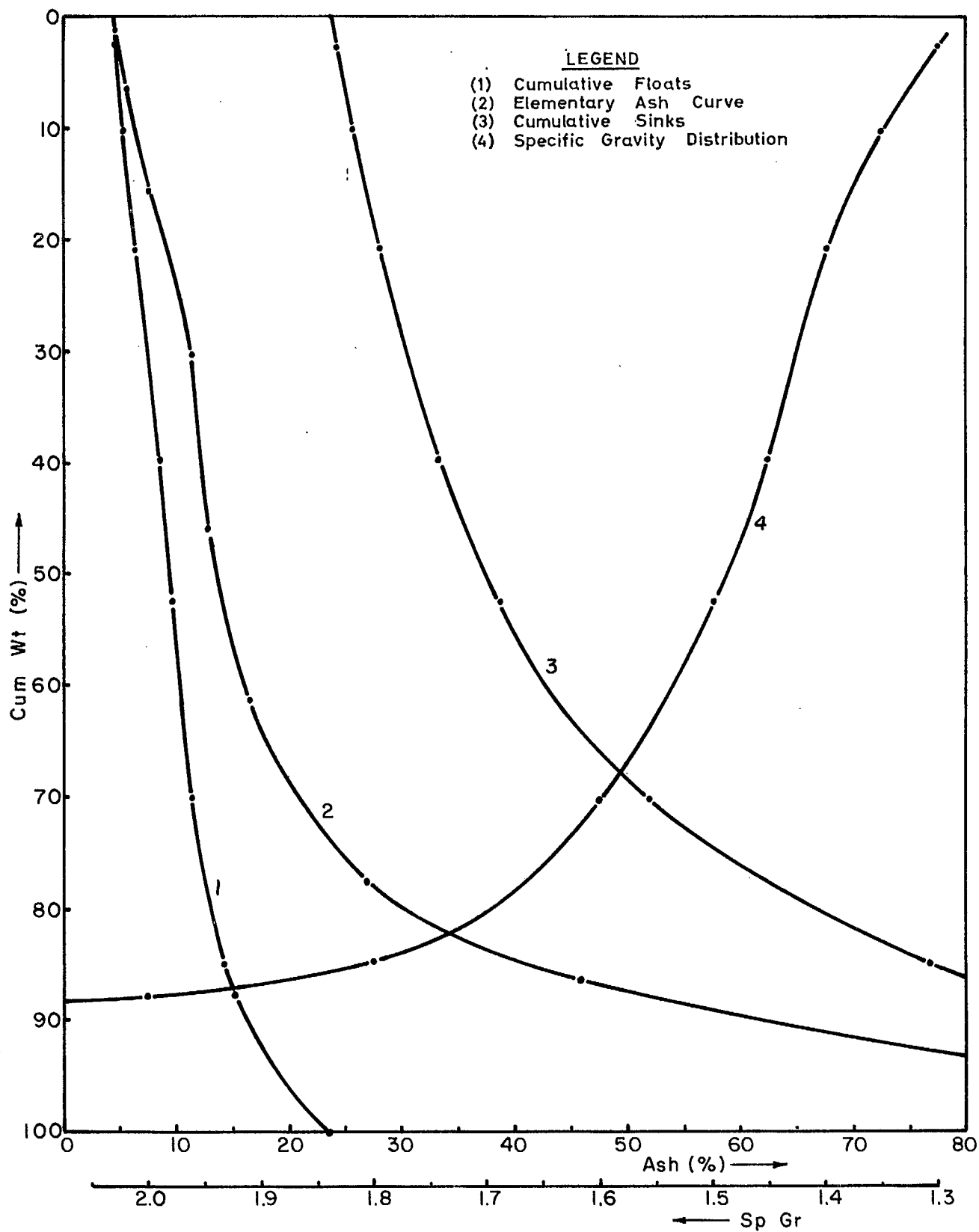


Fig. I-1 - Wood Mountain 54R: Washability Curves of Plus 200 -mesh Fraction.

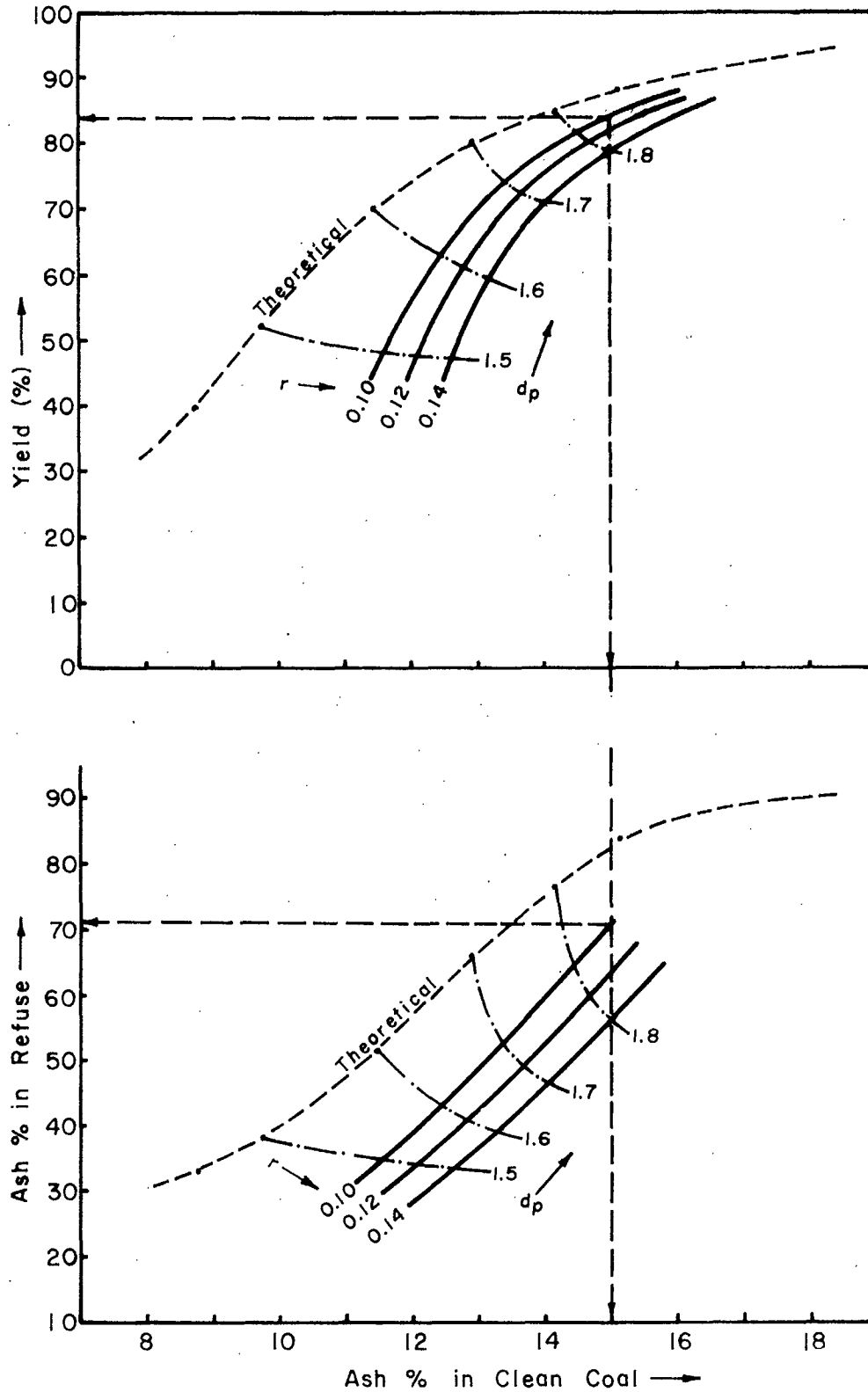


Fig. I-2 - Wood Mountain 54R: Performance Evaluation,
Plus 200 - mesh Fraction.

II - CYPRESS 20R

Like Wood Mountain, the Cypress samples appeared very wet and contained very little clay.

Preparation

The same procedure was used as described earlier for the Wood Mountain material. The 80 samples were spread on the clean concrete floor of the pilot plant and turned over daily with breaking of lumps. Air-drying moisture loss during the mixing process as determined on grab samples from the plastic bags was 36.38%.

The oven-drying moisture loss determined on a 1-lb air-dried subsample was 34.09%. Approximately 7 days were required before the material was sufficiently dry for mixing and screening at 1/4 inch. The plus 1/4-inch fraction was passed through a Sturtevant crusher and re-combined with the undersize. The lab sample was obtained by coning and quartering.

Analysis

Proximate analysis is given in Table II - 1. Results of dry and wet screen analysis are given in Table II - 2 along with ash contents and screenability data for the wet-screened fractions. Data for float-sink analysis shown in Table II - 3 refer to the plus 1/4-inch, 1/4-inch x 6 mesh, 6 x 48 mesh and 48 x 200 mesh fractions, which together accounted for 76% of the total. Ash content of all sizes combined was 26.13% (as analysed). Calculated washability data for the plus 200 mesh fraction are shown in Table II - 4. Washability curves and a performance evaluation are shown in Figs. II - 1 and II - 2 respectively. Total sodium content was 0.033% (dry coal basis).

Results and Conclusions

The material contained 24.0% minus 200 mesh with an ash content of 59.6%. According to Table II - 3, desliming for removal of this fraction would give a clean coal in the oversize containing 15.5% ash and a yield of approx 76%.

TABLE II - 1: CYPRESS 20R: Proximate Analysis

	<u>As Received Basis</u>	<u>Dry Basis</u>
Moisture %	58.07	-
Ash %	12.92	30.81
Volatile Matter %	15.62	37.25
Fixed Carbon %	13.39	31.94

TABLE II - 2: CYPRESS 20R: Results of Dry and Wet Screening

Screen Size (Mesh)	Dry Screening		Wet Screening					
	Wt %	Cum Wt %	Wt %	Ash % (dry basis)	Oversize		Undersize	
					Cum Wt %	Cum Ash %	Cum Wt %	Cum Ash %
1/2 x 1/4-inch	1.87	1.87	2.49	10.54	2.49	10.54	100.00	28.22
1/4-inch x 6	22.23	24.10	18.81	13.46	21.30	13.12	97.51	28.67
6 x 48	57.51	81.61	45.40	17.27	66.70	15.94	78.70	32.30
48 x 200	11.19	92.80	9.27	35.16	75.97	18.29	33.30	52.80
200 x 325	6.05	98.85	2.97	48.11	78.94	19.41	24.03	59.60
- 325	1.15	100.00	21.06	61.22	100.00	28.22	21.06	61.22
Total	100.00		100.00					

TABLE II - 3: CYPRESS 20R: Float-sink Analysis on Plus 200 Mesh Fractions
(Ash contents on as analysed basis shown in brackets)

Sp Gr Screen Size Mesh	1.30	1.35	1.40	1.45	1.50	1.60	1.80	2.00	Total	
1/2 - 1/4 inch	0.47 (3.22)	1.16 (4.05)	0.47 (9.16)	0.24 (12.26)	0.06 (19.79)	0.01 (27.10)	0.02 (39.83)	0.01 (53.90)	0.05 (55.83)	2.49 (7.65)
1/4 inch x 6	2.84 (2.79)	4.86 (3.53)	5.34 (7.53)	3.62 (10.76)	0.99 (12.83)	0.65 (19.76)	0.12 (32.30)	0.05 (36.20)	0.34 (71.11)	18.81 (8.49)
6 x 48	1.57 (3.03)	7.08 (3.63)	6.35 (6.73)	12.84 (9.28)	7.83 (11.63)	3.68 (19.70)	2.84 (27.61)	0.49 (45.89)	2.72 (77.29)	45.40 (14.69)
48 x 200	0.02 (3.20)	0.05 (4.30)	0.35 (6.23)	0.66 (8.34)	1.47 (10.21)	0.80 (13.14)	2.62 (20.39)	0.60 (44.01)	2.70 (82.14)	9.27 (36.15)
Total	4.90 (2.91)	13.15 (3.63)	12.51 (7.15)	17.36 (9.59)	10.35 (11.59)	5.14 (18.70)	5.60 (24.38)	1.15 (44.56)	5.81 (79.00)	75.97 (15.54)
200 - 325	This fraction forms 2.97% of the total sample and has an ash content of 48.11%.									
- 325	This fraction forms 21.06% of the total sample and has an ash content of 61.22%. Therefore the ash content in the total sample is 26.13%.									

TABLE II - 4: CYPRESS 20R: Washability Data for plus 200 mesh fraction (75.97% of total)

Sp Gr	Wt %	Ash % (As analysed)	Floats		Sinks	
			Cum Wt %	Cum Ash %	Cum Wt %	Cum Ash %
- 1.30	6.45	2.91	6.45	2.91	100.00	15.54
1.3 - 1.35	17.31	3.63	23.76	3.43	93.55	16.41
1.35 - 1.40	16.47	7.15	40.23	4.96	76.24	19.32
1.40 - 1.45	22.85	9.59	63.08	6.63	59.77	22.67
1.45 - 1.50	13.62	11.59	76.70	7.51	36.92	30.76
1.50 - 1.60	6.77	18.70	83.47	8.42	23.30	41.97
1.60 - 1.80	7.37	24.38	90.84	9.72	16.53	51.50
1.80 - 2.00	1.51	44.56	92.35	10.29	9.16	73.32
+ 2.00	7.65	79.00	100.00	15.54	7.65	79.00
Total	100.00	15.54				

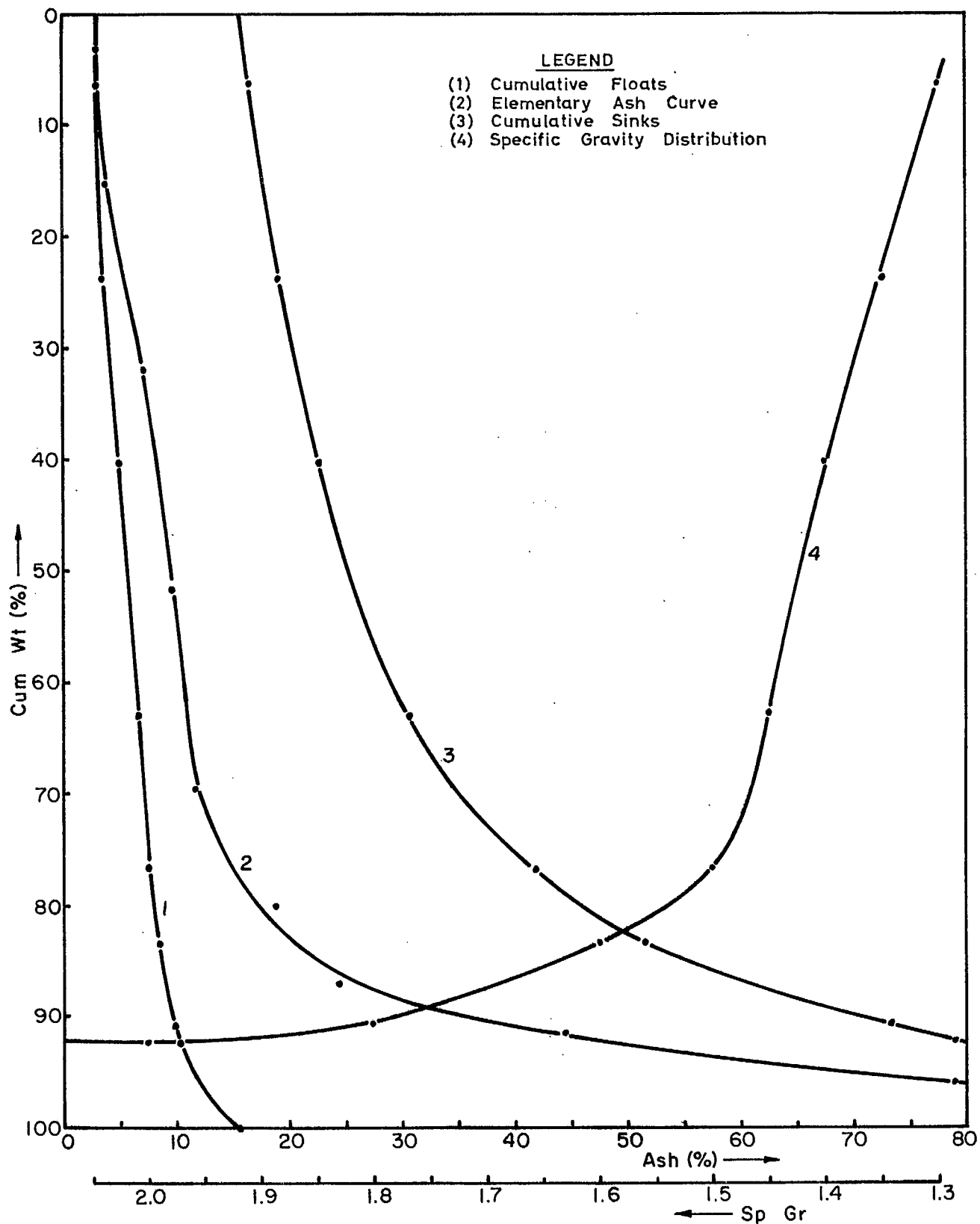


Fig. II-1 - Cypress 20R: Washability Curves of
Plus 200 -mesh Fraction.

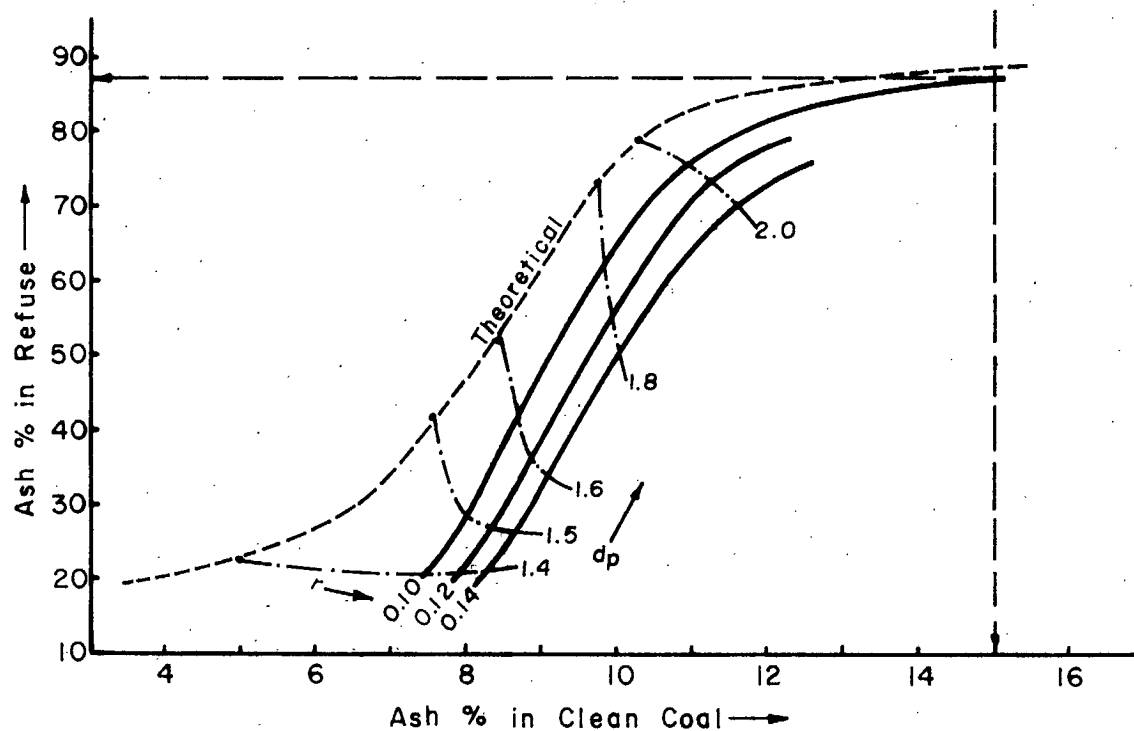
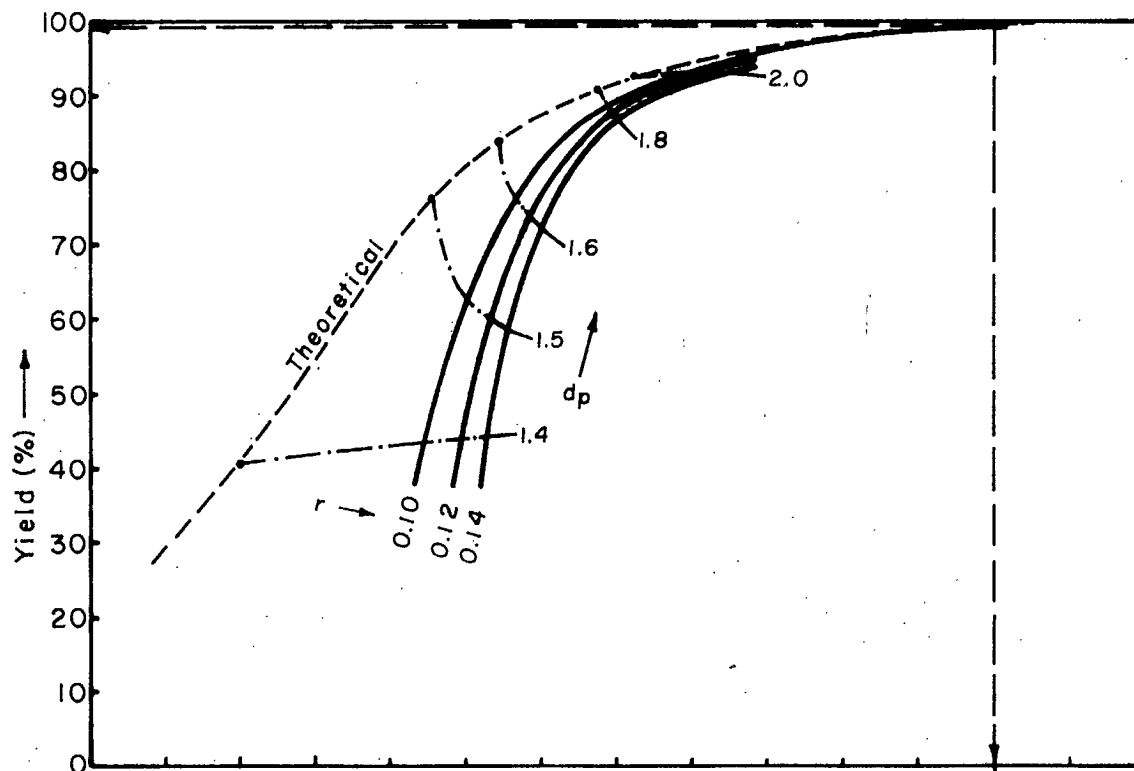


Fig. II-2 - Cypress 20R: Performance Evaluation,
Plus 200 -mesh Fraction.

LITERATURE REFERENCES

1. Rozenhart, C.F., "Washability Analysis of Lignite Borehole Samples from the Willowbunch and Estevan Areas, Saskatchewan", Dept. of Energy, Mines and Resources, Energy Research Laboratories, Divisional Report ERL 75/26 - WRL March, 1975.