ASSESSMENT REPORT

Coal-CASSIDY 43(1)A 49°-123° Nr.3.

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PRELIMINARY NOTES ON THE POSSIBLE UTILIZATION OF COAL FROM THE WASHERY WASTE DUMP AT CASSIDY, B.C.

by J. [illegible]

Situation:

The waste dump under discussion is situated at Cassidy, about one-quarter mile from the Island Highway, and approximately nine miles each way from Nanaimo and Ladysmith. It lies approxiamtely 600 yards from the Nanaimo River, and 150 yards from Haslaw Creek, and close to power lines.

History:

The dump is composed of refuse from the coal washer operated by Granby Mining Smelting and Power Co. Ltd. in conjunction with their Granby Colliery. A total of 2,500,000 long tons was produced from the Douglas seam during the period of 1918 to 1932. Owing to the crushed condition of the seam in this section less than 20% of the coal mined was sold in lump form, the remainder being washed to yield marketable fines and refuse. A large proportion of washed coal was shipped to the Company's smelter at Anyox for conversion to metallurgical coke.

The washer comprised two, 2-compartment jigs and nine Deister coal tables with auxiliary equipment including mechanical screens, a 75 foot Dorr Thickener, and an Oliver filter. Flotation was also provided for treatment of fines but proved unsuccesful.

Records show that approxiamtely 440,000 long tons of waste was discarded onto the present dump during the fourteen years of washer operation. An unspecified amount of this was re-washed at various times from which 13,400 long tons of marketable coal was obtained. An unknown but probably negligible amount of washer refuse was sluiced directly back to the workings for stowing.

Description of Dump:

Inasmuch as the dump occupies an irregular depression its

average depth cannot be satisfactorily estimated. Assuming, however, the obviously conservative figure of 15 feet, the pile would contain over 200,000 tons. On the basis of the old records mentioned above 400,000 long tons would probably be closer to the amount actually available taking into consideration various small lots which have been removed during the past ten years.

The dump is composed of loose material ranging in size from about three-quarters of an inch to dust.

Two samples, taken from pits at widely separated points and representing depths of about fifteen feet in each case, contained 35.7 and 37.5 per cent ash respectively. These were combined for the washing tests described in the accompanying report.

Only total ash was determined in the two samples mentioned above. However, after washing, cleaned coal would be expected to resemble coal from the Douglas seam obtained elsewhere but of comparable ash content. The following analysis # of run-of-mine coal from the Douglas seam, No. 10, South Wellington Mine, should therefore give a rough indication of the product obtainable from the dump.

Report of Investigations, Carbonization Section, 175,-Fuel Research Laboratory, Bureau of Mines, Ottawa, Can.-E. Swartzman, June 1942.

Ash	Volatile	Fixed Carbon	Sulphur	Calorific Value
16.5%	36.4%	47.1%	0.5%	12130BTU/Lb.

Analysis of Ash

SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	MnO	Na_2O	K_2O	P_2O_5	TiO_2	So
38.0	7.8%	20.5%	18.6%	5.8%	0.1%	0.5%	1.1%	1.2%	0.9%	5.3

Washing Tests:

Results of investigations are given in the accompanying report. Sink-and-float tests indicate a theoretically possible yield of 41% by weigth in a float product containing 16% ash. A recovery of 32% was made in a product containing 16% ash by a combination of heavy liquid

separation of the plus 10 mesh fraction and tabling of the minus 10 plus 90 mesh fraction. This recovery could be raised somewhat should a greater ash content be permissible.

Preliminary investigations made to date demonstrate that marketable coal can be produced from the waste dump without apparent difficulty. Further tests must be made on a larger scale, however, to establish most efficient treatment methods, cost of plant, and to allow an estimation to be made of operating costs and recoveries which may be anticipated in practice.

The following points should be noted in discussing the dressing of this material:

(1) A combination of heavy-medium separation of coarser sizes with tabling of finer sizes should be investigated further on a larger scale with standard test equipment. This is necessary to establish the size ranges of feed amendable to treatment by each method. In the accompanying report 10 mesh was arbitrarily chosen as the dividing point between the two processes but is not necessarily the most economic size division for practical treatment.

(2) Tabling the minus 10 plus 90 mesh fraction gave a product containing 16% ash and equal to 42% by weigth of table feed or 22% of origin ls heads. No tests were run on minus 4 plus 10 mesh or minus 90 mesh fractions. Yield from the fine fraction, however, would only increase overall recovery by 2% under optimum conditions.

The minus 4 plus 10 mesh fraction should respond fairly well to tabling although further tests are required to establish its amendability to this form of treatment. Assuming comparable efficiency to that obtained with the finer fraction a recovery of 26%, equivalent to 6% of total feed, would be possible. On this basis the combined yield by tabling all the minus 4 mesh fraction would be about 28%. In practice this could probably be attained only by sizing the feed into plus and minus 10 mesh fractions and

tabling each separately.

The plus 4 mesh product, equal to 20% by weight of heads, is too coarse to respond well to tabling. Jigging would be difficult as well, owing to the flat slab-like shape of larger pieces. This fraction would require to be crushed to at least 4 mesh to make it amendable to treatment methods other than sink-and-float. By tabling the crushed product a recovery of 20 to 25 % might be obtained in a product containing 16% ash. This would be equivalent to 4 or 5 % of total heads.

In review it appears likely that a total of 31 to 33 % by weight of heads could be recovered in a minus 4 mesh product by screening, crushing oversize, screening to give roughly sized table feed, and tabling. Test-work should be carried out long these lines to establish recoveries possible in practice, and to contrast results with those obtained by sink-and-float testing as suggested in the previous section. In passing it should be noted that apart from other considerations which may arise when test-work is complete, the sink-and-float or heavy-medium method of treatment would be advantageous inasmuch as 10 or 12 % of the coal recovered would be marketable as pea coal.

Throughout the above discussion an ash content of 16 % in the cleaned product was assumed. Should 20 % ash be permissible, recoveries in the order of 40 %, instead of 32 %, would be possible.

Markets:

Irrespective of the treatment used the bulk of cleaned coal products would be classed as slack or washed smalls. In 1941 production of this grade of material from Vancouver Island collieries was about 122,000 tons, none of which was sold for domestic purposes. Among the chief users of washed slack are gas manufacturers and pulverized coal coal fired installations.

Statistics show that about 70,000 tons of coal are used annually in Vancouver and Victoria for the manufacture of gas. The proportion of

washed slack used for this purpose is not known.

Chief consumers of slack for pulverized coal firing are the B.C. Cement Co. at Bamberton, B.C. and the B.C. Sugar Refinery Ltd., in Vancouver. Boilers at the B.C. Electric power station at Brentwood are being converted to use pulverized coal at present and this plant will also constitute and important consumer. To date data has been obtained on only the B.C. Cement Company's installation at Bamberton. Consumption there is in the order of 35,000 tons per year at the present rate of production. Washed slack from Canadian Collieries plant at Nanaimo is brought in by scow at a delivered cost of $4.50 per short ton, of which 47 cents is the cost of scowing from Nanaimo to Bamberton. Ash content is in the order of 16 % but it is understood that a higher figure would be permissible as long as variations were minimized and the necessary heat could be obtained.

In general the average selling price for washed slack coal has been in the order of $4.25 per ton f.o.b. Nanaimo in recent months.

Approximate Cost Estimates for Producing Coal from Cassidy Dump:

The following estimates are very rough and are intended to serve only as a guide to the economic possibility of treating the waste dump at Cassidy. More accurate estimates must await the determination of the most satisfactory treatment methods to be employed and the scale of operation.

In arriving at the following figures the dump was assumed to contain only 300,000 short tons, of which 100,000 tons would be recoverable in a product containing 16 % ash.

Cost of Plant:

Washer--(100T/2 shifts production or 300 T/2 shifts of dump material.		$ 30,000
Excavating equipment, etc.		10,000
	Total	40,000
Water, Power, dockage, etc.		10,000
	Total	50,000

Operating Costs: (on basis of cleaned coal)

Excavating-- @ 10¢ per ton -------	$0.30 per ton
Washing ---- @ 30¢ per ton -------	.90 " "
Trucking---- 9 mi. @ 10¢ a mi. ---	.90 " "
Scow Haulage--Vanc. or Bamberton--	.50 " "
Amortization--$50,000 on 100,000 T.-	.50 " "
Overhead and Misc.-- @ 10 % -----	.30 " "
Total cost per ton cleaned coal produced and delivered.	$ 3.40 per ton.

At present delivered costs of comparable material this would allow a difference of approxiamtely $1.00 to cover royalty and profit. The above cost estimates are considered to be conservative and might be reduced somewhat in practice.

In view of the present labor shortage the following comparison is interesting:

Tons of coal mined per day per employee--

South Wellington, #10 Mine, Nanaimo---	3.23
Wellington Mine ---	2.95
Comox Colliery, #5 Mine ---	1.36
Comox Colliery, #8 Mine ---	2.05

Tons of coal produced per day per employee (estimated)

Cassidy Waste dump ---	10-15

Summary and Conclusions:

(1) The waste coal dump at Cassidy is estimated to contain at least 100,000 tons of recoverable coal with a 16 % ash content. This is based on preliminary examination, old records, and small scale washing tests. Before final estimates can be made the dump should be systematically drilled and larger scale washing tests made on truly representative samples.

(2) Rough estimates demonstrate the possibility of producing washed slack from this source at lower cost delivered to Vancouver or Bamberton than the present selling price for washed smalls produced by Canadian Collieries at Nanaimo. Furthermore the production per man per day would greatly exceed that possible from a mining operation.

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BRITISH COLUMBIA WAR METALS RESEARCH BOARD

THE UNIVERSITY OF BRITISH COLUMBIA

VANCOUVER, CANADA

July 20, 1943

Dean J. N. Finlayson,
Chairman,
B. C. War Metals Research Board,
University of British Columbia,
Vancouver, B. C.

Dear Sir:

PROJECT NO. O.D. 7 -- PROGRESS REPORT NO. 1

COAL WASHERY WASTE FROM CASSIDY, B. C.

Object of Investigation:

To investigate the possibility of recovering marketable coal from washery waste at Cassidy, B. C.

Description of Sample

Two preliminary samples from the dump were taken by officers of the B. C. Department of Mines. These assayed 35.7% and 37.6% ash respectively. The samples were combined for test-work.

Summary and Conclusions:

Results of sink-and-float tests are shown on Figure 1. Recoveries of 40 per cent in a product containing 16 per cent ash, or 30 per cent in a product containing 10 per cent ash, were made.

By a combination of sink-and-float and tabling a recovery of 33 per cent in a product assaying 16 per cent ash was obtained.

Froth flotation failed to yield any concentrate assaying less than 20 per cent ash.

Details of Investigation:

Screen-assay results on the combined head sample are shown

below:

Product	% Weight	% Ash
Plus 4-mesh	20.3	40.7
Minus 4 plus 10-mesh	22.2	40.8
Minus 10 plus 40 mesh	41.0	33.5
Minus 40 plus 90-mesh	10.6	42.8
Minus 90-mesh	5.9	43.0
	100.0%	

Sink-and-float tests were made on each size fraction, using mixtures of carbon tetrachloride and benzol as media. Tests were made at specific gravities of 1.40, 1.50, and 1.60. Results of these tests are tabulated below and illustrated in Figure 1.

Size	Sp. Grav.	Wt. %	Ash %	Cum. Wt.%	Cum Ash %
Plus 4-mesh	minus 1.40	10.2	9.3	10.2	9.3
	plus 1.40 minus 1.50	4.7	18.1	14.9	12.1
	plus 1.50 minus 1.60	4.9	26.9	19.9	15.8
	plus 1.60	80.1	49.9	100.0	40.7
Minus 4 plus 10-mesh	minus 1.40	19.3	9.7	19.3	9.7
	plus 1.40 minus 1.50	7.7	21.5	27.0	13.1
	plus 1.50 minus 1.60	6.1	33.7	33.1	16.9
	plus 1.60	66.8	60.2	100.0	40.8
Minus 10 plus 40-mesh	minus 1.40	31.6	8.6	31.6	8.6
	plus 1.40 minus 1.50	12.7	21.0	44.3	12.2
	minus 1.50 plus 1.60	10.9	32.2	55.2	16.1
	plus 1.60	44.7	57.5	100.0	33.5
Minus 40 plus 90-mesh	minus 1.40	19.5	9.1	19.5	9.1
	plus 1.40 minus 1.50	11.0	22.1	30.5	13.5
	minus 1.50 plus 1.60	9.1	32.9	39.6	17.9
	plus 1.60	60.6	59.8	100.0	42.8
Minus 90-mesh	minus 1.40	14.0	8.1	14.0	8.1
	plus 1.40 minus 1.50	17.5	16.9	31.5	12.9
	plus 1.50 minus 1.60	8.5	28.9	40.0	16.3
	plus 1.60	60.0	58.6	100.0	43.0
Head Sample	minus 1.40	22.3	8.9	22.3	8.9
	plus 1.40 minus 1.50	10.0	20.5	32.3	12.4
	plus 1.50 minus 1.60	8.3	31.2	41.0	16.3
	plus 1.60	59.3	56.4	100.0	38.0

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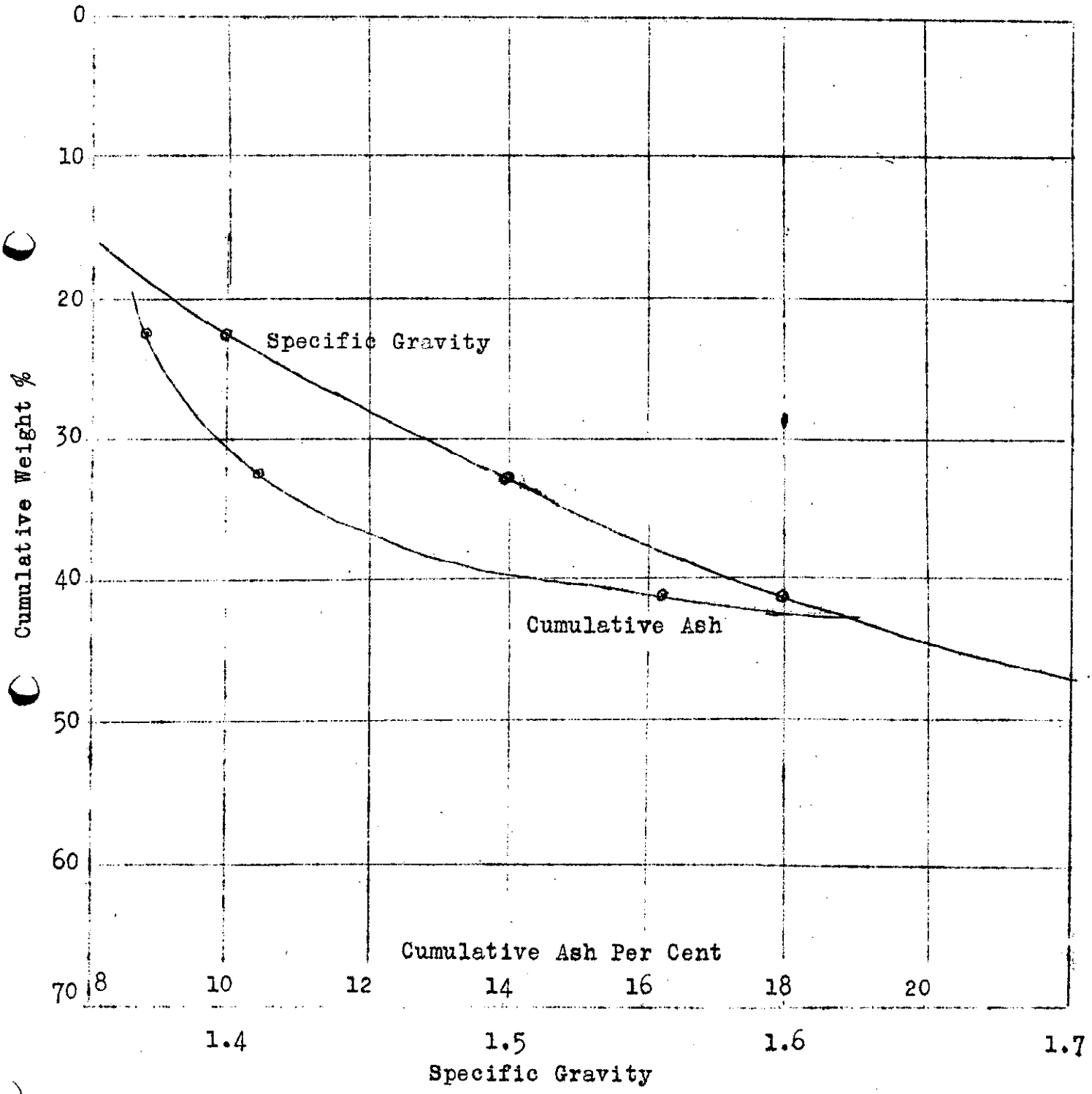
FIGURE 1

Sink-and-Float Calculated Curves for Raw Coal - Cassidy Dump Coal



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Tests were run to determine the effect of re-grinding the plus 10-mesh sink products on overall recovery.

Samples of the plus 4-mesh, and minus 4 plus 10-mesh products were separated into sink-and-float fractions using a medium with a specific gravity of 1.50. The sink fractions were then crushed through 10 mesh by rolls, the minus 100-mesh material rejected and the plus 100 mesh product again subjected to sink-and-float fractionation. Results follow:

Plus 4-mesh -- S.G. 1.50	% Wt. Product	% Total Wt.
Primary float product	10.0	2.2
Re-float product	5.1	1.0
Sink product	78.6	15.8
Minus 100-mesh rejects	6.3	1.2
		20.2

Minus 4 plus 10-mesh -- S.G. 1.50	% Wt.Product	% Total Wt.
Primary float product	27.2	5.9
Re-float product	2.9	0.6
Sink product	75.9	16.7
Minus 100 mesh rejects	4.0	0.9
		22.1

Re-grinding of plus 10-mesh products increased overall recovery by only 1.6 per cent.

A series of froth flotation tests were run on -10-mesh material, using various collectors and frothers. Most satisfactory reagents were combinations of kerosene or stove oil with cresylic acid. Results of a typical test are shown below:

Reagents

Stove oil -- 1.2 lb./T. (added in increments of 0.4#/T. between each concentrate).

Cresylic acid -- 0.4 lb./T.

	% Wt.	% Ash
Concentrate 1	13.7	23.0
Concentrate 2	23.8	21.4
Concentrate 3	16.8	28.4
Tailings	45.6	45.9

In no test was a concentrate obtained assaying less than 20 per cent ash.

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A series of tests were run on sized products, using the laboratory Wilfley table. Results are tabulated below and appear on Figure 2. In each case a series of Products were caught simultaneously in pans arranged along the side of the deck. In the following tables concentrates are numbered consecutively, commencing from the feed end of the table.

Minus 10 plus 20-mesh -- Per cent total weight -- 16.8%.

	Conc. 1	Conc. 2	Conc. 3	Tails
Ash %	8.5	18.1	39.3	61.6
Weight %	20.2	25.4	23.0	31.4

Minus 20 plus 40-mesh -- Per cent total weight -- 24.2%.

	Conc. 1	Conc. 2	Conc. 3	Tails
Ash %	12.0	23.6	48.2	72.6
Weight %	34.6	22.5	35.2	7.7

Minus 40 plus 90-mesh -- Per cent total weight -- 10.5%

	Conc. 1	Conc. 2	Conc. 3	Tails
Ash %	23.7	35.3	61.1	74.3
Weight %	21.5	27.4	40.4	9.7.

Cumulative results of these tests are plotted in Figure 2.

For comparison, a table test was run on minus 10 plus 90-mesh with the following results:

Minus 10 plus 90-mesh

	Conc. 1	Conc. 2	Conc. 3	Tails
Ash %	12.1	21.3	47.6	64.8
Weight %	79.0	26.0	47.0	8.0

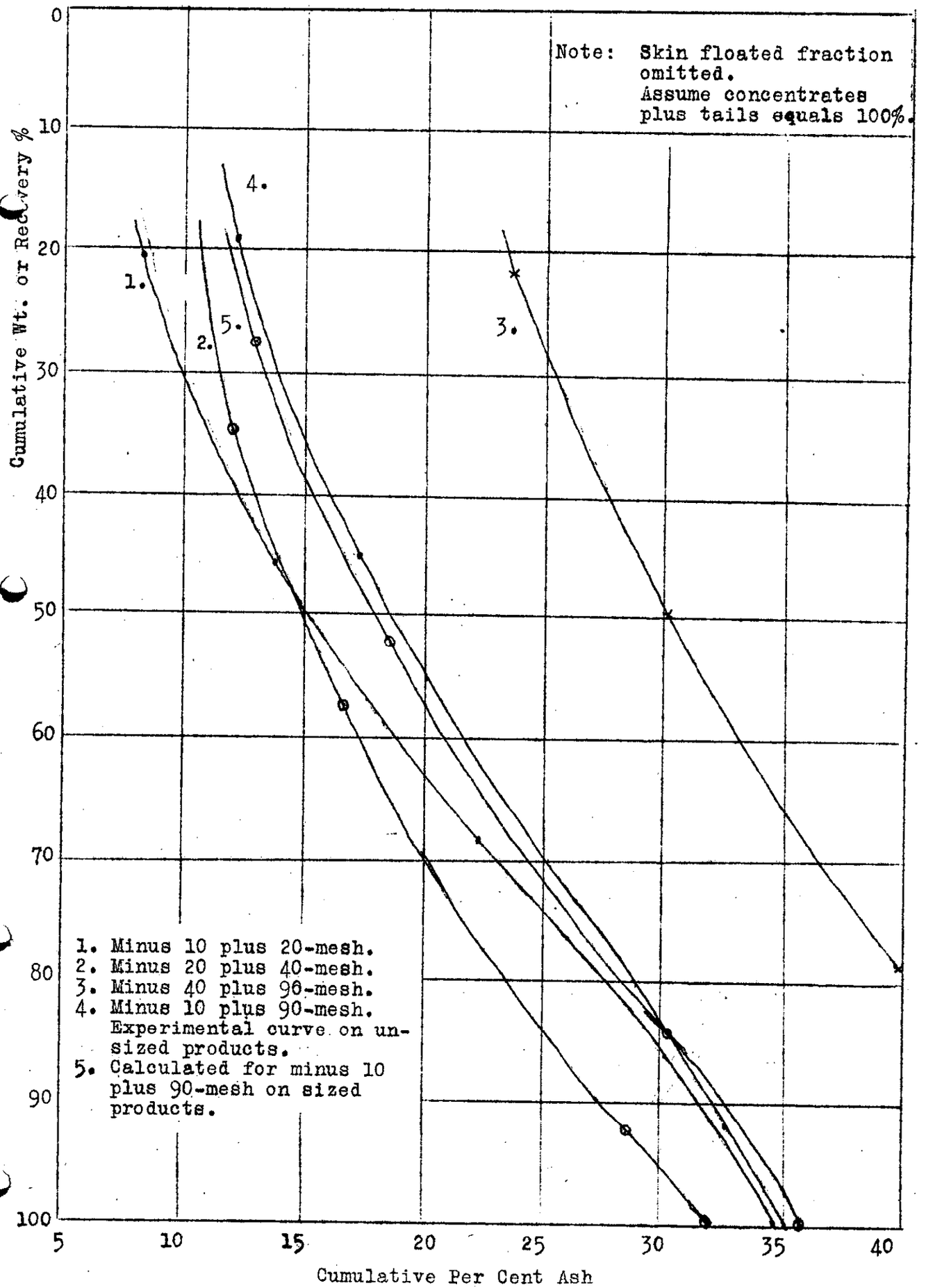
Cumulative results of this test are shown in Figure 2.

Comparing curves 4 and 5 (Fig. 2), it is apparent that tabling of closely sized fractions shows little advantage over tabling the minus 10 plus 90 mesh product directly. A recovery of 36 to 38 per cent in a product assaying 16 per cent ash is indicated.

By a combination of sink-and-float fractionation of the plus

Project No. O.D. 7 FIGURE 2 Progress Report No. 1

Cassidy Dump Coal - Table Tests



10-mesh fraction, and tabling of the minus 10 plus 100-mesh fraction, a total recovery of 32 per cent in a product assaying 16% ash is indicated (see Fig. 3), distributed as follows:

		% Recovery	% Tot. Recovery
Sink-and-float	(plus 10-mesh)	26.0	11.0
Tabling	(minus 10 plus 90-mesh)	40.0	21.0

Results of tests are sufficiently encouraging to merit large scale tests on a composite sample from the dump.

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/MG

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FIGURE 3

Ash-Recovery Curve for Cassidy Dump Coal