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K-FERNIE COAL AREA 67(1)B

OPEN FILE

SURVEY REPORT
ON
FERNIE COAL MINE
B.C., CANADA

MAY, 1968

NITTETSU MINING CO., LTD.
TOYO MENKA KAISHA, LTD.

Part 1

September 23, 1968.

TO: A. FOUKS

FROM: M. HARA

RE ATTACHED REPORT

There are a few corrections which have been written into the Survey Report on the Fernie Coal Mine as follows:

1) Page 6 - second paragraph entitled "The Summary of the First Survey (1965); the second sentence should read, in part: " The coking quality of samples from Seams K-1 and K-5 was not always satisfactory..."

2) Page 76 - the last line should read, in part" "Among other characteristics, Fernie coal has a slightly high P.205 content compared......." P_2O_5

3) Page 77 - line 14 should read "The Seam A coal did not show measurable degree...... (instead of Seam B.)

4) Page 76 - the (Note) half way down the page refers to Seam A coal.

I would like to know what we are going to do about filing the report to the Federal Government.

As I told you over the phone, I wish to see a copy of the letter from the Provincial Government, part of which you read at the last Board meeting. As you will see from my attached memo, I feel it is necessary to amend the figure to a certain extent.

Regarding the Drawings, please note an Explanation of Abbreviations has been placed in the front of this book, as the original was missing.

P_2O_5

Mike

M. Hara

/d
Encls.

cc L. K. Turner

EXPLANATION OF ABBREVIATIONS FOR COLUMNAR SECTION DRAWINGS

GENERAL ITEMS

Abbreviation	Explanation
SL	Above Sea Level.
TH	Thickness.
COL. SEC.	Columnar Section.
S. NO.	Sample Number.
M.	Moisture.
V.M.	Volatile Matter.
(D.A.F.)	Dry ash free basis (moisture & ash free).
FC	Fixed carbon.
FSI	Free swelling index.

ROCK NAMES

C.	Coal
C.SH.	Coaly shale.
B.SH	Black shale
B.C.	Bad coal
D.SH.	Dark shale
S.SH	Sandy shale
SS	Sandstone
D.	Dark
G.	Gray
V.F.	Very fine
C.P.	Coal patch
ALT.	Alternation

INTRODUCTION

This report was made to detail the findings of the geological survey that was conducted in 1967 in accordance with the option contract concluded on September 13, 1967, between Pacific Coal Limited and Nittetsu Mining Co., Ltd. and Toyo Menka Kaisha, Ltd. It also contains the results of the surveys carried out in 1965 and 1966, which have already been reported, and the results of various test made by steel mills in Japan using samples collected during the surveys.

July, 1968

Kakuzo Harada (Geology)

Fumio Nakamura (Land Survey)

Noriyuki Iwamoto (Coal Quality & Coal Preparation)

Nittetsu Mining Co., Ltd.

Soichi Hayashi (Geology)

Toyo Menka Kaisha, Ltd.

CONTENTS

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List of Attached Drawings

List of Drawings in the Separate-Volume Supplement, "DRAWINGS ATTACHED TO FERNIE COAL MINE SURVEY REPORT"

(1) S U M M A R Y

i) It must be pointed out that Seam B is the most suitable object of mining in Fernie Coal properties. In addition to this seam, Seam A, which is located below Seam B, and one or two other seams can prove of exploitability depending on further exploratory works.

ii) The coal quality of Seam B belongs in the medium-volatility group, the volatile content being 19 to 23 percent. Various tests conducted by steel mills of Japan revealed that coal from Seam B is fit for the use as heavy coking coal. The tests proved that it has a good shatter strength, either single or blended with other high-fluidity coals, but its own fluidity is slightly low, which is the common characteristic of Canadian coals, and it has rather high content of phosphor.

iii) There is trend that the volatile matter content decreases as the coal seams including Seam B run from the south-eastern part (the Pipeline Side area) of the properties north-westward (to Morrissey Creek.) The volatile content of Seam A coal on the side of Pipeline is about 20 to 21 percent and the coal is fit for use as heavy coking coal. But on the side of Morrissey Creek, the volatile content of Seam A coal is below 17 or 18 percent level, and the coal therefrom offers a problem in its use.

iv) The coal reserve of Seam B and Seam A (taking Pipeline Side above) is estimated at about 24,000,000 tons and 9,500,000 tons, respectively, in terms of clean coal output. These figures are enough to justify a mining project on the scale of 1,000,000 to 1,500,000 tons per annum.

v) Some remaining questions

(1) Much variation is seen in the ratio of clean to raw coal in Seam B.

(2) Investigation of the change of conditions of each coal seam in its deeper part cannot be deemed enough owing to limited drill holes.

vi) Further investigation needed

(1) How to use the Seam A coal on the Morrissey Creek side.

(2) Further exploration of other seams, especially in the area south of No. 9 Ridge (Pipeline side), where geological features are stable.

(II) L O C A T I O N

Located some 12 miles south-southeast of the town of Fernie (population 3,000) on the southeast corner of British Columbia, Canada, the claim covered by the survey lies in the southermost part of what is called the Crowsnest Coal Basin in the east foothills of the Rocky Mountains which run along the border of the provinces of British Columbia and Alberta. More specifically, it is established in Lat. 49°29' N and Long. 114°55' W, and between 1,100 meters and 2,000 meters above sea level.

The Crowsnest Coal Basin is one of the largest coal mining districts in Canada. It contains Balmer (operated by Crows Nest Industries Ltd.) and Vicary mines (by Coleman Collieries Ltd.).

From this area, nearly 1,000,000 tons of coking coal are being shipped to Japan annually.

(III) ACCESS

Fernie itself once thrived as a coal town. It is still a center of the district. The claim, which is situated about 12 miles south-southeast of Fernie, is easily accessible. Highway No. 3 and the C.P.R. railroad runs through a point 3 to 4 miles from the western extremity of the claim. (It is only 15 to 20 minutes from Fernic by car).

Although there is no direct flight service between Vancouver and Fernie (a distance of 650 miles), regular air service is available between Vancouver and Cranbrook, and between Vancouver and Calgary. Fernie can be reached in one-hour's drive from Cranbrook and three-and-a-half hour's drive from Calgary.

(IV) CLAIMS AND NEIGHBORING AREA

Mining activities in the Crowsnest Coal Basin can be traced back to the latter part of the 18th century. Although small in scale, there were a number of collieries. Therefore, the existence of coal-beds in this basin has been known for some time. Most of the coal fields, however, were owned by Crowsnest Industries Ltd. except for some limited parts of the area, which were possessed by the Government and C.P.R., separately.

Later, P.C.L., interested in the favorably located Government-owned land measuring about 5 x 20 miles (45,000 acres) and extending from Morrissey Creek to Michel Creek, applied for leases of the most promising section in the southwestern part of the land to the Government and B.C. authorities. As a result, P.C.L. won exploration licences for an area of 18,421 acres.

(V) HISTORY

In the eastern part of the Crowsnest area, the coal deposit was first discovered in 1811, and in this claim, the existence of coal seams was also found in 1845.

It has been reported that in the opening year of the 20th century, mining activities were started by Crows Nest Industries Ltd. along Morrissey Creek, and during the 1902 - 1909 period, a total of about 500,000 tons of coal was mined. Even today, there are still the old pits and the ruins of coke ovens.

According to some other records, as many as 240 ovens were in operation and the total output of coke amounted to 300,000 tons. The operation was conducted only within Crow Nest Industries' claims situated on the northern side of Morrissey Creek. In addition, there are fair indications that small-scale exploitation as well as investigations had been carried out in the fields south of Morrissey Creek, which have now passed into the possession of P.C.L. In fact, two or three old pits still remain there at present.

These Morrissey coal mines were shut down after the 1909 bumps and outbursts of gas, and the subsequent depression of the coal industry.

During the past years, geological surveys have been carried out in this area by government institutes and public organs. And their reports have been published, but those are mostly too general in content.

Here are major reports concerning this area.

C.B. Newmarch: Geology of the Crowsnest Coal Basin with special reference to the Fernie Area
Bulletin No. 33, 1953

R.A. Price: Fernie Map-Area East Half Alberta and British Columbia
82 G. E ½ Geological Survey of Canada 1961

The first prospecting in recent years was carried out by P.C.L. in 1964, when ten exploratory drill holes and trenchings were conducted under the direction of Dr. D. D. Campbell in a limited area along Morrissey Creek. As a result, the existence of more than 10 coal seams have been confirmed and among these, several seams were found worthy of further investigation.

Douglas D. Campbell: Morrissey Creek Coal Project
Nov. 1, 1964
Feb. 10, 1965

John T. Boyd & Associates Mining Engineers:

Preliminary Mining Study, Pacific Coal Field

Oct. 1965

Then, in 1965, at the request of P.C.L. and Toyo Menka Kaisha, Ltd., Nittetsu Mining Consultants Co., Ltd., a subsidiary of Nittetsu Mining Co., Ltd. made a survey (the First). Based on the findings on this survey, a joint survey by Nittetsu Mining Co., Ltd. and Toyo Menka Kaisha, Ltd. was conducted in 1966 (the Second) and in 1967 (the third). As a result, the general conditions of coal-beds in the Fernie Coal Mine area were clarified.

The Summary of the First Survey (1965)

The coal samples for drum tests were collected from Seams K-1 and K-5 along Morrissey Creek by tunnelling. The results of the tests conducted by Japanese steel mills revealed that the coking quality of samples from both Seams K-1 and K-5 was not always satisfactory because that carbonization of the coal of these seams was rather excessive.

Coal samples from Seam B, which had been regarded as the most prospective could not be collected at that time. Thereupon, the Second survey was planned and carried out in 1966.

The Summary of the Second Survey (1966)

The investigation was made on Seams B and A by bulldozing to locate these seams. Two tunnels were driven at Seam A for collecting samples for drum tests. In addition, three drill holes were made in the northwestern part of the claim to examine the coal quality by unweathered coal cores and to confirm the continuity of the coal seams with depth. Furthermore, topographical surveys were carried out.

Various tests using the samples showed that although the fluidity of the coal is generally low and the phosphorous content is a little high, Seams B and A have a good coking quality.

As bulk samplings from Seam B for drum tests was prevented due to severe weather conditions and drillings did not supply with enough information of the coal seams in covered area, further exploration was deemed necessary, feasibility study of this mining claim.

(VI) DESCRIPTION OF EXPLORATORY WORKS

(See Drg. No. 1 Road and Trench Map)

1. Exploratory Works done in 1965, 1966 and 1967

They are summarized as follows:

Time		Tunnels for Collecting Coal Samples for Drum Test				Drilling			Road and Cutting by Bulldozers	
Year	Time	Number of Tunnels	Coal Seam	Tunneling (m.)	Amount of collected Samples (Number of Drums)	Number of Drills	Total Length of Drills (m.)	Surveyed Area (ha)	Repair (m.)	Newly Opened (m.)
1965	mid.Sept. mid.Dec.	2	K-1	52.4	27	0	0	0	300	0
			K-5	38.7	28					
1966	late Sept. end of Nov.	*3	A	87.71	40	3	585	640	6,700	11,500
1967	late July early Nov.	7	B	178.06	159	4	1,014	1,400	-	17,800
			A	95.56	105					
Total		12	K-1	52.40	27	7	1,599	2,040	7,000	29,300
			K-5	38.70	28					
			B	178.06	159					
			A	183.27	145					

* The digging of one of the tunnels was called off at 16.61 m. and no sample was collected from it.

2. Details of Tunnels for Collecting Coal Samples for Drum Test

Year	Coal Seam	Tunnel	Location	Height Above Sea Level(m.)	Pitch (°)	Tunnelling (meter) Incline	Level or Raise	Sink	Total Length of Tunnel	Amount of Collected Samples (No. of Drums)
1965	K-1	K-1	Morrissey Creek	1,190.40	0	35.40	17.00	0	52.40	27
	K-5	K-5	Morrissey Creek	1,157.50	0	33.70	5.00	0	38.70	28
	Total	2 tunnels				69.1	22.00	0	91.10	55
1966	A		Pipe line Road	1,925.00	0	16.61	-	-	16.61	0
	A	TA-1	No. 20 Ridge	1,930.00	(-)15	27.74	6.70	-	34.44	20
	A	TA-4	No. 3 Ridge	1,500.00	(-)13	19.32	11.55	5.79	36.66	20
	Total	3 tunnels				63.67	18.25	5.79	87.71	40
1967	B	TB-2	No. 5 Ridge	1,906.80	(-)23	26.50	1.90	1.13	29.53	25
	B	TB-3	No. 7 Ridge	2,012.90	(-)13	34.38 16.55	2.44 3.05	- -	36.82 19.60	24 25
	B	TB-4	No. 11 Ridge	2,009.40	(-)16	25.15	3.96	-	29.11	25
	B	TB-5	No. 14 Ridge	1,945.50	(-)15 ~(-)23	31.00	2.74	-	33.74	25
	B	TB-6	No. 20 Ridge	1,959.20	(-)9 ~(-)18	23.62	5.64	-	29.26	35
	A	TA-2	No. 15 Ridge	1,936.90	(-)18 ~(-)24	30.94	3.05	-	33.99	25
	A	TA-3	No. 5 Ridge	1,873.00	(-)19 ~(-)23	25.60	17.37	-	42.97	40
	A	*TA-4	No. 3 Ridge	1,501.00	(-)13	9.91	8.69		18.60	40
	Total	7 tunnels				223.65	48.84	1.13	273.62	264

* This tunnel which had been dug in 1966 was reopened to collect samples again. The tunnelling work was carried out by a local firm in Fernie in 1965, and by R.F. Fry & Associates (Western) Ltd. of vancouver, B.C., in 1966 and 1967.

3. Drillings

Year	Name of Drills	Work Period	Drilled Depth (m.)	Drilling Work Efficiency: Per day, Work: No. of days	Per day, Work: Efficiency (m.)	Per day, Drilling: No. of days	Per day, Drilling: Efficiency (m.)	Per hour, Work: No. of hours	Per hour, Work: Efficiency (m.)	Per hour, Drilling: No. of hours	Per hour, Drilling: Efficiency (m.)	Per shift, Work: No. of shift	Per shift, Work: Efficiency (m.)	Per shift, Drilling: No. of shift	Per shift, Drilling: Efficiency (m.)	Per crew, Work: No. of crews	Per crew, Work: Efficiency (m.)	Per crew, Drilling: No. of crews	Per crew, Drilling: Efficiency (m.)	Core Recovery: Average for Coal Seams (%)	Core Recovery: Average for Main Coal Seams (%)	Casing
1966	J-1	Sept. 28 - Oct. 8	184.25	11	16.75	6	30.70	174	1.05	120	1.53	16	11.51	10	18.42	36	5.11	20	9,21	95	88	5.18
	J-2	Oct. 9 - Oct. 16	152.40	8	19.05	4	38.10	129	1.16	36	4.23	12	12.70	8	19.05	32	4.76	16	9,52	94	90	7.01
	J 3	Oct. 17 - Oct. 31	248.41	14	17.74	10	24.84	241	1.03	206	1.20	22	11.29	18	13.80	52	4.77	36	6.90	89	80	30.78
	Total	Sept. 28 - Oct. 31	585.06	33	17.73	20	29.25	544	1.07	362	1.61	50	11.70	36	16.25	120	4.87	72	8.11	93		
1967	J-4	July 31 - Aug. 31	419.09	31	13.51	23	18.21	481	0.87	343	1.21	50	8.38	35	11.69	109	3.84	76	5.51		B 95 A 89	9.14
	J-5	Sept. 14 - Sept. 30	320.95	15	21.40	8	40.12	231	1.38	146	2.19	25	12.80	16	20.06	62	5.17	39	8.21	-	B 51 A 82	7.62
	J-6	Sept. 22 - Oct. 14	177.70	15	11.84	11	16.16	207	0.85	102	1.74	26	6.83	17	10.45	67	2.65	47	3.78	-	B 90 A 86	4.57
	J-7	Oct. 1 - Oct. 12	96.62	11	8.78	6	16.10	165	0.58	85	1.13	18	5.37	9	19.73	44	2.19	18	5.37	-	failed	92.66
	Total	July 31 - Oct. 14	1,014.36	72	14.08	48	21.13	1,084	0.93	676	1.50	119	8.53	77	93.17	282	3.59	180	5.63			

The drilling work was conducted by Canadian Longyear of Vancouver, B.C. in 1966 and by Boyles Industries in 1967.

4. Topographical Survey

Control point:	The B.C. Forest Service Road (BM elev. = 3,275.23 ft.) which is near the juncture of Morrissey Creek and Lodgepole road was used.
Period of survey:	Sept. 17 to Nov. 1 in 1966 (actual work, 40 days) July 21 to Nov. 6 in 1967 (actual work, 95 days)
Surveyed area:	A tract three kilometers wide and nine kilometers long extending from Morrissey Creek to the east boundary of the claims.
Survey method:	Traverse stations were established along the line connecting bench mark, Morrissey Creek and Flathead Ridge. Stadia stations were set up at each ridge from the traverse station, then, all stations were connected by surveys.
Employed personnel:	Surveyor and two helpers.

(VII) TOPOGRAPHY

(See Drg. 2 General Map of Fernie Coal Mine)

Located in the central part of the Rocky Mountains, the claim is a hilly area, rising to 1,100 meters along Morrissey Creek and 2,300 meters at Flathead Ridge.

A crest line, which almost runs in parallel with the strike of the strata, divides the claim into two slopes. Its west slope, with sandstone cliffs in places, form a characteristically steep terrain. The east side of the crest line, called Flathead, is a gently rising spacious plain generally conforming to the dip of the strata.

A number of large and small streams flowing through the hilly area form waterfalls at various places in the claim. Morrissey Creek, which is the largest of the streams and cuts the Flathead crest, has a considerably wide flat terrain along it. This flat terrain, when this claim is developed in the future, will play a very important role by providing space for mining operations and washery.

Trees abound along Morrissey Creek and other streams, particularly in the western half of the claim, but are scarce in the eastern half due partly to past forest fires and also to the fact that the crest line is too high for trees. Rock exposes pretty well in the area. Coal outcrops are relatively good.

(VIII) GEOLOGY

(See Drg. 2 General Map of Fernie Coal Mine)

1. General

Crowsnest Coal Basin consist of Jurassic and Createaceous sedimentary rocks containing coal beds,i.e., from the lower upward; Fernic (mainly shales), Kootenay (coal-bearing) and Blaimore (mainly conglomerates) formations. No unconformity is observed.

This claim is situated in the south wing of Crowsnest Coal basin where these formations have NW-SE trend and dip north at 10 - 20°.

2. Formation

(1) Fernie Formation

This formation is composed of so-called Fernie shales of which dark gray shales are the principal element. It is a marine sediment with partially dark fine-grained calcarious sandstones, sandy shales and silstones.

This formation can roughly be divided into three parts; upper part is black shales, middle part grey shales,and lower part black shales with a dark gray or brownish gray tint. The upper part of the formation change gradually to Kootenay Formation.

This formation and lower parts of Kootenay formation are considerably folded and sporadically small-scale synclinal and other overlaps are observed.

(2) Kootenay Formation

This is the coal bearing formation of Crowsnest Coal Basin. It mainly consists of alternations of sandstones and shales containing a number of thick and thin coal seams with some slightly prominent conglomeratic beds.

The formation is 600 to 700 meters thick, with ELK conglomerate about 500 meters thick at the top.

The lowest part of the formation consists of dark gray medium-coarse grained sandstones, called Kootenay sandstones, which is 40 to 50 meters thick and indicates the lowest limits of coal seam (especially K-1 seam).

This sandstone beds form sharp cliffs in the west slope which contribute to the peculiar feature of the land.

Cross-bed carbonaceous matter, and pieces of flora are observed in places.

Date of the flora is estimated from the Barremian period to the late Neocomian period, although an exact determination is difficult.

The lower half of the formation together with Fernic formation are severely folded. It can be observed in the north western part of the claim. As this folding is likely to have promoted devolatilization of the coal and reducing its fluidity, lower coal seams are affected hard to be poor at coking quality.

However, there is little disturbance in the middle and upper coal seams including Seam B, and at the same time, the quality of coal is getting improved.

The pitch of the formation is about 25 degrees in the lower parts and about 10 degrees in upper parts.

The following chart shows the pitch of drill cores.

J-1		J-2		J-3		J-4		J-5		J-6		J-7	
depth (m.)	pitch (angle)	depth (m.)	pitch (angle)	depth (m.)	pitch (angle)	depth (m.)	pitch (angle)	depth (m.)	pitch (angle)	depth (m.)	pitch (angle)	depth (m.)	pitch (angle)
5	24	15	26	34	27	93	12	71	10	12	19	25	21
65	30	73	22	104	28	100	14	131	8	23	16	46	24
75	26	141	27	105	25	192	12			86	24	50	20
				141	21	220	12			92	16	64	18
						287	10			121	26	67	18
						294	13			156	18		
						328	13			177	20		
						337	17						
						349	14						
						351	9						
						383	9						

(3) Blaimore Formation

This formation exists extensively and thickly in the plateau east of the hills more than 2,000 meters high which occupy the center of this claim.

It is mainly composed of quartz rich sandstones and multi-colored shales. The lower parts consist of pebble conglomerates which are finer than Elk conglomerates. The formation is said to belong to the early Creataceous period.

3. Geological structure

Being located in the foothill belt of the Rocky Mountains, this coalfield is considerably complex in its geological structure, especially Fernie Formation has a severely folded structure.

However, relatively little effects of faults and foldings are in evidence in Kootenay and Blaimore formations in this area. These formations run more or less in parallel with the Float-head crest, NW-SE strike, dipping 20^{O} to 10^{o} degrees to NW.

Consequently, the coal seams are generally stable except the lower ones for a distance of 8,500 meters between Morrissey Creek and Pipeline Road, and the area is suitable for mining.

(IX) COAL SEAMS

(See Drg. 4 Map Showing Coal Seams)

The coal seams in Kootenay Formation were named by Dr. D. D. Campbell Seam K-1 --- K-15 from the bottom up as a result of drillings conducted under the direction of him in 1964.

But the report written by him had not enough description on the basis of the surveys are on coal seams particularly on coal quality, because information available at that time was very poor. This made it difficult to compile the results of subsequent drillings.

Under the circumstances, we sank drill J-3 in the vicinity of Campbell's drill B-1. Correlating both core logs, we decided to re-name the coal seams above Seam K-5 in alphabetical order from the bottom up, leaving the names of Seam K-1 --- K-5 as they are.

Seam K-11, which Dr. Campbell recommended as the most promising seam, was renamed Seam B under the new system. Seam B presumably corresponds to Seams K-9 or K-10 under the old system, but we cannot say this for certain because of the incomplete data provided by him.

Survey results to date point out that Seams B and A are most suitable seams for mining in this claim. Some description on these seams are given on the following pages.

The drillings carried out in 1966 and 1967 did not drill down through the coal seams below Seams B and A, and then, they did not furnish data concerning lower coal seams. In addition, as the trenching surveys were concentrated mostly on Seams B and A enough information of the lower coal seams are unavailable at this moment. However, there is a possibility that some parts of Seam K-1, K-2 and K-3 coal seams could be mined.

1. Seam B

Drg.	5	Columnar Section of Coal Seam B at Outcrop; No. 1
Drg.	6	Columnar Section of Coal Seam B at Outcrop; No. 2
Drg.	7	Columnar Section of Coal Seam B (Upper Part) at Outcrop; No. 1
Drg.	8	Columnar Section of Coal Seam B (Upper Part) at Outcrop; No. 2
Drg.	9	Lateral Variation of Seam B
Drg.	10	Columnar Sections of Drill Core of Seam B

This seam is believed to be the most promising coal seam. It can be traced for about 8.5 kilometers from Morrissey Creek at the western end of the claim to the eastern end across the Pipeline.

The seam have been exposed successively by bulldozers, and it was found out that the seam shows considerable changes in the thickness and bones and partings, and that as the seam runs to southeast, it begins to split at No. 11 Ridge and completely disintegrates into the upper and lower parts at No. 16 Ridge (Pipeline), and only the upper part is exploitable east of the ridge.

Along the exposed Seam B, five spots were selected for bulk sampling at as intervals equal as much as possible. Tunnels were dug at each spots 30 to 50 meters in from the outcrops. Bulk samples free from weathering were collected at the end.

Six drills hit the seam and observations and analyses were made on the cores collected.

As compared with the outcrops, drill cores indicate that Seam B in covered area is more varied in the thickness, and the bones and partings.

Although we have not sufficiently grasped their conditions, it can be inferred from the observation of the explosed seam at the surface that the coal at the level of 1,200 meters above s sea level --- expected main haulage level --- is still fit for mining. But the inference is not backed up by sufficient evidence. Further studies are needed on proving this up.

Seam B Measurement

Location	Index	Total Thickness (m.)		Minable Thickness (m.)	
		Thickness of working coal face	Thickness of part of coal out of the left column	Thickness of working coal face	Thickness of part of coal out of the left column
No. 1 Ridge	3,840	3.78	3.00	2.08	1.83
No. 2 Ridge	3,709	3.12	2.60	2.68	2.43
No. 3 Ridge	435	3.29	2.50	2.54	2.27
No. 3 - 4 Ridge	4,415	3.27	2.59	2.39	2.27
No. 3 - 4 Ridge	4,411	1.16	0.36	0.78	0.36
No. 3 - 4 Ridge	4,408	3.90(+)	3.55(+)	2.45	2.35
No. 4 Ridge	4,405	3.73	3.33	2.89	2.55
No. 5 Ridge	1,189	3.18	2.75	2.80	2.55
No. 5 - 6 Ridge	TB - 2	3.03	2.85	3.03	2.85
No. 6 Ridge	701	3.68	3.14	2.80	2.60
No. 6 - 7 Ridge	704	5.25	4.79	3.24	3.08
No. 6 - 7 Ridge	707	1.39	1.04	1.39	1.04
No. 6 - 7 Ridge	709	1.47	1.17	1.47	1.17
No. 6 - 7 Ridge	710	2.57 (3.38)	2.16 (2.45)	1.84	1.61
No. 6 - 7 Ridge	712	5.86	4.94	2.82	2.65
No. 6 - 7 Ridge	714	4.91	4.33	2.60	2.48
No. 7 Ridge	TB - 3	4.57	3.69	2.92	2.53
No. 7 Ridge	343	4.45	3.65	2.89	2.62
No. 8 - 9 Ridge	4,365	3.31	3.03	2.98	2.86
No. 10 Ridge	270	4.12	3.78	3.16	3.13
No. 11 Ridge	TB - 4	4.67	4.54	2.78	2.78
No. 11 Ridge	544	3.49	3.12	2.76	2.76
No. 12 Ridge	560	1.80	1.63	1.80	1.63
No. 13 Ridge	523	4.24	3.92	3.17	3.17
No. 14 Ridge	TB - 5	4.25	3.52	2.79	2.79
No. 14 - 15 Ridge	517	2.31(+)	2.31(+)	2.31(+)	2.31(+)
No. 15 Ridge	500	2.59	2.42	2.59	2.42
No. 16 Ridge	34	2.27	1.74	2.27	1.74

Location	Index	Total Thickness (m.)		Minable Thickness (m.)	
		Thickness of working coal face	Thickness of part of coal out of the left column	Thickness of working coal face	Thickness of part of coal out of the left column
No. 17 Ridge	700	2.66	1.51	1.12	1.06

Seam B (Upper) Measurement

Location	Index	Total Thickness (m.)		Minable Thickness (m.)	
		Thickness of working coal face	Thickness of part of coal out of the left column	Thickness of working coal face	Thickness of part of coal out of the left column
No. 11 Ridge	544	2.43	1.15	1.53	0.73
No. 11 - 12 Ridge	547	2.71	1.72	1.80	1.21
No. 11 - 12 Ridge	554	2.38	1.72	1.53	1.18
No. 11 - 12 Ridge	535	2.51	1.89	1.99	1.55
No. 12 - 13 Ridge	527	2.02	1.60	1.77	1.60
No. 12 - 13 Ridge	526	1.93	1.73	1.93	1.73
No. 13 Ridge	522	1.75	1.60	1.60	1.60
No. 14 Ridge	519	1.66	1.47	1.55	1.47
No. 14 Ridge	505	1.25	1.22	1.25	1.22
No. 14 - 15 Ridge	503	1.26	1.03	1.26	1.03
No. 14 - 15 Ridge	502	1.78	1.69	1.65	1.65
No. 14 - 15 Ridge	501	1.43	1.34	1.43	1.34
No. 14 - 15 Ridge	501	1.48	1.38	1.48	1.38
No. 15 Ridge	500	1.36	1.26	1.36	1.26
No. 15 Ridge	33	1.57	1.50	1.57	1.50
No. 17 Ridge	708	1.73	1.68	1.73	1.68
No. 18 Ridge	705	2.39	2.02	1.56	1.46
No. 18 Ridge	704	2.20	2.18	2.20	2.18
No. 19 Ridge	702	3.96	3.96	3.96	3.96
Pipeline Road	153	3.98	3.40	3.30	3.30
No. 20 Ridge	TB - 6	4.30	3.68	3.03	3.03
No. 21 Ridge	714	3.33	2.98	3.03	2.93

Drill Cores	Index	Total Thickness (m.)		Minable Thickness (m.)	
		Thickness of working coal face	Thickness of part of coal out of the left column	Thickness of working coal face	Thickness of part of coal out of the left column
	J - 3	7.32	3.97	3.96	3.33
	J - 2	3.64	2.28	2.44	1.79
	J - 1	5.92	5.14	4.57	4.37
	J - 6	4.91	3.09	2.70	1.99
	J - 4	5.58	4.48	2.87	2.87
	J - 5	3.85(+)	2.88(+)	2.39(+)	2.29(+)

2. Seam A

Located 25 to 45 meters stratigraphically lower than Seam B.

On the basis of the observation on the seam exposed by bulldozers, it can be divided into three parts: western section -- Morrissey Creek to No. 8 Ridge (4,500 meters in length); central section -- No. 8 Ridge to No. 16 Ridge (2,000 meters); and eastern section -- No. 16 Ridge (Pipe Line) to the east end of the claim (2,000 meters).

In the western and eastern sections,the seam has enough thickness for mining. But in the central section, it splits, and becomes too thin for mining.

As regards to the covered area, further exploration is required as is the case with Seam B.

Seam A Measurement

Location		Index	Total Thickness (m.) Thickness of working coal face	Thickness of part of coal out of the left column	Minable Thickness(m.) Thickness of working coal face	Thickness of part of coal out of the left column	Remarks
West	No. 3 Ridge	TA 4	13.47(+) 6.81(+)	9.91(+) 6.68(+)	8.16(+) 3.80(+)	7.69(+) 3.75(+)	
	No. 4 Ridge	3130	3.00(+)	3.00(+)	3.00(+)	3.00(+)	
	No. 5 Ridge	TA 3	8.35(+)	8.09(+)	3.78(+)	3.75(+)	Top of the seam is not confirmed
	No. 6 - 7 Ridge	4240	6.31(+)	6.18(+)	3.87	3.87	"
	No. 6 - 7 Ridge	4238	3.73(+)	3.48(+)	2.50(+)	2.50(+)	"
	No. 7 Ridge	4381	7.10(+)	6.56(+)	5.75	5.65	Bottom of the seam is not confirmed
	No. 8 - 9 Ridge	4362	3.53	3.10	2.54	2.28	
Central	No. 8 Ridge - No. 16 Ridge (Pipeline)	Since coal thickness is less than 1.6 meters with plenty of partings and the seam changes sporadically into coaly shale. It is hardly worth mining.					
East		TA 2	4.30	2.62	-	-	
	No. 16 Ridge (Pipeline)	36	3.10	3.02	3.10	3.02	
	No. 17 Ridge	600	2.88	2.84	2.80	2.80	
	No. 18 Ridge	615	2.60	2.47	2.35	2.35	
	No. 19 Ridge	621	4.18	3.94	3.89	3.78	
	Pipeline Road	150	4.30	4.22	4.22	4.22	
	No. 20 Ridge	TA 1	4.17	4.17	4.17	4.17	
	No. 20 Ridge	623'	5.74	5.52	4.36	4.36	
	No. 21 Ridge	627'	7.72	7.53	6.67	6.67	
Drill cores		J - 3	17.77	17.11	17.77	17.11	
		J - 6	2.68	2.68	2.68	2.68	
		J - 4(t)	2.78	1.71	1.63	1.34	
		J - 4(b)	2.28	1.24	2.28	1.24	
		J - 5	7.35(+)	6.30(+)	t 2.23 b 2.94(+)	2.18 2.94(+)	

3. Seam A 1
(See Drg. 18)

This seam is a branch of Seam A and located a little lower horizon. It measures 1.1 to 1.5 meters in total thickness, with the coal thickness 0.9 to 1.24 meters in the area from Ridge No. 14 to No. 17.

As it runs eastward, the coal thickness increases and it moves gradually away from Seam A to be located eventually about 10 meters below at the east end of the claim.

However, since the ash content in the raw coal is generally high (about 25 percent) and a low yield is anticipated, the value of the seam for mining is considered to be little.

Location	Index	Total Thickness (m.)		Minable Thickness (m.)	
		Thickness of working coal face	Thickness of part of coal out of the left column	Thickness of working coal face	Thickness of part of coal out of the left column
No. 17 Ridge	600	2.47	1.90	2.24	1.80
No. 18 Ridge	614	2.34	2.27	2.34	2.27
No. 19 Ridge	620 - 621	2.78	2.18	2.00	1.78
Pipeline Road	150	3.05	3.12	1.93	1.57
No. 21 Ridge	4,291	2.88	1.94	2.88	1.94

4. Seam A 2

This seam is another branch and located about eight to more than ten meters below Seam A 1. Toward the east from the No. 17 Ridge, it shows a fast increase in coal thickness and getting stable.

Having a low ash content, this seam can be mined.

Location	Index	Total Thickness (m.)		Minable Thickness (m.)	
		Thickness of working coal face	Thickness of part of coal out of the left column	Thickness of working coal face	Thickness of part of coal out of the left column
No. 17 Ridge	601	1.82	1.79	1.82	1.79
No. 18 Ridge	607	2.26	2.26	2.26	2.26
No. 18 - 19 Ridge	612	2.75	2.72	2.75	2.72
No. 19 Ridge	620	2.55	2.45	2.55	2.45
Pipeline Road	148	3.36	3.23	3.22	3.15
No. 21 Ridge	4,294	3.16	3.11	3.16	3.11

5. Seam K-5

(See Drg.25 Columnar Sections of Coal Seam K-1, K-5 in Tunnel)

	Location	Total Thickness (m.)		Minable Thickness (m.)	
		Thickness of working coal face	Thickness of part of coal out of the left column	Thickness of working coal face	Thickness of part of coal out of the left column
Drill core	Morrisey Creek, DH·A10	5.18	2.43		
Tunnel	Morrisey Creek, DH·A5	5.79	0.76		
	Morrisey Creek, K-5 tunnel	5.36	4.34	(u) 2.93 (d) 1.53	2.51 1.51

Few information is available on the lower coal seams such as K-5 and K-1. In 1965, a tunnel was dug on this seam and the bulk sample for drum test was collected. It was found that the coal is divided into two parts with about 0.9 meters thick parting located about one-third of the thickness from the bottom. Drills DHA5 and DHA10 made in 1964 fit this seam.

6. Seam K-1

(See Drg. 25 Columnar Sections of Coal Seam K-1, K-5 in Tunnel)

	Location	Total Thickness (m.)		Minable Thickness (m.)	
		Thickness of working coal face	Thickness of part of coal out of the left column	Thickness of working coal face	Thickness of part of coal out of the left column
Drill Core	Morrissey Creek, DHA·8	16.58	13.11		
	Morrissey Creek, DHA·1	11.59	11.59		
Index	Morrissey Creek, K-1 tunnel	15.64	9.75	*3.01	2.65
	No. 2 Ridge	13.29(+)	7.85(+)		
	No. 16 Ridge (Pipeline)	3.06	2.71		
	Pipeline Road	4.14	3.70		

* Exploitable thickness at the lowest level

A tunnel was put on this seam in 1965 for taking bulk samples. In cross-cuttings, it was found that this seam contains many coaly shales, shales and other bones ranging from 0.2 meters to several centimeters in thickness.

The total thickness of the seam at the tunnel site is about 15 meters and drops sharply to 3.06 meters at the Pipeline about 7,000 meters southeast of Morrissey Creek. Not much can be known about the lateral change of the seam between these two points, because of the poor outcrops. But it is surmised that the seam keeps enough thickness for mining in the whole area.

(note)

Seam No. 10 in the Balmer Colliery about 30 miles north located as the same stratigraphical horizon as this seam. In Balmer, only the top of it is being mined.

7. Other Seams
(See Drg. 20 Columnar Section of Other Coal Seams (No. 3, 5, 7 Ridge), Drg. 21 Columnar Section of Other Coal Seams (No. 9, 11, 16 Ridge), Drg. 22 Columnar Drg.21 of Other Coal Seams (No. 20 Ridge, Pipeline Road)

Besides the above-mentioned seams, it is hoped that two or three more seams will be found suitable for mining, even in limited areas. But so far available information of them is very poor, and further prospecting is needed, especially in the Pipe Line area.

(XI) COAL RESERVE

Because of the extensive size of lease, exploration in depth through drilling has not been sufficient to obtain satisfactory data on the conditions of these seams in deeper parts.

However, as for outcrops, the findings thus far made available by means of trenching and tunnelling operations have disclosed the general conditions.

To give an estimate of coal reserve, the calculation is made on the basis of the assumptions listed below:

Reference:

Bases for Coal Reserve Calculations (See Drg. 26)

1. Seams Included in Calculation

As described in (IX) Coal Seams, Seams B, A, A_1, and A_2 are considered as suitable coal seams for mining and included in the calculations.

2. Area Excluded from Calculation

Part of seams which lie under those covered for the calculations was excluded. (For example, Morrissey Creek side)

3. Sections

With the conditions of the outcrops taken into account, a distance of about 8,500 meters along the strike of the seams included in the calculation was divided into a number of sections to make them calculation unit areas.

Seam B ---------- 8 sections

Seam A ---------- 5 sections

(In addition, A_2 ----- 2 sections; A_1 ----- 3 sections)

4. Excluded Sections

A zone of 100 meters wide from the outcrops is excluded from the items for calculations.

The coals lower than 1,200 meters above sea level --- proposed main haulage level --- is excluded.

For the calculation of the minable reserve, parts of the coal seams where it is disadvantages to mine, judging from quality and yield are excluded.

5. Calculation Formulas

- Theoretical Reserve: Total Area x Total Coal Thickness* x Specific Gravity

* (Total Coal Thickness: Total Thickness of part of coal out of thickness of working coal face)

- Theoretically Mineable Reserve: Total Area x Mineable coal thickness x Specific gravity

- Mineable reserve:	Theoretically Mineable Reserve x Recovery
- Recovered Clean Coal:	Mineable Reserve x Yield (%)

6. Calculation Bases

(1) Pitch

Judging from the cross section of the seams, the following pitches are adopted for seams B and A.

$18^{0}30'$ for the area from No. 8 ridge westward

$14^{0}30'$ for the area from No. 8 ridge eastward

(2) Mineable Coal Thickness

There are sections in which it is disadvantageous to mine because of partings, and some of these sections are excluded, taking coal quality and yield into account in addition.

In the case where there are no outcrop measurements in the calculation sub-area, the coal thickness of the nearest outcrop is corrected taking lateral variation of the seam into consideration and adopted as the coal thickness of outcrop in the sub-area.

The thickness of the coal at the 1,200-meter-level is estimated at 70 percent of the thickness of the outcrop, and the mean value is taken as the average coal thickness in the sub-area.

(3) Recovery

The surveys have so far revealed almost no faults that would seriously affect mining operations. However, for the sake of safety, recovery rate was held down to 80 percent, taking into account the possible existence of unfavorable faults and coal quality.

In addition, the recovery rate would fall off to 80 percent, when reserve coal along the pits and faults were allowed. Then, recovery is estimated at 64 percent --- (80% x 80%).

(4) Yield

The yield was estimated at 85 percent by allowing for the socalled intermediate coal that cannot be made into clean coal, and loss at mining operations, transportation and coal preparation process.

(Note)

It is not necessary to add coal preparation yield independently because the coal thickness was taken as the thickness factor in the calculation of coal reserve and loss at coal preparation was taken into account in calculation yield.

7. Theoretical Reserve

Name of Seam	Sub-Area (No. of Outcrop)	Average Coal Thickness (m)	Total Area (m^2)	Specific Gravity	Theretical Reserves (M/ton)
B	3840-4415	2.26	633,219	1.30	1,860,000
	4415-4408	1.83	161,323	1.30	380,000
	4408-704	2.89	2,506,677	1.30	9,410,000
	704-710	2.00	850,110	1.30	2,600,000
	710-270	3.13	2,968,812	1.30	12,080,000
	270-34	2.52	6,157,375	1.30	20,170,000
	Sub-total				46,500,000
B (Upper)	544-33	1.25	4,898,631	1.30	7,940,000
	33-704	1.47	1,578,374	1.30	3,000,000
	704-border	2.75	2,956,004	1.30	10,560,000
	Sub-total				21,500,000
Total of B					68,000,000
A	TA4-4238	4.65	3,912,667	1.30	23,620,000
	4238-4362	3.74	1,660,954	1.30	8,080,000
	4362-36	1.08	6,637,570	1.30	9,300,000
	36-615	2.35	2,042,404	1.30	6,260,000
	615-4294	3.95	2,042,404	1.30	14,940,000
	Sub-total				62,200,000
A_1	600-36	0.86	1,587,825	1.30	1,780,000
	36-614	1.44	2,042,404	1.30	3,820,000
	614-border	1.80	2,906,942	1.30	6,800,000
	Sub-total				12,400,000
A_2	601-607	1.71	1,041,886	1.30	2,340,000
	607-border	2.34	2,906,942	1.30	8,860,000
	Sub-total				11,200,000
Group of B + A					153,800,000

8. Theoretically Mineable Reserve, Mineable Reserve, Recovered Clean Coal

Seam	Sub-Area (No. of Outcrop)	Average Thickness of working face at 1,200 m above sea level	Average Thickness, part of Coal out of the left Column (m)	Total Area (m^2)	Specific Gravity	Theoretically Mineable Reserves (M/ton)	Recovery (%)	Mineable Reserves (M/ton)	Yield (%)	Recovered Clean Coal (M/ton)
B	3840-4415	2.34	1.43	633,219	1.3	1,300,000	64	800,000	85	700,000
	4408-704	2.65	2.26	2,506,677	1.3	7,500,000	64	4,700,000	85	4,000,000
	710-270	3.05	2.46	2,968,812	1.3	9,700,000	64	6,200,000	85	5,300,000
	270-34	2.26	2.13	6,157,375	1.3	17,100,000	64	11,000,000	85	9,400,000
	Sub-total				1.3	35,600,000	64	22,700,000	85	19,400,000
B(Upper)	704-border	2.48	2.11	2,956,004	1.3	8,400,000	64	5,300,000	85	4,600,000
Total of B					1.3	44,000,000	64	28,000,000	85	24,000,000
A	36-615	2.00	2.31	2,042,404	1.3	6,100,000	64	4,300,000	85	3,300,000
	615-4294	3.36	3.00	2,906,942	1.3	11,400,000	64	7,700,000	85	6,200,000
	Sub-total				1.3	17,500,000	64	12,000,000	85	9,500,000
A_2	607-border	1.96	2.32	2,906,942	1.3	8,800,000	64	5,600,000	85	4,800,000
Total of A group					1.3	26,300,000	64	17,600,000	85	14,300,000
Total ($B+A+A_2$)					1.3	70,300,000	64	45,600,000	85	38,300,000

9. Calculation Table of Theoretically Mineable Reserves

Seam	Sub-Area (No. of Outcrop)	Average Thickness of working face at 1,200 m above sea level	Average Thickness, part of Coal out of the left Column (m)	Total Area (m^2)	Specific Gravity	Theoretically Mineable Reserves (M/ton)	Recovery (%)	Mineable Reserves (M/ton)	Yield (%)	Recovered Clean Coal (M/ton)
B	3840-4415	2.34	1.43	633,219	1.3	1,300,000	64	800,000	85	700,000
	4415-4408	1.93	1.41	161,323	excluded; there are some sections at the outcrop with 1.16m & 0.36m of seam and coal thickness					
	4408-704	2.65	2.26	2,536,677	1.3	7,500,000	64	4,700,000	85	4,000,000
	704-710	2.00	1.46	850,110	excluded; there are some sections at the outcrop with 1.39 - 1.47m & 1.04 - 1.7m seam and coal thickness					
	710-270	3.05	2.46	2,965,812	1.3	9,700,000	64	6,200,000	85	5,300,000
	270-34	2.26	2.13	6,157,375	1.3	17,100,000	64	11,000,000	85	9,400,000
	Sub-total				1.3	35,600,000	64	22,700,000	85	19,400,000
B (Upper)	544-33	1.33	1.15	4,898,631	excluded; at 1,200m level there are many sections with less than 1.5m seam thickness. 1.5m is an average mineable seam thickness.					
	33-704	1.56	1.30	1,578,374						
	704-border	2.48	2.11	2,956,004	1.3	8,400,000	64	5,300,000	85	4,600,000
	Sub-total				1.3	8,400,000	64	5,300,000	85	4,600,000
Total of B					1.3	44,000,000	64	28,000,000	85	24,000,000
A	TA-4-4238	3.94	2.86	3,912,667	excluded; poor quality (V.M., Fluidity) in spite of enough thickness.					
	4238-4362	3.72	2.94	1,660,954						
	4362-36	1.28	0.96	6,637,570	excluded; the same as No. 544-33 & 33-704 of outcrop.					
	36-615	2.00	2.31	2,042,404	1.3	6,100,000	64	4,300,000	85	3,300,000
	615-4294	3.36	3.00	2,906,942	1.3	11,400,000	64	7,700,000	85	6,200,000
	Total				1.3	17,500,000	64	12,000,000	85	9,500,000
A_2	601-607	1.42	1.71	1,041,886	excluded; the same above and insufficient data.					
	607-border	1.96	2.32	2,906,942	1.3	8,800,000	64	5,600,000	85	4,800,000
	Total				1.3	8,800,000	64	5,600,000	85	4,800,000
Total of A broup					1.3	26,300,000	64	17,600,000	85	14,300,000
Total ($B+A+A_2$)					1.3	70,300,000	64	45,600,000	85	38,300,000

(Note)

The part where more than 70% of seam thickness is less than 1.50 m at outcrop on 1,200m above sea level, proposed main haulage level is in general excluded from the items for calculations, taking into account mining equipments and mining method.

Supplement:

YIELD

Studying from various angles the results of tests on samples from tunnels to know the actual yield of Fernie coal, we made the following conjectures.

We carried out studies only on Seam B, which is considered to be good for exploitation, postponing until later studies on Seam A since there is a question about coal in the Morrissey Creek sections and samples from drills were collected at only a few places in the Pipeline sections.

Reference:

Places where samples were collected ---------- Drg. 2

Coal pillars where samples were collected ----- Drg. 23

Washability curves according to places -------- P. 34

1. Yield as Considered from Washability Curve

P. 34 shows the washability curves of samples from various tunnels. The theoretical yield, as calculated on the basis of the washability curves, is shown in Table 1.

Table 1

Coal seam	Thickness, working coal face (m.)	Thickness, part of coal out of left column(m.)	Ash of raw coal %	Theoretical yield %
TB - 2	3.01	2.90	17.8	84
TB - 3	2.51	2.24	27.4	64
TB-4 (Upper)	2.71	1.80	18.7	63
TB-4 (Lower)	2.50	2.50	17.9	61
TB-5	2.79	2.79	21.1	54
TB-6 (Upper)	1.95	1.33	23.9	61
TB-6 (Lower)	2.35	2.23	7.8	99
J - 1	4.22	4.22	6.3	100
J - 4	4.32	4.16	18.3	60
J - 5*	2.56	2.29	22.1	-
J - 6*	2.73	2.14	36.7	-

* Coring yield questionable.

But some of the samples were derived from the portions of coal seams which contained little coal, and the coal face which will be actually exploited will be 2.5 to 3 meters thick.

The theoretical yield and actual yield, when this is taken into consideration, are as follows.

The collection rate of core samples is problematical.

For the purpose of checking the yield and the quality of raw coal in Table 1, we figured out ash content in raw coal by adding specific gravity and thickness to ash content according to each ply. The result is as shown in Table 2.

Table 2

Coal Seam		Sink and Flotation Test		Ash according ply
		by Kobukuro	by Mitaka	
TB - 2	Ash % of Raw Coal	17.8	15.8	15.3
	Theoretical Yield %	84	88	89
TB-3 (Upper)	Ash % of Raw Coal	27.4	19.2	23.9
	Theoretical Yield %	64	82	75
TB-4 (Upper)	Ash % of Raw Coal	18.7	20.0	22.8
	Theoretical Yield %	63	64	59
TB-4 (Lower)	Ash % of Raw Coal	17.9	15.9	17.3
	Theoretical Yield %	61	67	63
TB - 5	Ash % of Raw Coal	21.1	15.6	16.9
	Theoretical Yield %	54	70	65
TB-6 (Lower)	Ash % of Raw Coal	7.8		11.4
	Theoretical Yield %	99		93

(Note)

i) A large amount of samples were analyzed at Kobukuro. The coal particles were 0.5 to 20 millimeters in diameter.

ii) Materials at Mitaka analysis consisted of samples according to each ply put together, with the coal particles ranging from 10 millimeters to 100 mesh.

iii) The theoretical yield under the heading of ash content according to each ply was figured out by means of the ash content equalization method.

iv) The yield of fine particles was considered as +0.5 millimeters, or about the same as slack.

v) Since materials at Mitaka analysis were small in practicle size and particles were separated from each other, their yield was naturally higher than samples for analysis at Kobukuro.

The results of the analysis at Kobukuro and at Mitaka analysis cannot be compared with each other directly because of differences in the sampling method, particle size and the analysis method. (Specific gravity was not taken into consideration in preparing at Mitaka samples for a sink and float test).

In particular, that TB-3 and TB-5 samples showed considerable differences in ash content in raw coal and yield is problematical. But this time we mainly concentrated on analysis at Kobukuro (the samples, being large in quantity, would resemble raw coal that would be dug out in actual exploitation).

2. Yield as Determined by Thickness of Coal Face

(1) TB-2 (tunnel)

Samples were collected from a 3.01-meter-thick of coal face with a 2.9-meter thick coal seam.

The ash content in raw coal is 17.8 percent and the theoretical yield is 84 percent. Since the thickness of coal face translates as the exploitable thickness, the actual yield is also set at 84 percent.

(2) TB-3 (tunnel)

Samples were collected from 2.51 meters thick. As this can be considered as an exploitable thickness, the theoretical yield is 64 percent.

(3) TB-4 (tunnel)

Thickness of seam of 4.67 meters was divided into the upper and lower parts in taking the samples. But the section that can actually be exploited is a thickness of 2.78 meters in the central part. In this case, the ash content in raw coal is 13.8 percent. The following two methods were used in inferring the yield.

A) Ash Content Equalization Method

Table 3 lists the ash content in refuse of various samples when ash content in clean coal is 7 percent, as shown by the washability curves.

Table 3

Sample	Ash in Refuse %
TB - 2	80
TB - 3	74
TB-4 (Upper)	40
TB-4 (Lower)	39
TB - 5	42
TB-6 (Upper)	58
Average	55

The ash content in refuse for lower TB-4 samples is 39 percent. On the assumption that ash content in raw coal is 13.8 percent and ash content in clean coal is 7 percent, the yield is calculated as follows.

$$R_e = \frac{\text{Ash in refuse - Ash in raw coal}}{\text{Ash in refuse - Ash in clean coal}} \times 100$$

$$= \frac{39.0 - 13.8}{39.0 - 7.0} \times 100 = 78.8\ (\%)$$

Namely, when ash content in raw coal is 13.8%, the yield rises to 78.8%.

B) Washability Curve Correction Method

We put together the washability curves for the upper and lower parts of TB-4 on a 50-50 basis and composed a single curve for the whole layer. The ash content in raw coal, as indicated by the synthesized curve, is 19.6 percent.

An improvement in the quality of raw coal means a reduction in elements with high ash content or high specific gravity and an increase in components with low ash content or low specific gravity.

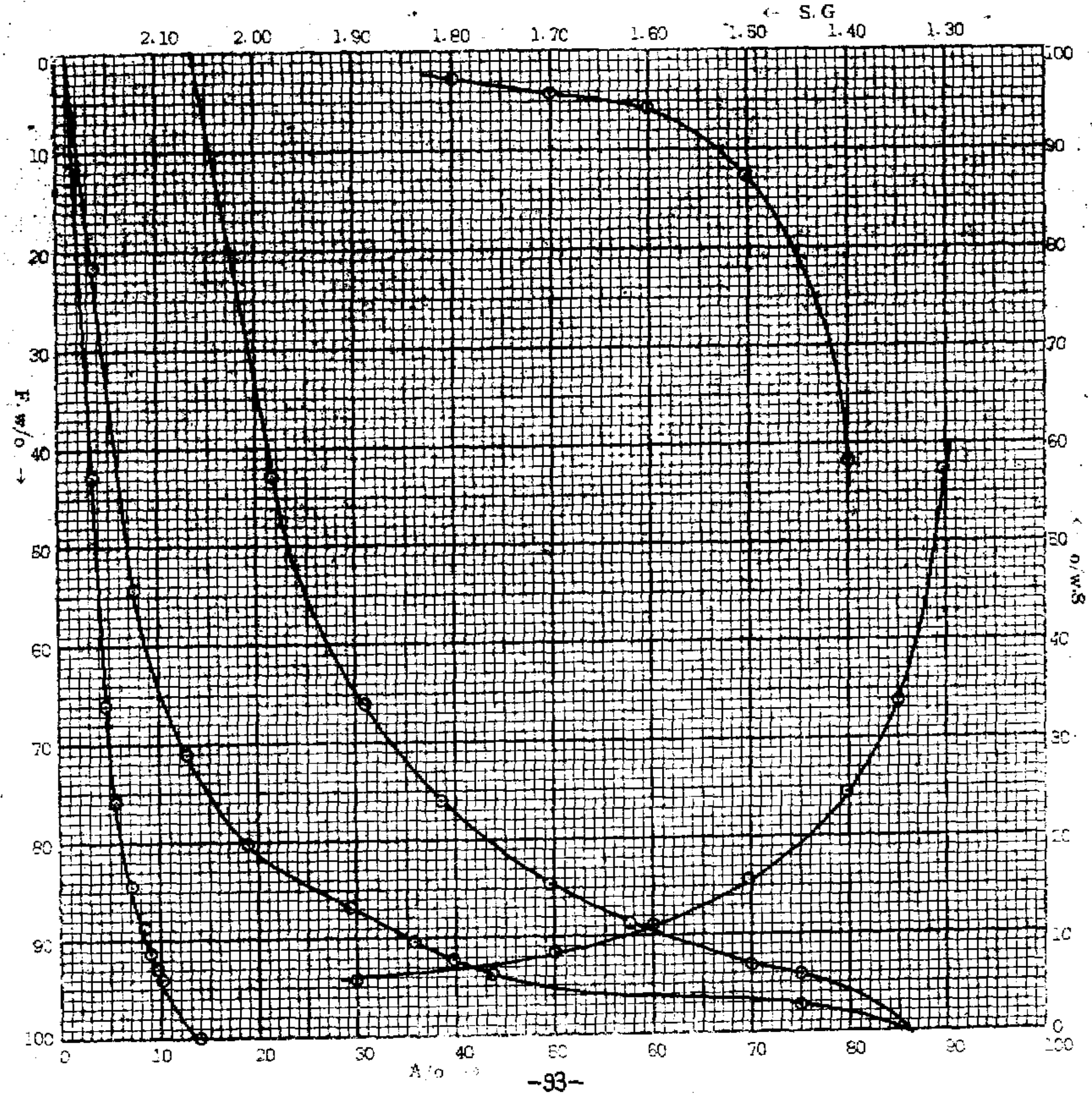
Now if we uniformly cut elements with a specific gravity higher than 1.35 by 40 percent and add the curtailed amount to ingredients with a specific gravity lower than 1.35, it results in washability curves as shown in the following page. The washability curves put ash content in raw coal at 13.6 percent, and the theoretical yield in this case is 84 percent.

To be on the safe side, we adopt the lower 79 percent as the theoretical yield for TB-4.

TB-4 B SEAM

The washability curves for the upper and lower parts of TB-4 were synthesized into a single curve on an equal basis. It was then adjusted so that ash content in raw coal would come to 13.6 %.

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100S(-\Sigma WA)}{100-\Sigma W}$
-1.3	42.8	3.3	21.4	141.24	141.24	42.8	3.3	21.4
1.3~1.35	23.2	7.2	54.4	167.04	308.28	66.0	4.7	31.0
1.35~1.4	10.0	12.4	71.0	124.00	432.28	76.0	5.7	38.8
1.4~1.5	8.5	18.8	80.3	159.80	592.08	84.5	7.0	49.7
1.5~1.6	4.3	29.1	86.7	125.13	717.21	88.8	8.1	57.7
1.6~1.7	2.6	35.5	90.1	92.30	809.51	91.4	8.9	64.4
1.7~1.8	1.6	39.5	92.2	63.20	872.71	93.0	9.4	70.1
1.8~1.9	1.1	43.5	93.6	47.85	920.56	94.1	9.8	75.0
+1.9	5.9	75.0	97.1	442.50	1363.06	100.0	13.6	



(4) TB-5 (tunnel)

The 2.79-meter thickness which was sampled can be regarded as wholly exploitable. The theoretical yield is 54 percent.

(5) TB-6 (tunnel)

The upper layer, with coaly shales 0.62 meters thick at the top, provides coal poor in ash content in raw coal and yield. But coal from the lower layer shows an excellent 7.8 percent in ash content in raw coal which makes it usable without washing.

If the bordering sections of the upper and lower layers where the coal is poor in quality and exploitation is limited to a thickness of 3.03 percent which furnishes good coal, the theoretical yield can be called 100 percent.

But the ash content in raw coal, as calculated from ash content according to each ply, comes to 9 percent, and this leads us to set the yield at 95 percent. We put the theoretical yield at 95 percent to be on the safe side.

(6) J-1 (drill)

Sampling thickness is 4.22 meters. There are almost no partings. The ash content in raw coal is 6.3 percent. If only the 3-meter thickness where the coal is good, the ash content in raw coal is expected to drop to 6 percent. As such, the yield can be considered as 100 percent.

(7) J-4 (drill)

Samples were collected from a 4.32-meter-thick coal-containing stratum. Raw coal samples were mixed on the basis of ash content, thickness and specific gravity according to each ply, and they were put to a sink and float test at 1.4 and 1.6 of specific gravity. The result is shown in Table 4.

Table 4

S.G.	W%	A%	Σ W%	Σ A%
-1.4	59.50	6.92	59.50	6.92
1.4-1.6	19.96	18.78	79.46	9.90
+1.6	20.54	50.70	100.00	18.28

A proportional calculation based on the above table puts the yield at 60 percent when ash content in clean coal is 7 percent.

The columnar section of coal seam shows that there is an partings between the upper and lower parts like TB-4. If the good coal sections in the middle measuring 2.87 meters thick are exploited, ash content in raw coal is obtainable from ash content according to each ply.

The ash content is 13.4 percent or about the same as the figure for TB-4. Since the layer is located deepèr than TB-4, the yield as shown by the washability curves of TB-4 is 84 percent.

The yield calculated under the ash content equalization method is 80 percent. Consequently, we adopt the 80 percent.

(8) J-5 (drill)

The total thickness of the coal-containing stratum is 3.85 meters, with a 2.29-meter-thick coal bed without partings in the bottom. But since there was a flood during the drilling operation. the core sample collection rate was less than 50 percent. The good coal deposit is apt to become powdery, and as good elements flowed out with water in the flood, the yield is unknown.

(9) J-6 (drill)

Table 5 shows the result of a sink and float test on samples at Mitaka analysis.

The above table puts the yield in a very low range of 10 to 15 percent. But we excluded it from our studies this time as the core sample collection rate is problematical.

Table 5

S. G.	W%	A%	Σ W%	Σ A%
-1.4	27.62	9.14	27.62	9.14
1.4-1.5	15.99	22.02	43.61	13.86
1.5-1.6	13.44	31.47	57.05	18.01
+1.6	42.95	61.45	100.00	36.67

3. Inferment of Actual Yield

The yields that have so far been obtained from calculations and diagrams are theoretical values. But in the event of actual exploitation, declines in yield resulting from the mingling of non-coal matter and the washability of raw coal should be taken into account.

(1) Yield Decrease Resulting from Mining

In actual exploitation, circumstances cannot be as good as when samples are collected. In particular, highly mechanized exploitation is inevitably accompanied by such conditions as fall of rock from roof and relative rise of floor against advance of working face which put waste non-coal matter in coal.

Even if only good-coal sections ranging from 2.5 to 3 meters in thickness are selected for exploitation, as we suggested, it seems difficult to carry the project out as planned. Since it is impossible to figure out the mingling rate of non-coal matter theoretically, we put the decline in the yield at 10 percent, considering our past experience, the sampling conditions and the geological conditions in the coalfield.

(2) Yield Decline Resulting from Coal Preparation

Even though the most advanced washing machines are used, the actual yield cannot be expected to be the same as the theoretical value. The difference varies in accordance with the kind of the washing machine and the washability of the raw coal.

The degree of difficulty of the various samples when ash content in clean coal is 7 percent, as we figured out from the washability curves, is listed in Table 6.

Except for TB-5, the washability of the samples is generally good. The degree of difficulty being as they are, the yield drop will be 1.5 to 2 percent if heavy medium cyclone are used.

But from a comprehensive viewpoint, we set the yield decrease at 3 percent, including the loss of some fine coal.

Table 6

Sample	Degree of Difficulty
TB - 2	3
TB - 3	7
TB - 4	13
TB - 5	42
TB - 6	-

We figured out the actual yield in the following manner. For example, when the theoretical yield is 80 percent;

$$(80 \times 0.9) - 3.0 = 69 \%$$

The actual yields for the various locations, as we calculated by the above method, are as follows.

Table 7

Sample	Thickness, working coal face (m)	Thickness, part of coal out of left column (m)	Ash in Raw coal (%)	Theoretical yield (%)	Actual yield (%)
TB - 2	3.01	2.90	17.8	84	73
TB - 3	2.51	2.24	27.4	64	55
TB - 4	2.78	2.78	13.8	79	68
TB - 5	2.79	2.79	21.1	54	46
TB - 6	3.03	3.03	9.0	95	83
J - 1	2.97	2.97	6.3	100	87
J - 4	2.87	2.87	13.4	80	69

(note) J-5 and J-6 samples were excluded because their coring yield was questionable.

The average actual yield for the samples listed in Table 7 is 68.7 percent, but TB-5 and TB-6 are located in the eastern part in an area where exploitation is possible only after 10 years.

It seems advisable to use the average yield for locations to be initially exploited as the anticipated yield in drafting a development program and then to find out precise yields for the respective locations while mining is under way.

Therefore, we suggest drafting the program on the basis of the average yield for the five sites of TB-2, TB-3, TB-4, J-1 and J-4. The average is 70.4 percent.

At some of the locations, coal deposit conditions are poor near the outcrops but are good at the lower levels.

Distances between the locations differ considerably, and it is difficult to interprete how wide each sample is represented over the area.

We gave the sections near the outcrops the value of 1 and those at the lower levels explored by drilling 2, and added them up for the average yield as follows.

$$\frac{(73 + 55 + 68) + (87 + 69) \times 2}{7} = 72.6\ (\%)$$

But just to be on the safe side, we feel that the 70 percent arithmetic average derived before should be adopted this time.

4. Conclusion

Although various problems are, as were mentioned in 3 above, involved such as estimate of the scope represented by samples, determination of the area for initial exploitation, estimation of the mingling rate of non-coal matter, it would be safe to put the actual yield at 7 percent in ash content in clean coal and actual yield is 70 percent in guaranteed ash content, 7 percent.

When guaranteed ash content is increased, the yield also goes up just a little. Coking coal, which has to compete against other coal descriptions, should be given a merit of some sort, particularly when it is newly-exploited coal. If Fernie coal is to be given a merit artificially, it necessitates the reduction of ash content as compared with conventional Canadian coal.

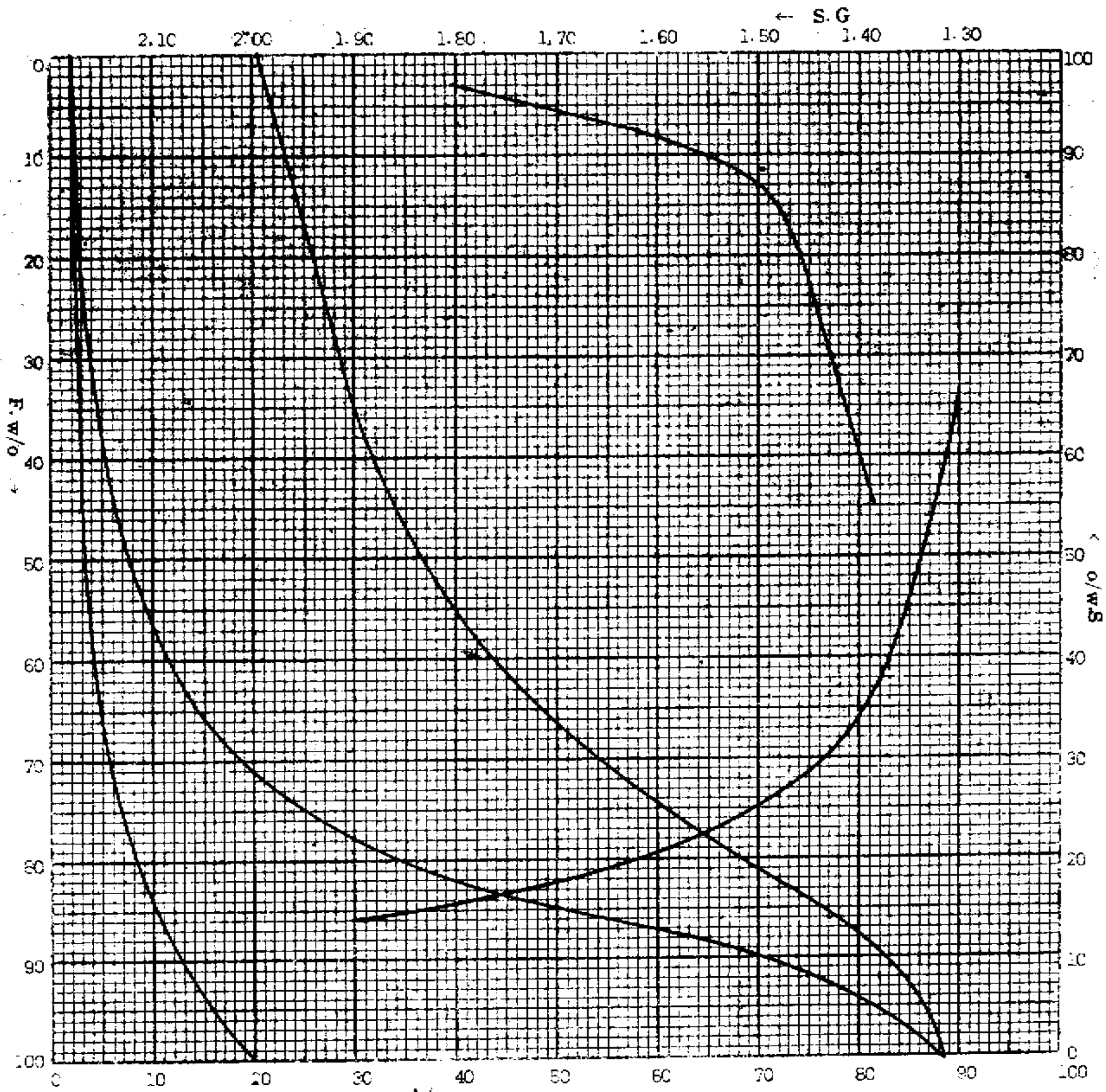
In conclusion, it seems appropriate at the present time to say that guaranteed ash content for Fernie coal is 7 percent and the yield is 70 percent.

The following curve shows the average washability curve for the area scheduled for initial exploitation. This makes allowances for a decline in yield which would result from the mixing of non-coal matter in actual mining work.

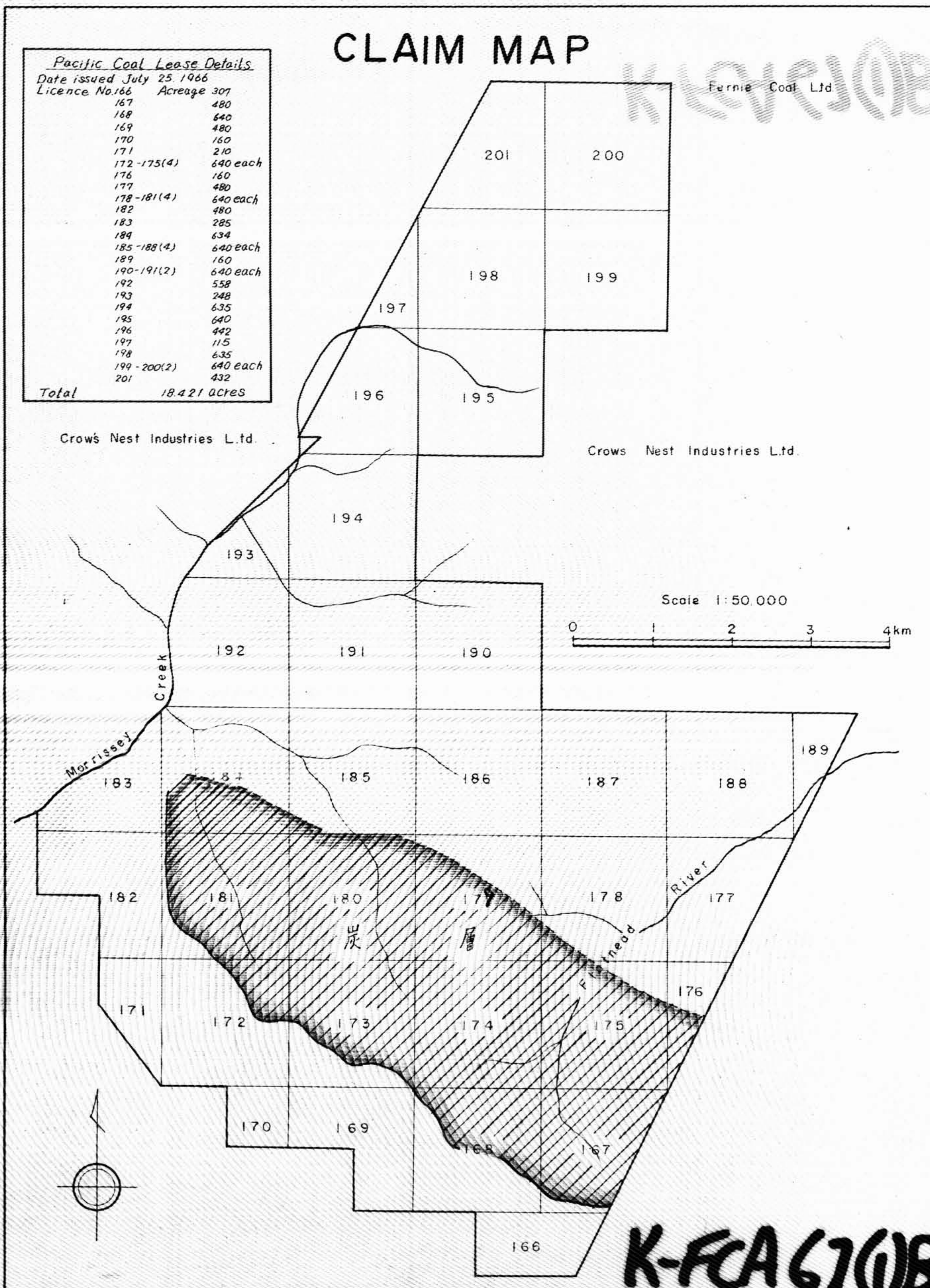
B SEAM

Size	wt%	Ash%
+0.5 mm	70.0	20.5
−0.5 mm	30.0	14.0
Total	100.0	18.6

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af - \Sigma WA}{100 - \Sigma W}$
−1.30	34.7	2.9	17.4	100.63	100.63	34.7	2.9	29.8
1.30~1.35	19.3	6.4	44.4	123.52	224.15	54.0	4.2	39.6
1.35~1.40	12.2	11.2	60.1	136.64	360.79	66.2	5.5	49.9
1.40~1.50	8.2	18.4	70.3	150.88	511.67	74.4	6.9	59.9
1.50~1.60	4.8	29.5	76.8	141.60	653.27	79.2	8.2	67.0
1.60~1.70	3.4	37.8	80.9	128.52	781.79	82.6	9.5	72.6
1.70~1.80	1.6	44.4	83.4	71.04	852.83	84.2	10.1	75.5
1.80~1.90	1.4	50.9	84.9	71.26	924.09	85.6	10.8	77.9
+1.90	14.4	77.9	92.8	1121.76	2045.85	100.0	20.5	



GEOLOGICAL AND TOPOGRAPHICAL
CROWS NEST COAL-FIELDS
EAST KOOTENAY DISTRICT, B.C.
ELKO


CLAIM MAP
Pacific Coal Lease Details
Date issued July 25. 1966
Licence No.166 Acreage 307
167 480
168 640
169 480
170 160
171 210
172-175(4) 640 each
176 160
177 480
178-181(4) 640 each
182 480
183 285
184 634
185-188(4) 640 each
189 160
190-191(2) 640 each
192 558
193 248
194 635
195 640
196 442
197 115
198 635
199-200(2) 640 each
201 432
Total 18.421 acres
Fernie Coal Ltd.
Crow's Nest Industries L.td.
Crows Nest Industries L.td.
Scale 1:50.000
0 1 2 3 4km
Morrissey Creek
Flathead River
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層
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198
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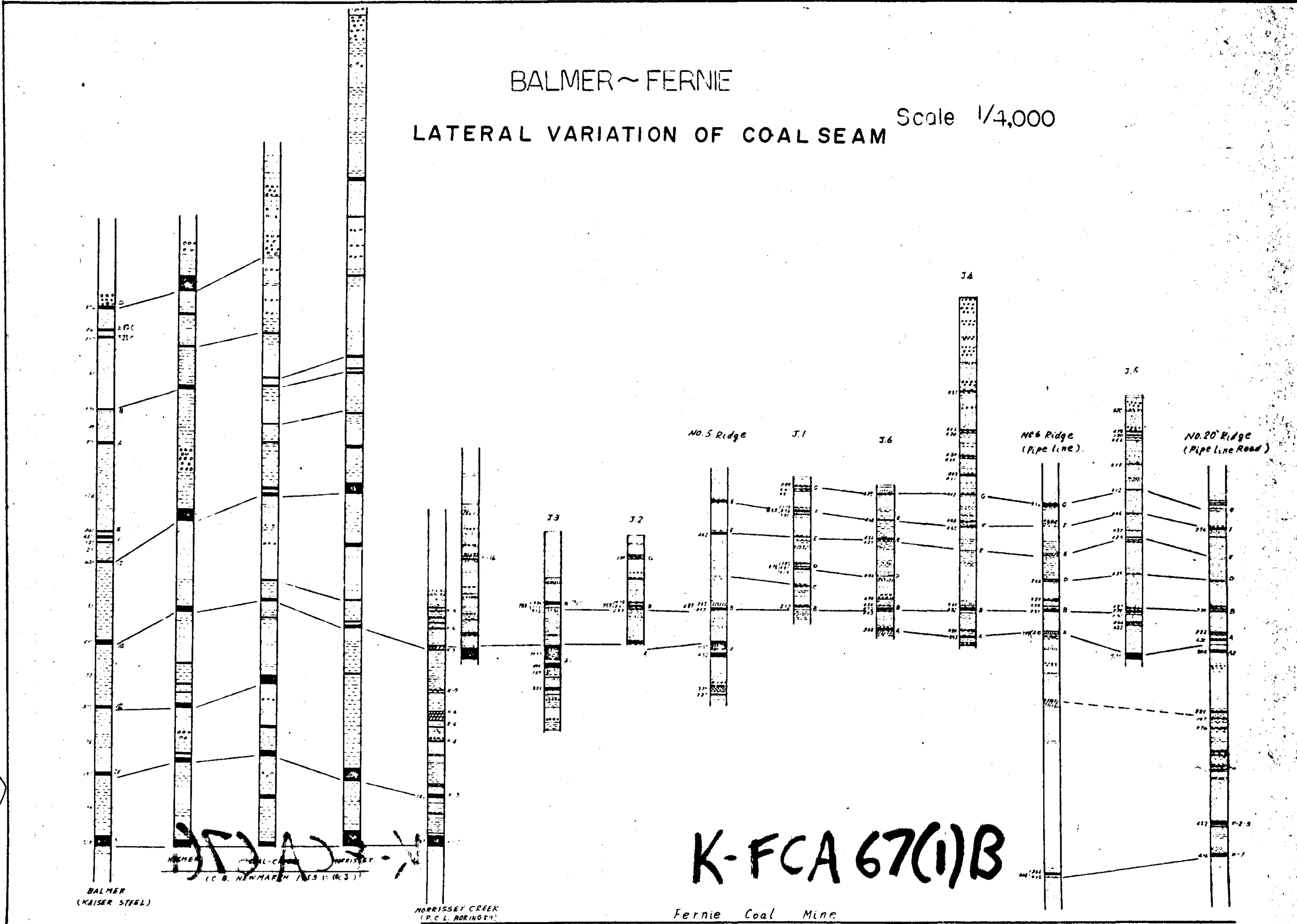
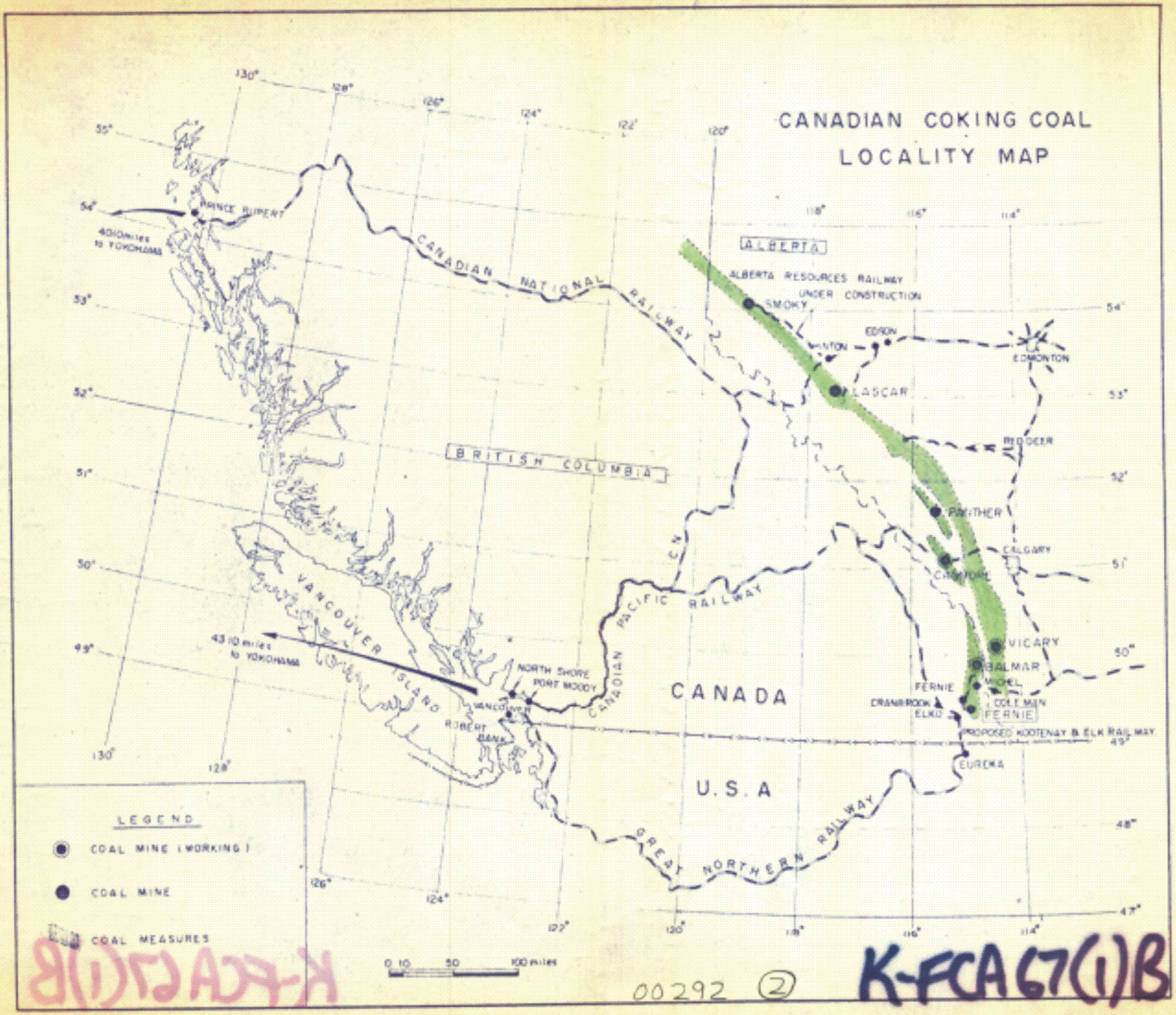
BALMER ~ FERNIE

LATERAL VARIATION OF COAL SEAM

Scale 1/4,000



K-FCA 67(1)B


CANADIAN COKING COAL
LOCALITY MAP
ALBERTA
BRITISH COLUMBIA
CANADA
U.S.A
VANCOUVER ISLAND
CANADIAN NATIONAL RAILWAY
CANADIAN PACIFIC RAILWAY
GREAT NORTHERN RAILWAY
CN
ALBERTA RESOURCES RAILWAY
UNDER CONSTRUCTION
PROPOSED KOOTENAY & ELK RAILWAY
PRINCE RUPERT
4010 miles
to YOKOHAMA
4310 miles
to YOKOHAMA
NORTH SHORE
PORT MOODY
VANCOUVER
ROBERT
BANK
SMOKY
HINTON
EDSON
EDMONTON
LASCAR
RED DEER
PANTHER
CALGARY
CANMORE
VICARY
BALMAR
MICHEL
COLEMAN
FERNIE
CRANBROOK
ELKO
EUREKA
LEGEND
COAL MINE (WORKING)
COAL MINE
COAL MEASURES
0 10 50 100 miles
K-FCA 67(1)B
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K - FERNIE COAL AREA 67 (1) B

COAL ANALYSIS

00 292 Part 2

CONFIDENTIAL

GEOLOGICAL BRANCH
ASSESSMENT REPORT

00 292

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(X) COAL QUALITY

1. Samples Taken From Tunnels

See Drg. 23, 24 and 25.

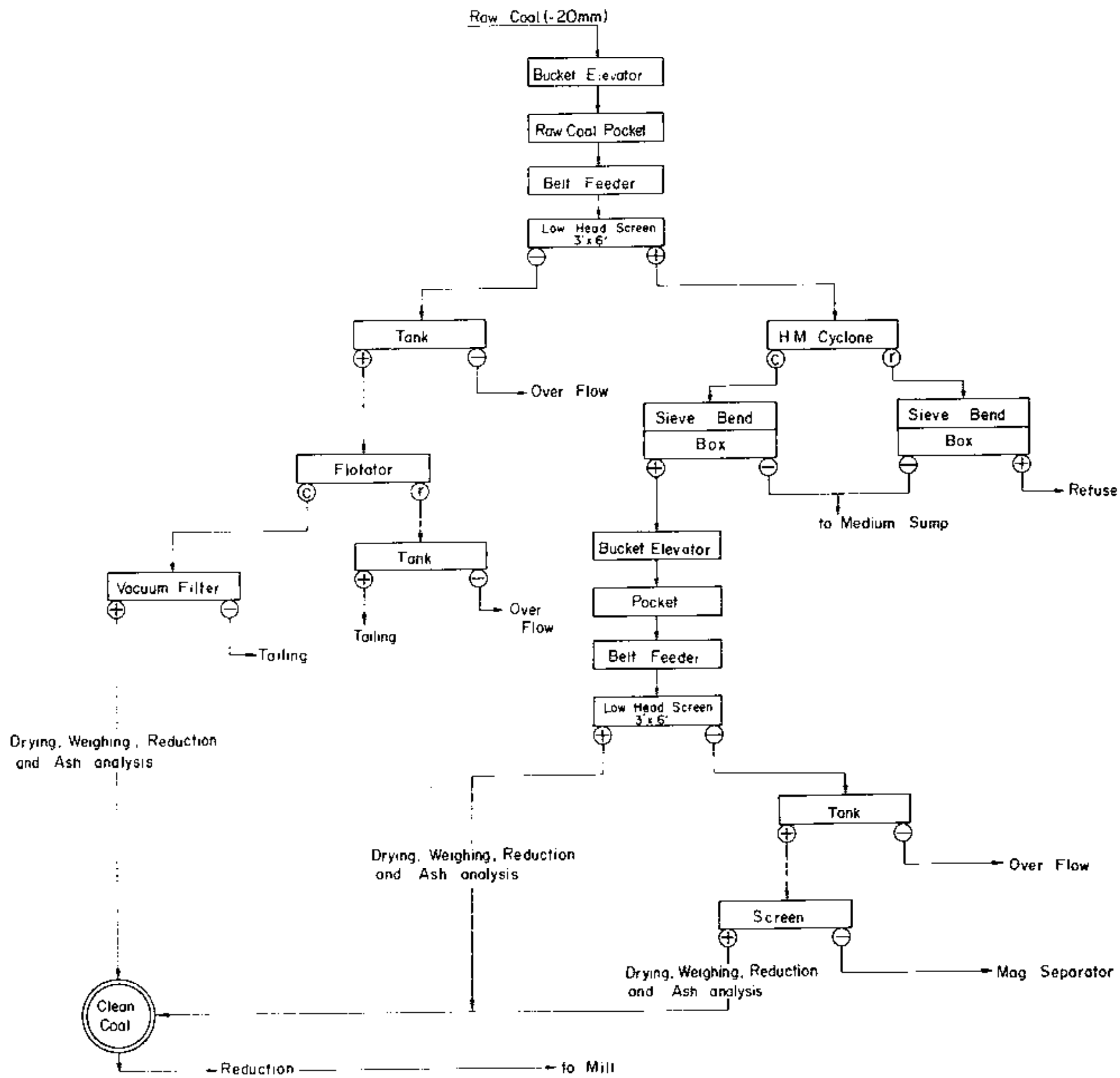
Tunnels were driven for collecting samples for drum tests from Seams B, A, K-1 and K-5. The samples, thus collected, were washed and prepared so that they had a certain fixed ash content at Kobukuro Iron Works Co., Ltd. in Kyushu, Japan (preparation process is shown in the attached table), and were forwarded to six steel mills to undergo chemical analyses, drum tests, and other tests.

(1) Test results at Kobukuro Iron Works Co., Ltd.

A) Preparation process

(See attached table)

Flow sheet of Coal preparation for Sample



B) Size Distribution of Coal Samples

Test Method .... Screening samples by 50mm and 20mm sieves.

(unit: weight %)

Year	Coal Seam \ Size (mm)	+50	50 - 20	-20	Total
1967	TB-2, upper and lower mixed	12.7	14.1	73.2	100.0
	TB-3, upper	4.4	10.0	85.6	100.0
	TB-3, middle and lower mixed	10.0	14.2	75.8	100.0
	TB-3, upper and lower mixed	5.7	12.6	81.7	100.0
	TB-4, upper	7.4	10.3	82.7	100.0
	TB-4, lower	10.3	13.4	76.3	100.0
	TB-5, upper	6.3	12.8	80.9	100.0
	TB-5, middle and lower mixed	15.7	16.5	67.8	100.0
	TB-6, upper	17.8		82.2	100.0
	TB-6, lower	27.3		72.7	100.0
	TA-2, upper	3.6	11.0	85.4	100.0
	TA-2, lower	21.2	21.0	57.8	100.0
	TA-3, 2-1	2.4	5.2	92.4	100.0
	TA-3, 2-2, 2-3) mixed	6.9	8.2	84.9	100.0
	TA-3, 2-4, 2-5) mixed	4.4	6.8	88.8	100.0
	TA-4, 1-1, 1-2) mixed	2.7	4.9	92.4	100.0
	TA-4, 1-3, 1-4) mixed	6.4	9.5	84.1	100.0

C) Size Distribution after crushing +20mm

Crushing method:

Raw coal of more than 50 mm size was crushed by hand and, together with 20-50 mm raw coal, was crushed by a jaw crusher (20mm), and sieved by a 20 mm screen. +20mm coal on the screen were hand-crushed and mixed with -20mm coal.

Coal Seam / Size (mm)	W%	A%	↓Σ W%	↓Σ A%	↑Σ W'%	↑Σ A'%
	TB-2 (upper, lower mixed)					1967
20 - 10	21.4	25.4	21.4	25.4	100.0	19.0
10 - 5	16.8	23.0	38.2	24.4	78.6	17.2
5 - 2	24.4	18.6	62.6	21.3	61.8	15.7
2 - 1	12.0	14.1	74.6	20.8	37.4	13.8
1 - 0.5	9.5	13.9	84.1	20.0	25.4	13.6
- 0.5	15.9	19.0	100.0	19.0	15.9	13.4
	TB-3 (upper)					1967
20 - 10	16.9	46.7	16.9	46.7	100.0	27.8
10 - 5	13.3	33.9	30.2	41.1	83.1	24.0
5 - 2	24.1	27.1	54.3	34.9	69.8	22.1
2 - 1	11.2	24.4	65.5	33.1	45.7	19.5
1 - 0.5	9.9	21.7	75.4	31.6	34.5	17.9
- 0.5	24.6	16.4	100.0	27.8	24.6	16.4
	TB-3 (middle and lower mixed)					1967
20 - 10	23.9	67.7	23.9	67.7	100.0	42.5
10 - 5	15.9	48.9	39.8	60.2	76.1	34.5
5 - 2	21.0	39.6	60.8	53.1	60.2	30.7
2 - 1	10.9	34.9	71.7	50.3	39.2	26.0
1 - 0.5	9.2	27.4	80.9	47.7	28.3	22.5
- 0.5	19.1	20.2	100.0	42.5	19.1	20.2
	TB-3 (upper and lower mixed) (not delivered to mills)					1967
20 - 10	16.5	45.4	16.5	45.4	100.0	27.3
10 - 5	14.5	35.2	31.0	40.6	83.5	23.7
5 - 2	24.3	26.7	55.3	34.5	69.0	21.3
2 - 1	14.0	21.0	69.3	31.8	44.7	18.3
1 - 0.5	9.3	19.6	78.6	30.3	30.7	17.1
- 0.5	21.4	16.0	100.0	27.3	21.4	16.0
	TB-4 (upper)					1967
20 - 10	15.2	21.6	15.2	21.6	100.0	19.3
10 - 5	14.7	17.3	29.9	19.5	84.8	18.8
5 - 2	23.8	21.1	53.7	20.2	70.1	19.2

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Coal Seam / Size (mm)	TB-4 (upper) (cont'd)					1967
	W%	A%	↓Σ W%	↓Σ A%	↑Σ W'%	↑Σ A'%
2 - 1	11.1	21.0	64.8	20.3	46.3	18.1
1 - 0.5	11.9	19.5	76.7	20.2	35.2	17.2
- 0.5	23.3	16.1	100.0	19.3	23.3	16.1
	TB-4 (lower)					1967
20 - 10	20.6	30.0	20.6	30.0	100.0	18.9
10 - 5	16.4	24.5	37.0	27.6	79.4	16.0
5 - 2	24.0	15.5	61.0	22.8	63.0	13.8
2 - 1	10.4	12.8	71.4	21.4	39.0	12.8
1 - 0.5	10.5	11.3	81.9	20.1	28.6	12.8
- 0.5	18.1	13.6	100.0	18.9	18.1	13.6
	TB-5 (upper)					1967
20 - 10	18.1	48.3	18.1	48.3	100.0	42.5
10 - 3	17.8	36.2	35.9	42.3	76.1	24.5
5 - 2	22.4	35.9	58.3	39.8	60.2	30.7
2 - 1	11.4	31.5	69.7	38.5	39.2	26.0
1 - 0.5	9.3	26.4	79.0	37.1	28.3	22.5
- 0.5	21.0	20.1	100.0	33.5	19.1	20.2
	TB-5 (middle and lower mixed)					1967
20 - 10	25.7	30.4	25.7	30.4	100.0	21.1
10 - 5	19.0	24.0	44.7	27.7	74.3	17.8
5 - 2	21.2	18.6	65.9	24.8	55.3	15.7
2 - 1	10.2	14.2	76.1	23.3	34.1	13.9
1 - 0.5	8.0	16.1	84.1	22.7	23.9	13.8
- 0.5	15.9	12.6	100.0	21.1	15.9	12.6
	TB-6 (upper)					1967
20 - 10	15.2	38.2	15.2	38.2	100.0	24.1
10 - 5	13.0	32.2	28.2	35.4	84.8	21.6
5 - 2	24.3	25.2	52.5	30.7	71.8	19.7
2 - 1	14.1	19.4	66.6	28.3	47.5	16.8
1 - 0.5	10.7	18.2	77.3	26.9	33.4	15.8
- 0.5	22.7	14.6	100.0	24.1	22.7	14.6

Coal Seam / Size (mm)	W%	A%	↓Σ W%	↓Σ A%	↑Σ W'%	↑Σ A'%
	TA-6 (lower)					1967
20 - 10	13.8	10.9	13.8	10.9	100.0	7.7
10 - 5	15.4	8.5	29.2	9.6	86.2	7.1
5 - 2	27.0	6.9	56.2	8.3	70.8	6.8
2 - 1	15.1	6.8	71.3	8.0	43.8	6.8
1 - 0.5	9.9	6.4	81.2	7.8	28.7	6.8
- 0.5	18.8	7.0	100.0	7.7	18.8	7.0
	TA-1 (upper)					1966
20 - 10	22.7	2.7	22.7	2.7	100.0	2.8
10 - 5	17.5	3.2	40.2	2.9	77.3	2.8
5 - 2	23.1	2.7	63.3	2.8	59.8	2.7
2 - 1	8.6	2.9	71.9	2.8	36.7	2.8
1 - 0.5	6.5	2.5	78.4	2.8	28.1	2.7
- 0.5	21.6	2.8	100.0	2.8	21.6	2.8
	TA-1 (lower)					1966
20 - 10	22.4	7.6	22.4	7.6	100.0	6.2
10 - 5	15.9	6.7	38.3	7.2	77.6	5.8
5 - 2	22.5	5.5	60.8	6.6	61.7	5.6
2 - 1	11.7	4.5	72.5	6.3	39.2	5.6
1 - 0.5	7.1	5.9	79.6	6.2	27.5	6.0
- 0.5	20.4	6.1	100.0	6.2	20.4	6.1
	TA-2 (upper)					1967
20 - 10	17.9	50.9	17.9	50.9	100.0	29.0
10 - 5	14.5	39.3	32.4	45.7	82.1	24.2
5 - 2	22.7	28.8	55.1	38.7	67.6	21.0
2 - 1	13.0	21.8	68.1	35.5	44.9	17.1
1 - 0.5	10.9	17.2	79.0	33.0	31.9	15.2
- 0.5	21.0	14.1	100.0	29.0	21.0	14.1
	TA-2 (lower)					1967
20 - 10	33.6	62.1	33.6	62.1	100.0	43.9
10 - 5	16.0	52.0	49.6	58.8	66.4	34.8
5 - 2	20.9	37.1	70.5	52.4	50.4	29.3

Coal Seam / Size (mm)	TA-2 (lower) (cont'd)					1967
	W%	A%	↓Σ W%	↓Σ A%	↑Σ W%	↑Σ A%
2 - 1	10.6	26.1	81.1	49.0	29.5	23.7
1 - 0.5	7.3	23.7	88.4	46.9	18.9	22.4
- 0.5	11.6	21.6	100.0	43.9	11.6	21.6
	TA-3, 2-1					1967
20 - 10	6.6	18.6	6.6	18.6	100.0	15.7
10 - 5	11.1	19.4	17.7	19.1	93.6	15.5
5 - 2	23.4	19.4	41.1	19.3	82.3	15.0
2 - 1	16.1	16.1	57.2	18.4	58.9	13.2
1 - 0.5	13.5	13.4	70.7	17.4	42.8	12.1
- 0.5	29.3	11.5	100.0	15.7	29.3	11.5
	TA-3, ($^{2-2}_{2-3}$ mixed					1967
20 - 10	10.7	17.1	10.7	17.1	100.0	10.2
10 - 5	14.9	12.6	25.6	14.5	89.7	9.4
5 - 2	21.0	10.3	46.6	12.6	74.4	8.8
2 - 1	13.4	9.3	60.0	11.9	53.4	8.2
1 - 0.5	12.3	8.1	72.3	11.2	40.0	7.8
- 0.5	27.7	7.7	100.0	10.2	27.7	7.7
	TA-3, ($^{2-4}_{2-5}$ mixed					1967
20 - 10	6.2	30.8	6.2	30.8	100.0	23.4
10 - 5	10.2	27.8	16.4	28.9	93.8	22.9
5 - 2	22.2	28.3	38.6	28.6	83.6	22.3
2 - 1	15.1	25.4	53.7	27.7	61.4	20.1
1 - 0.5	16.6	22.1	70.3	26.4	46.3	18.4
- 0.5	29.7	16.3	100.0	23.4	29.7	16.3
	TA-4, ($^{1-1}_{1-2}$ mixed					1967
20 - 10	3.8	22.5	3.8	22.5	100.0	11.7
10 - 5	8.2	18.8	12.0	20.0	96.2	11.3
5 - 2	20.1	16.0	32.1	17.5	88.0	10.6
2 - 1	15.5	10.8	47.6	15.3	67.9	8.9

Coal Seam / Size (mm)	W%	A%	↓Σ W%	↓Σ A%	↑Σ W'%	↑Σ A'%
	TA-4,($\genfrac{}{}{0pt}{}{1\text{-}1}{1\text{-}2}$ mixed (cont'd)					1967
1 - 0.5	12.7	9.6	60.3	14.1	52.4	8.4
- 0.5	39.7	8.0	100.0	11.7	39.7	8.0
	TA-4,($\genfrac{}{}{0pt}{}{1\text{-}3}{1\text{-}4}$ mixed					1967
20 - 10	13.6	41.9	13.6	41.9	100.0	25.9
10 - 5	13.6	36.7	27.2	39.3	86.4	23.4
5 - 2	23.0	26.9	50.2	33.6	72.8	20.9
2 - 1	12.1	24.0	62.3	31.8	49.8	18.1
1 - 0.5	12.5	20.2	74.8	29.8	37.7	16.2
- 0.5	25.2	14.2	100.0	25.9	25.2	14.2
	TA-4,(M1)					1966
20 - 10	7.8	16.7	7.8	16.7	100.0	9.9
10 - 5	9.1	13.4	16.9	14.9	92.2	9.3
5 - 2	21.7	11.0	38.6	12.7	83.1	8.9
2 - 1	8.1	11.5	46.7	12.5	61.4	8.1
1 - 0.5	14.3	9.2	61.0	11.7	53.3	7.6
- 0.5	39.0	7.0	100.0	9.9	39.0	7.0
	TA-4,(M2)					1966
20 - 10	6.5	20.2	6.5	20.2	100.0	12.7
10 - 5	14.6	17.3	21.1	18.2	93.5	12.2
5 - 2	24.4	13.7	45.5	15.8	78.9	11.3
2 - 1	14.6	11.1	60.1	14.6	54.5	10.2
1 - 0.5	5.6	8.0	65.7	14.1	39.9	9.9
- 0.5	34.3	10.2	100.0	12.7	34.3	10.2
	TA-4,(M3)					1966
20 - 10	7.0	17.8	7.0	17.8	100.0	8.2
10 - 5	10.6	12.3	17.6	14.5	93.0	7.4
5 - 2	24.1	9.5	41.7	11.6	82.4	6.8
2 - 1	16.1	7.5	57.8	10.5	58.3	5.7
1 - 0.5	6.6	6.1	64.4	10.0	42.2	5.0
- 0.5	35.6	4.8	100.0	8.2	35.6	4.8

Coal Seam / Size (mm)	TA-4, (M_4)				1966	
	W%	A%	↓Σ W%	↓Σ A%	↑Σ W'%	↑Σ A'%
20 - 10	12.2	24.3	12.2	24.3	100.0	13.6
10 - 5	11.5	21.5	23.7	22.9	87.8	12.1
5 - 2	21.9	15.1	45.6	19.2	76.3	10.7
2 - 1	13.8	10.8	59.4	17.2	54.4	9.0
1 - 0.5	6.5	9.5	65.9	16.5	40.6	8.3
- 0.5	34.1	8.1	100.0	13.6	34.1	8.1
	K-1, (upper)				1965	
20 - 10	36.0	33.2	36.0	33.2	100.0	26.9
10 - 5	20.5	29.3	56.5	31.8	64.0	23.4
5 - 2	9.8	27.5	66.3	31.2	43.5	20.6
2 - 1	15.9	21.4	82.2	29.3	33.7	18.7
1 - 0.5	3.8	17.3	86.0	28.7	17.8	16.2
- 0.5	14.0	15.9	100.0	26.9	14.0	15.9
	K-1, (lower)				1965	
20 - 10	24.3	34.0	24.3	34.0	100.0	23.5
10 - 5	17.3	26.4	41.6	30.9	75.7	20.2
5 - 2	12.4	21.2	54.0	28.6	58.4	18.3
2 - 1	20.8	20.2	74.8	26.3	46.0	17.5
1 - 0.5	8.2	16.3	83.0	25.3	25.2	15.4
- 0.5	17.0	14.9	100.0	23.5	17.0	14.9
	K-5, (upper)				1965	
20 - 10	35.6	43.3	35.6	43.3	100.0	32.0
10 - 5	17.5	35.8	53.1	40.8	64.4	25.8
5 - 2	11.2	27.9	64.3	38.6	46.9	22.0
2 - 1	18.4	21.3	82.7	34.7	35.7	20.2
1 - 0.5	6.6	19.0	89.3	33.6	17.3	18.9
(-) 0.5	10.7	18.9	100.0	32.0	10.7	18.9
	K-5, (lower)				1965	
20 - 10	26.3	38.6	26.3	38.6	100.0	25.2
10 - 5	18.8	26.6	45.1	33.6	73.7	20.5
5 - 2	12.1	25.1	57.2	31.8	54.9	18.4

Coal Seam / Size (mm)	K-9, (lower) (cont'd)					
	W%	A%	$\downarrow \Sigma$ W%	$\downarrow \Sigma$ A%	$\uparrow \Sigma$ W%	$\uparrow \Sigma$ A%
2 - 1	20.2	18.7	77.4	28.4	42.8	16.5
1 - 0.5	5.2	15.7	82.6	27.6	22.6	14.5
- 0.5	17.4	14.2	100.0	25.2	17.4	14.2

Note: The figures of ΣA% are the calculated values.

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D) Washability Curves of Raw Coal

Conducted in 1966/1967

TB-2	B Seam	(Upper + Lower)
TB-3	B Seam	(Upper)
TB-3	B Seam	(Middle + Lower)
TB-4	B Seam	(Upper)
TB-4	B Seam	(Lower)
TB-5	B Seam	(Upper)
TB-5	B Seam	(Middle + Lower)
TB-6	B Seam	(Upper)
TB-6	B Seam	(Lower)
TA-1	A Seam	(Upper)
TA-1	A Seam	(Lower)
TA-2	A Seam	(Upper)
TA-2	A Seam	(Lower)
TA-3	A Seam	(2 - 1)
TA-3	A Seam	(2 - 2) + (2 - 3)
TA-3	A Seam	(2 - 4) + (2 - 5)
TA-4	A Seam	(1 - 1) + (1 - 2)
TA-4	A Seam	(1 - 3) + (1 - 4)
TA-4	A Seam	(M - 1)
TA-4	A Seam	(M - 2)
TA-4	A Seam	(M - 3)
TA-4	A Seam	(M - 4)

Conducted in 1965

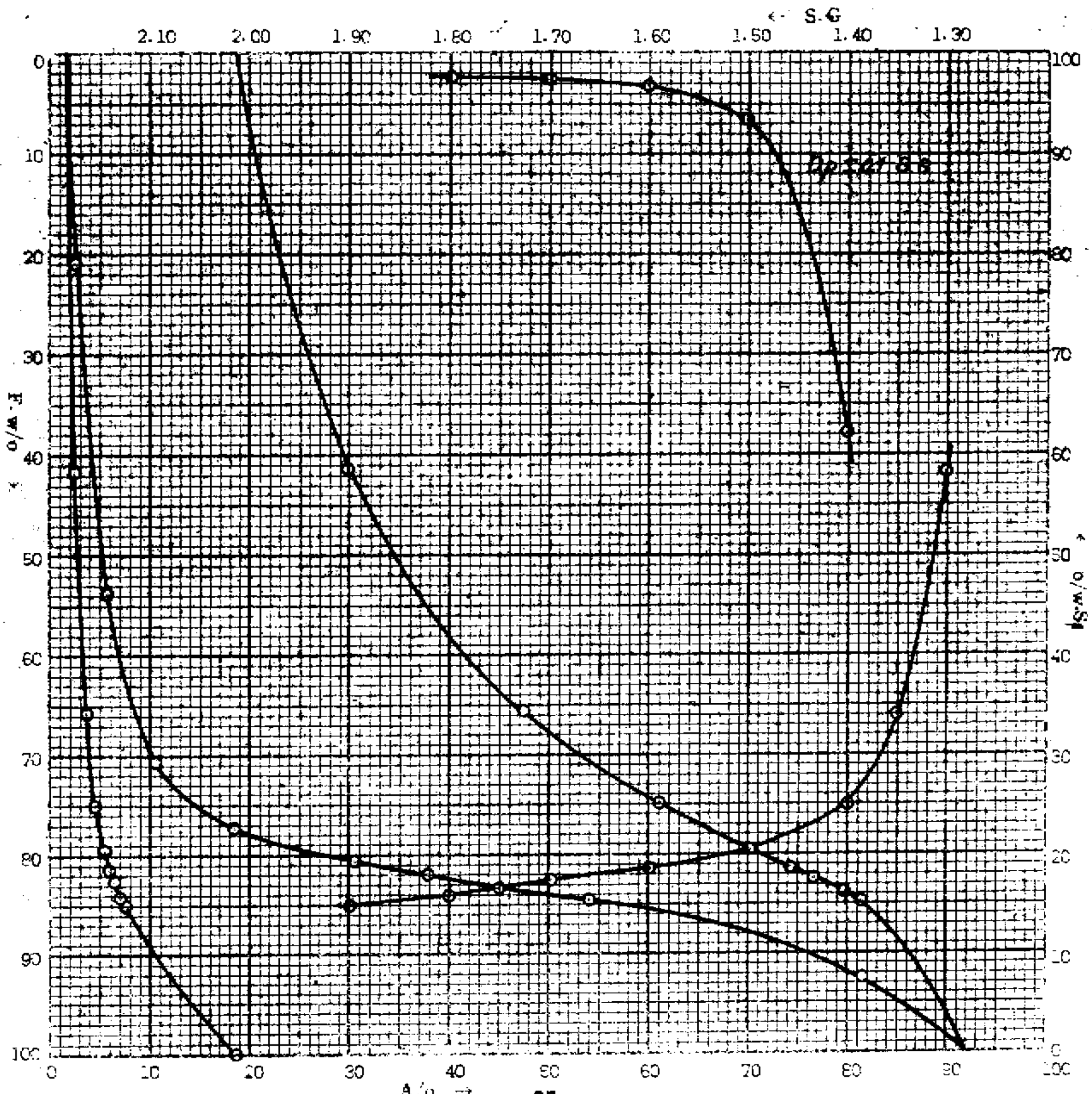
K-1	Seam	(Upper)
K-1	Seam	(Lower)
K-5	Seam	(Upper)
K-5	Seam	(Lower)

(1967)

TB-2 B SEAM
(upper+ Lower)

Size	wt %	Ash %
20 ~ 0.5 mm	84.5	18.6
−0.5 mm	15.5	13.2
Total	100.0	17.8

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100 Af - \Sigma WA}{100 - \Sigma W}$
−1.3	41.6	2.4	20.8	99.84	99.84	41.6	2.4	30.1
1.3 ~ 1.35	24.2	5.7	53.7	137.94	237.78	65.8	3.6	47.4
1.35 ~ 1.4	9.1	10.2	70.4	92.82	330.60	74.9	4.4	60.9
1.4 ~ 1.5	4.5	18.5	77.2	83.25	413.85	79.4	5.2	70.2
1.5 ~ 1.6	1.9	30.4	80.4	57.76	471.61	81.3	5.8	74.3
1.6 ~ 1.7	1.2	37.6	81.9	45.12	516.73	82.5	6.3	76.8
1.7 ~ 1.8	1.5	44.9	83.3	67.35	584.08	84.0	7.0	79.8
1.8 ~ 1.9	0.9	54.0	84.5	48.60	632.68	84.9	7.5	81.8
+1.9	15.1	81.3	92.5	1227.63	1860.31	100.0	18.6	



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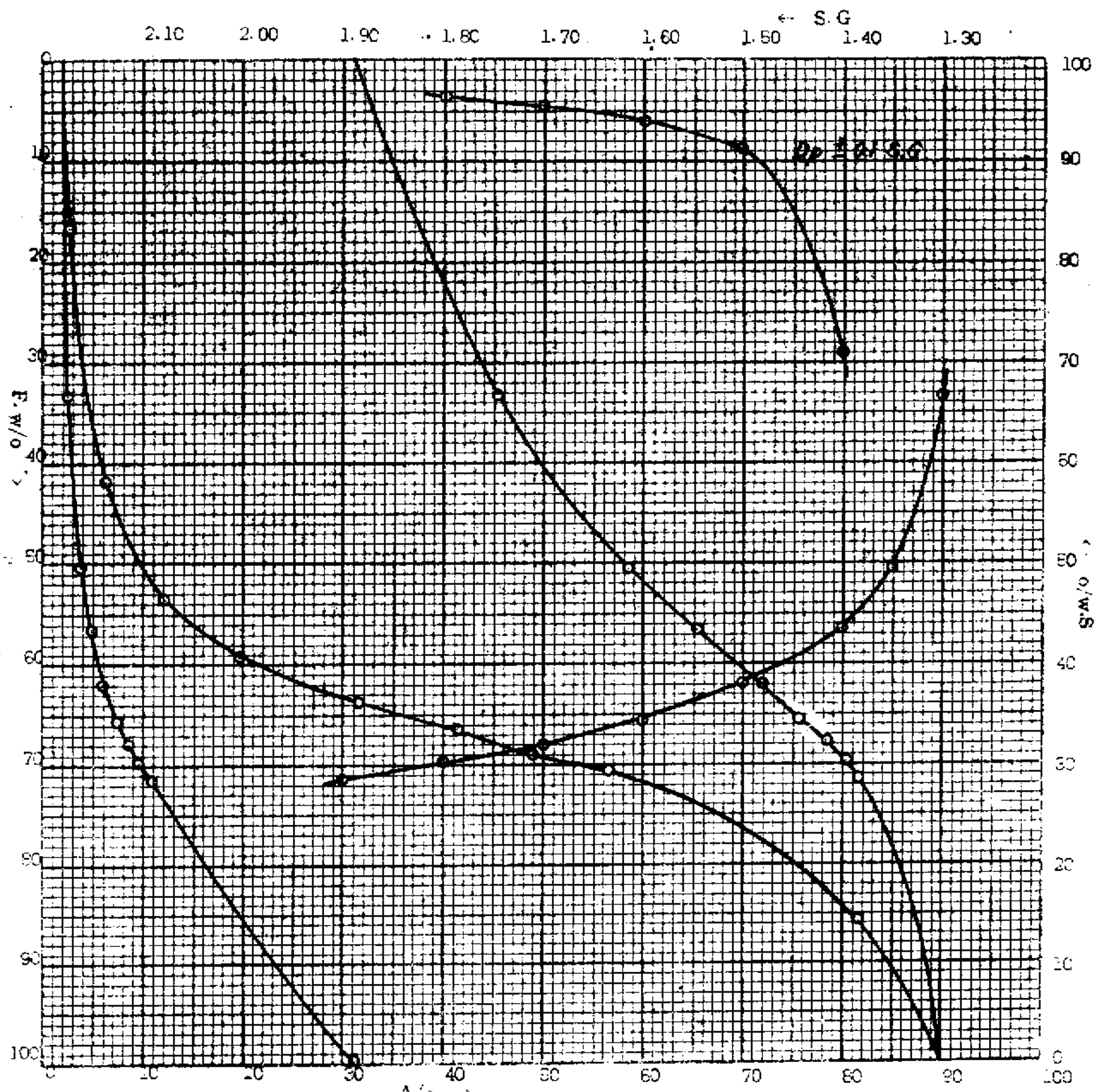
(1967)

TB-3 B SEAM (upper)

Size	wt %	Ash%
20 ~ 0.5 mm	76.1	31.0
−0.5 mm	23.9	16.4
Total	100.0	27.4

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100\,ST - \Sigma WA}{100 - \Sigma W}$
−1.3	33.1	2.5	16.6	82.75	82.75	33.1	2.5	45.1
1.3~1.35	17.2	6.3	41.7	108.36	191.11	50.3	3.8	58.5
1.35~1.4	6.3	12.1	53.5	76.23	267.34	56.6	4.7	65.2
1.4~1.5	5.3	19.7	59.3	104.41	371.75	61.9	6.0	71.6
1.5~1.6	3.4	31.6	63.6	107.44	479.19	65.3	7.3	75.5
1.6~1.7	2.6	41.4	66.6	107.64	586.83	67.9	8.6	78.2
1.7~1.8	1.9	48.9	68.9	92.91	679.74	69.8	9.7	80.1
1.8~1.9	1.7	56.5	70.7	96.05	775.79	71.5	10.9	81.5
+1.9	28.5	81.5	85.8	2322.75	3098.54	100.0	31.0	



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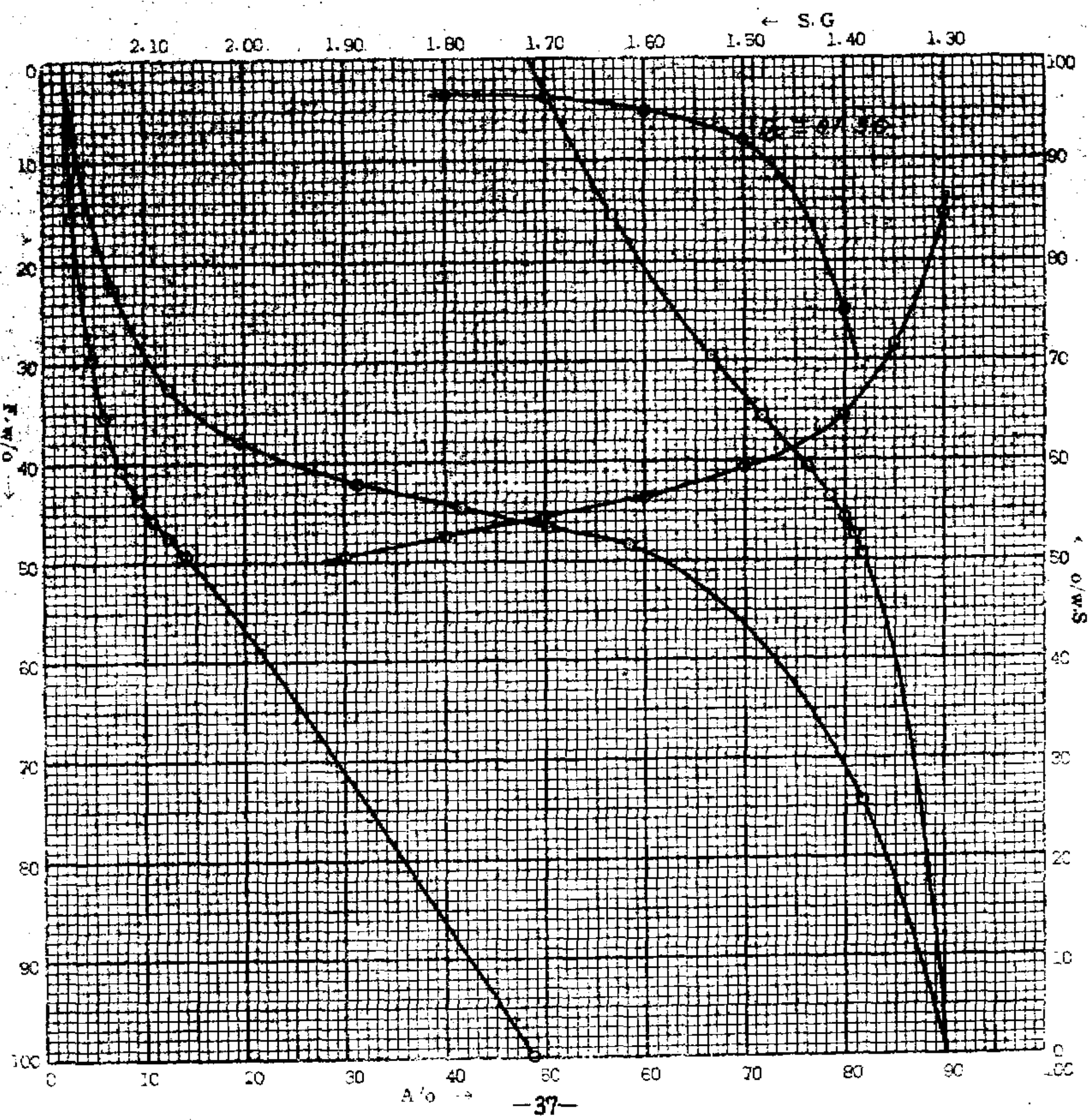
(1967)

TB-3 B SEAM
(Middle + Lower)

Size	wt %	Ash%
20 ~ 0.5 mm	81.0	48.4
− 0.5 mm	19.0	20.0
Total	100.0	43.0

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	Σ W	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af - \Sigma WA}{100 - \Sigma W}$
−1.3	15.6	2.8	7.8	43.68	43.68	15.6	2.8	56.8
1.3 ~ 1.35	13.8	6.8	22.5	93.84	137.52	29.4	4.7	66.6
1.35 ~ 1.4	6.1	12.3	32.5	75.03	212.55	35.5	6.0	71.7
1.4 ~ 1.5	5.2	19.6	38.1	101.92	314.47	40.7	7.7	76.3
1.5 ~ 1.6	2.9	31.1	42.2	90.19	404.66	43.6	9.3	78.6
1.6 ~ 1.7	2.2	41.9	44.7	92.18	496.84	45.8	10.8	80.1
1.7 ~ 1.8	1.6	50.3	46.6	80.48	577.32	47.4	12.2	81.0
1.8 ~ 1.9	2.0	58.3	48.4	116.60	693.92	49.4	14.0	81.9
+1.9	50.6	81.9	74.7	4144.14	4838.06	100.0	48.4	

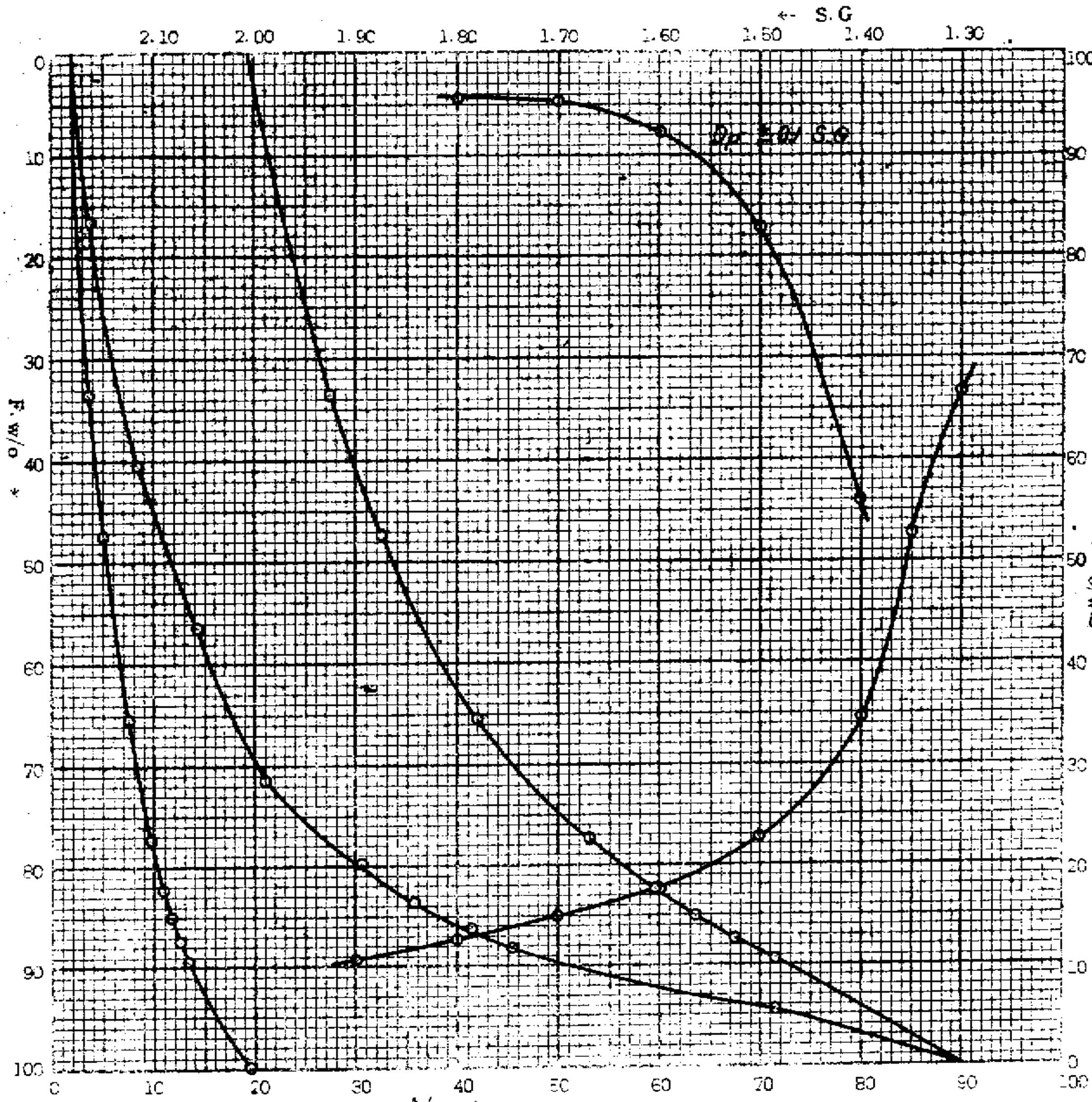


(1967)

TB-4 B SEAM (Upper)

Size	wt%	Ash%
20 ~ 0.5 mm	78.1	19.5
-0.5 mm	21.9	15.8
Total	100.0	18.7

S G	w/o	A/o	$\Sigma W_{n-1} - \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100S - \Sigma WA}{100 - \Sigma W}$
-1.3	33.4	3.6	16.7	120.24	120.24	33.4	3.6	27.4
1.3~1.35	13.8	8.3	40.3	114.54	234.78	47.2	5.0	32.4
1.35~1.4	18.1	14.1	56.3	255.21	489.99	65.3	7.5	41.9
1.4~1.5	12.0	21.0	71.3	252.00	741.99	77.3	9.6	53.0
1.5~1.6	5.1	30.6	79.9	155.55	897.54	82.4	10.9	59.5
1.6~1.7	2.5	35.8	83.7	89.50	987.04	84.9	11.6	63.4
1.7~1.8	2.3	41.6	86.1	95.68	1082.72	87.2	12.4	67.4
1.8~1.9	2.0	45.6	88.2	91.20	1173.92	89.2	13.2	71.4
+1.9	10.8	71.4	94.6	771.12	1945.04	100.0	19.5	



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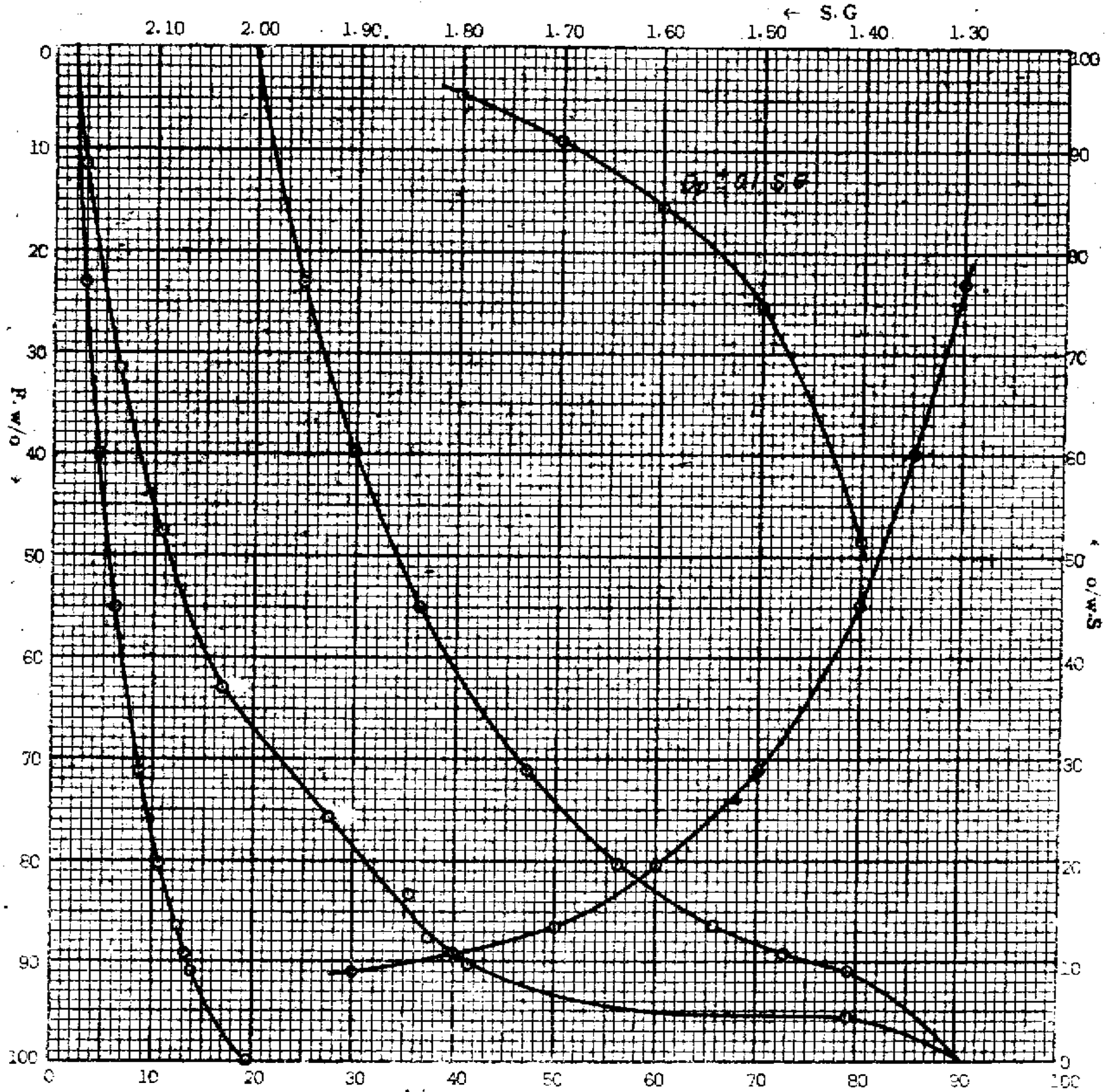
(1967)

TB-4 B SEAM (Lower)

Size	wt%	Ash%
20 ~ 0.5 mm	82.1	19.6
-0.5 mm	17.9	10.3
Total	100.0	17.9

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Sf - \Sigma WA}{100 - \Sigma W}$
-1.3	23.0	2.9	11.5	66.70	66.70	23.0	2.9	24.6
1.3~1.35	16.8	6.2	31.4	104.16	170.86	39.8	4.3	29.7
1.35~1.4	15.1	10.7	47.4	161.57	332.43	54.9	6.1	36.1
1.4~1.5	16.2	16.6	63.0	268.92	601.35	71.1	8.5	47.0
1.5~1.6	9.1	27.5	75.7	250.25	851.60	80.2	10.6	56.0
1.6~1.7	6.2	35.3	83.3	218.86	1070.46	86.4	12.4	65.4
1.7~1.8	2.8	37.3	87.8	104.44	1174.90	89.2	13.2	72.7
1.8~1.9	1.8	41.4	90.1	74.52	1249.42	91.0	13.7	79.0
+1.9	9.0	79.0	95.5	711.00	1960.42	100.0	19.6	



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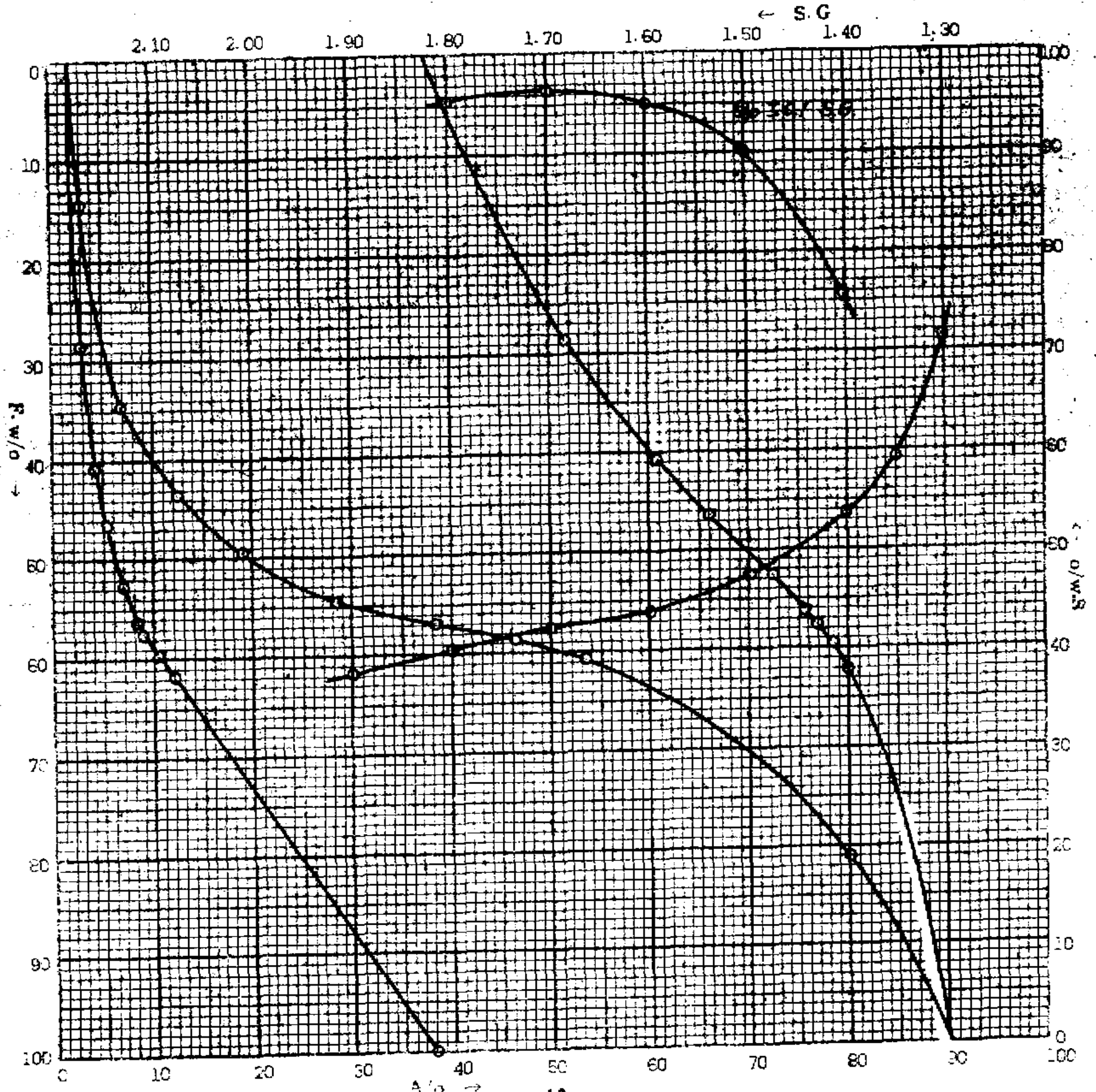
(1967)

TB-5 B SEAM (Upper)

Size	wt%	Ash%
20~0.5 mm	80.2	37.8
-0.5 mm	19.8	19.9
Total	100.0	34.3

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100 St - \Sigma WA}{100 - \Sigma W}$
-13	28.5	3.0	14.3	85.50	85.50	28.5	3.0	51.6
13~135	12.2	6.8	34.6	82.96	168.46	40.7	4.1	60.8
135~14	5.6	12.3	43.5	68.88	237.34	46.3	5.1	65.9
14~1.5	6.4	19.0	49.5	121.60	358.94	52.7	6.8	72.3
1.5~1.6	3.4	28.3	54.4	96.22	455.16	56.1	8.1	75.7
1.6~1.7	1.4	38.1	56.8	53.34	508.50	57.5	8.8	76.9
1.7~1.8	2.1	46.2	58.6	97.02	605.52	59.6	10.2	78.5
1.8~1.9	2.3	53.5	60.8	123.05	728.57	61.9	11.8	80.0
+1.9	38.1	80.0	81.0	3048.00	3776.57	100.0	37.8	



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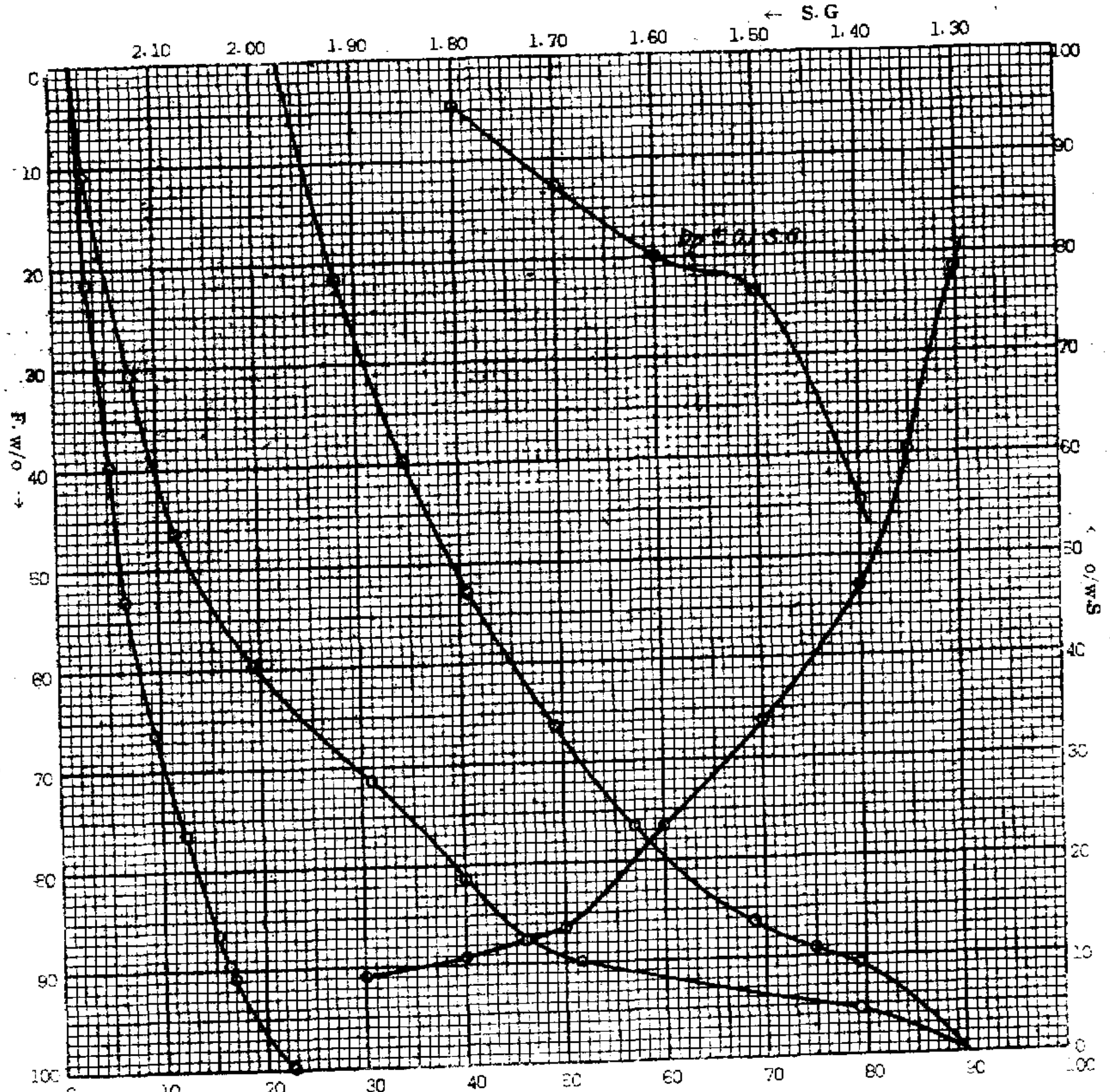
(1967)

TB-5 B SEAM
(Middle + Lower)

Size	wt%	Ash%
20~0.5mm	84.8	22.6
-0.5mm	15.2	12.5
Total	100.0	21.1

S G	w/o	A/o	$\frac{\Sigma W_{n-1}-W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af-\Sigma WA}{100-\Sigma W}$
-1.3	21.5	3.0	10.8	64.50	64.50	21.5	3.0	28.0
1.3~1.35	18.2	7.5	30.6	136.50	201.00	39.7	5.1	34.2
1.35~1.4	13.3	11.5	46.4	152.95	353.95	53.0	6.7	40.6
1.4~1.5	13.2	19.1	59.6	252.12	606.07	66.2	9.2	49.0
1.5~1.6	10.2	30.9	71.3	315.18	921.25	76.4	12.1	56.9
1.6~1.7	9.8	40.1	81.3	392.98	1314.23	86.2	15.2	68.8
1.7~1.8	2.9	46.0	87.7	133.40	1447.63	89.1	16.2	74.8
1.8~1.9	1.7	51.6	90.0	87.72	1535.35	90.8	16.9	79.1
+1.9	9.2	79.1	95.4	727.72	2263.07	100.0	22.6	



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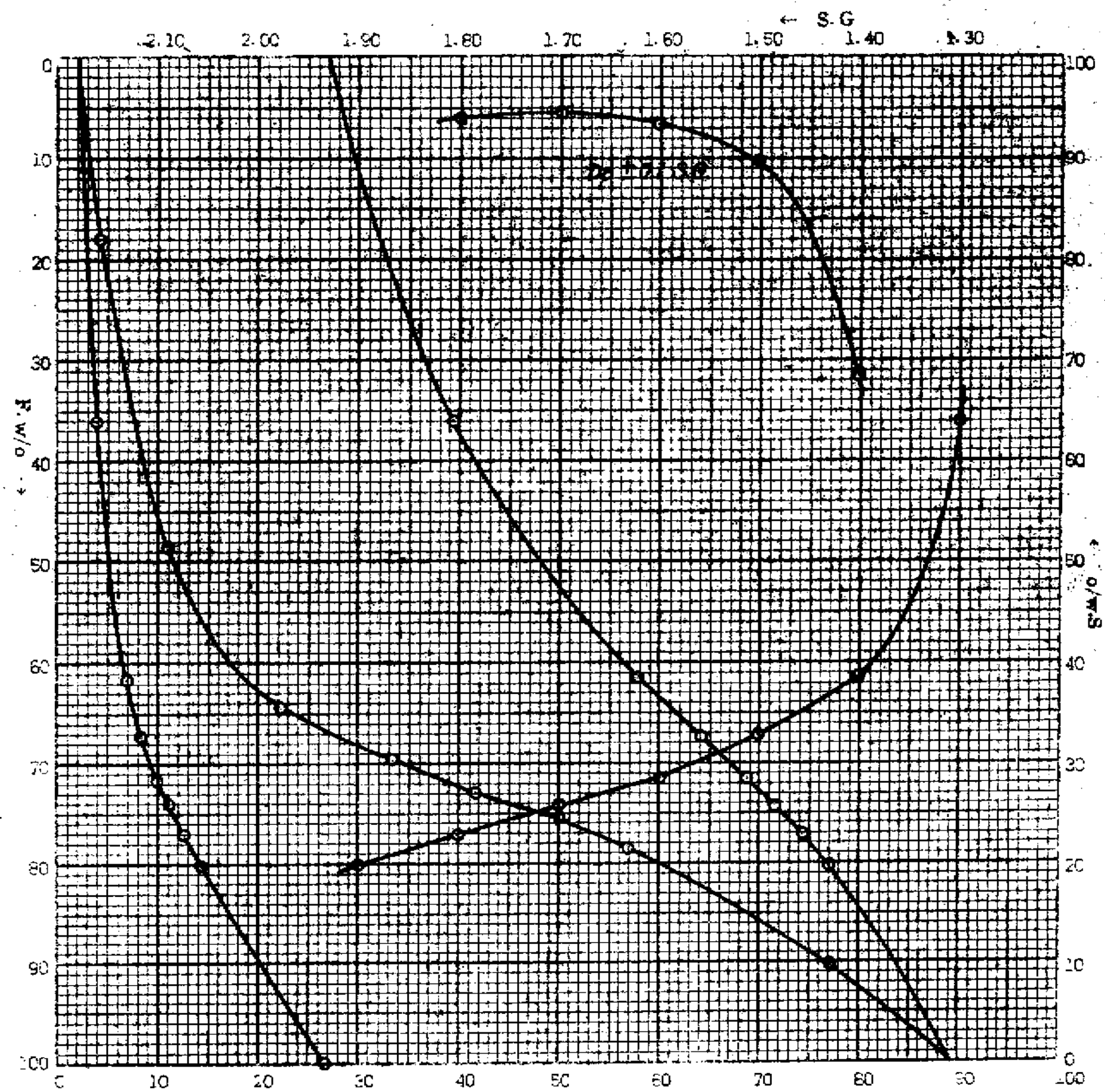
(1967)

TB-6 B SEAM (Upper)

Size	wt %	Ash%
20 ~ 0.5 mm	77.3	26.6
- 0.5 mm	22.7	14.6
Total	100.0	23.9

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af-\Sigma WA}{100-\Sigma W}$
-1.3	36.0	4.1	18.0	147.60	147.60	36.0	4.1	39.2
1.3~1.4	25.4	10.9	48.7	276.86	424.46	61.4	6.9	57.8
1.4~1.5	5.8	22.2	64.3	128.76	553.22	67.2	8.2	64.1
1.5~1.6	4.4	33.5	69.4	147.40	700.62	71.6	9.8	68.8
1.6~1.7	2.5	41.6	72.9	104.00	804.62	74.1	10.9	71.5
1.7~1.8	2.9	49.9	75.6	144.71	949.33	77.0	12.3	74.2
1.8~1.9	3.1	56.8	78.6	176.08	1125.41	80.1	14.1	76.9
+1.9	19.9	76.9	90.1	1530.31	2655.72	100.0	26.6	



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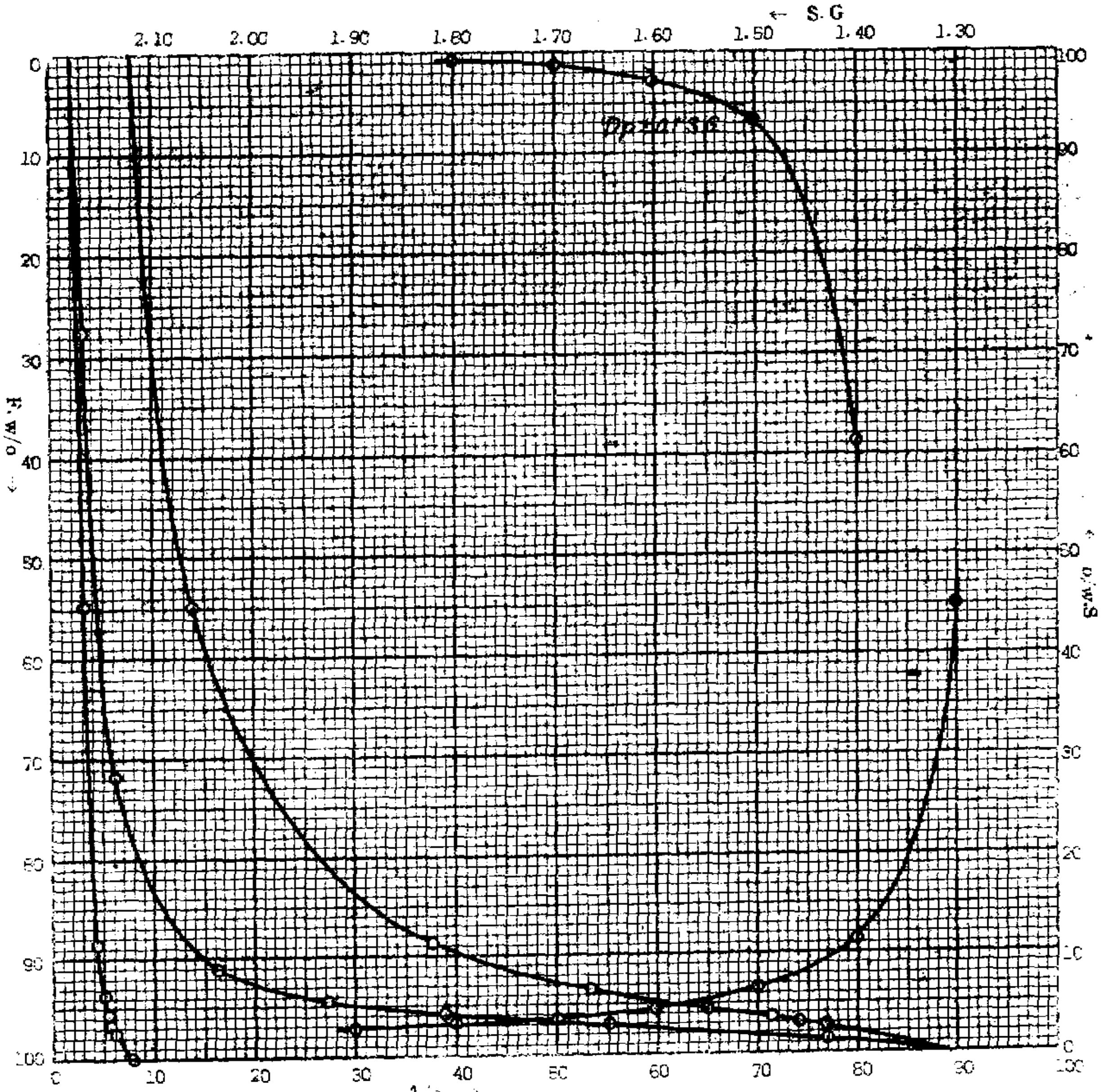
(1967)

TB-6 B SEAM (Lower)

Size	wt%	Ash%
20 ~ 0.5mm	81.2	8.0
-0.5mm	18.8	7.0
Total	100.0	7.8

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af-\Sigma WA}{100-\Sigma W}$
-13	54.8	3.1	27.4	169.88	169.88	54.8	3.1	14.0
13~14	33.9	6.2	71.8	210.18	380.06	88.7	4.3	37.5
14~15	4.8	16.2	91.1	77.76	457.82	93.5	4.9	53.3
1.5~1.6	2.0	27.2	94.5	54.40	512.22	95.5	5.4	64.9
1.6~1.7	0.9	38.9	96.0	35.01	547.23	96.4	5.7	71.4
1.7~1.8	0.4	49.1	96.6	19.64	566.87	96.8	5.9	74.2
1.8~1.9	0.4	55.1	97.0	22.04	588.91	97.2	6.1	76.9
+1.9	2.8	76.9	98.6	215.32	804.23	100.0	8.0	

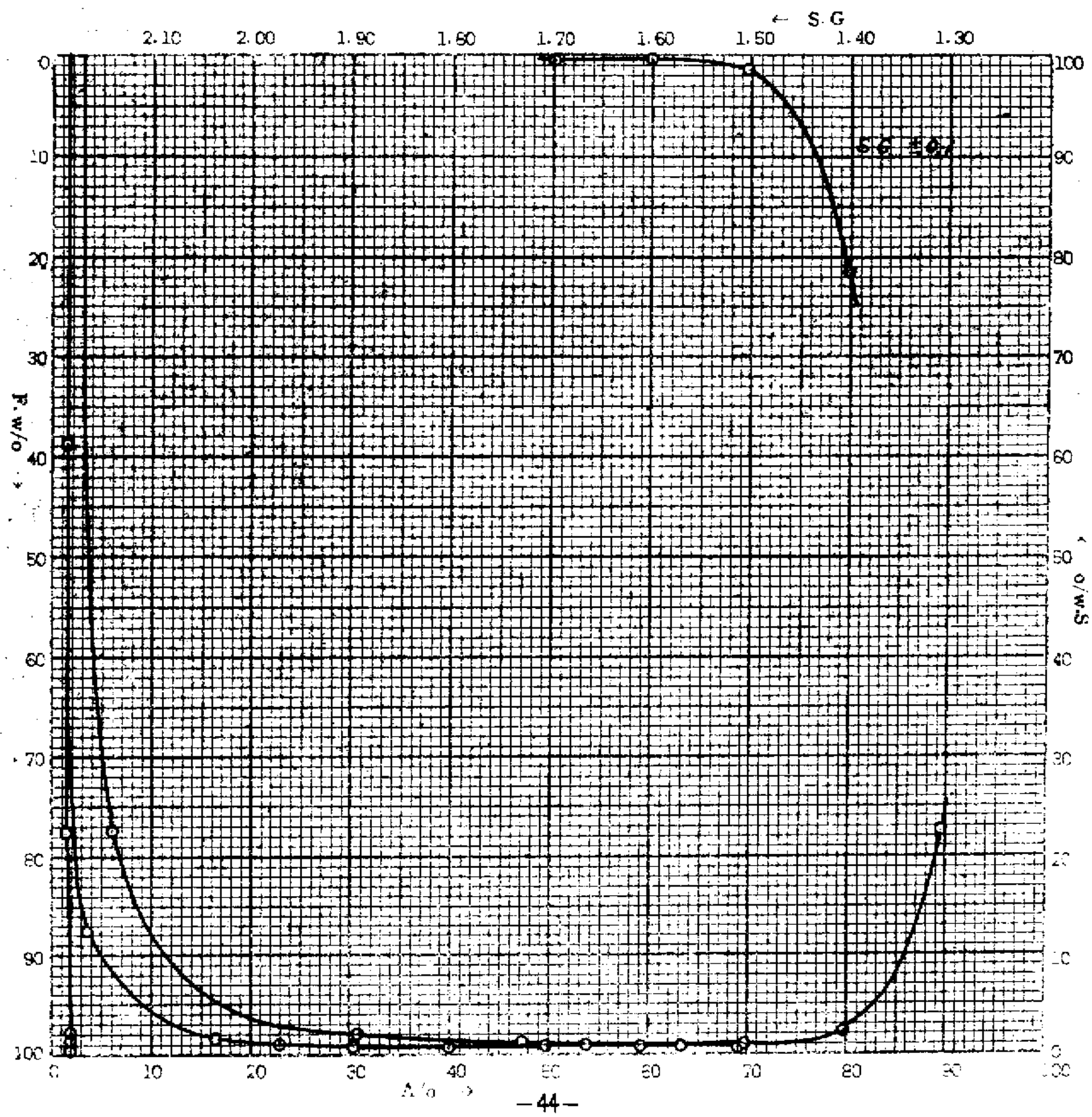


(1966)

TA-1 A SEAM (Upper)

S G	w/o	A/o	$\frac{\Sigma W_{n-1} + \frac{W_n}{2}}{}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af - \Sigma WA}{100 - \Sigma W}$
−1.8	77.7	1.9	38.9	147.63	147.63	77.7	1.9	6.6
1.4	20.4	4.3	87.9	87.72	235.35	98.1	2.4	31.1
1.5	1.0	16.5	98.6	16.50	251.85	99.1	2.5	47.3
1.6	0.2	23.2	99.2	4.64	256.49	99.3	2.6	54.2
1.7	0.2	30.6	99.4	6.12	262.61	99.5	2.6	63.6
1.8	0.1	40.5	99.6	4.05	266.66	99.6	2.7	69.4
+1.8	0.4	69.4	99.8	27.76	294.42	100.0	2.9	
Σ	100.0	2.9						

Size	W/O	A/O
+0.5mm	78.4	2.9
−0.5mm	21.6	2.8
Σ	100.0	2.9



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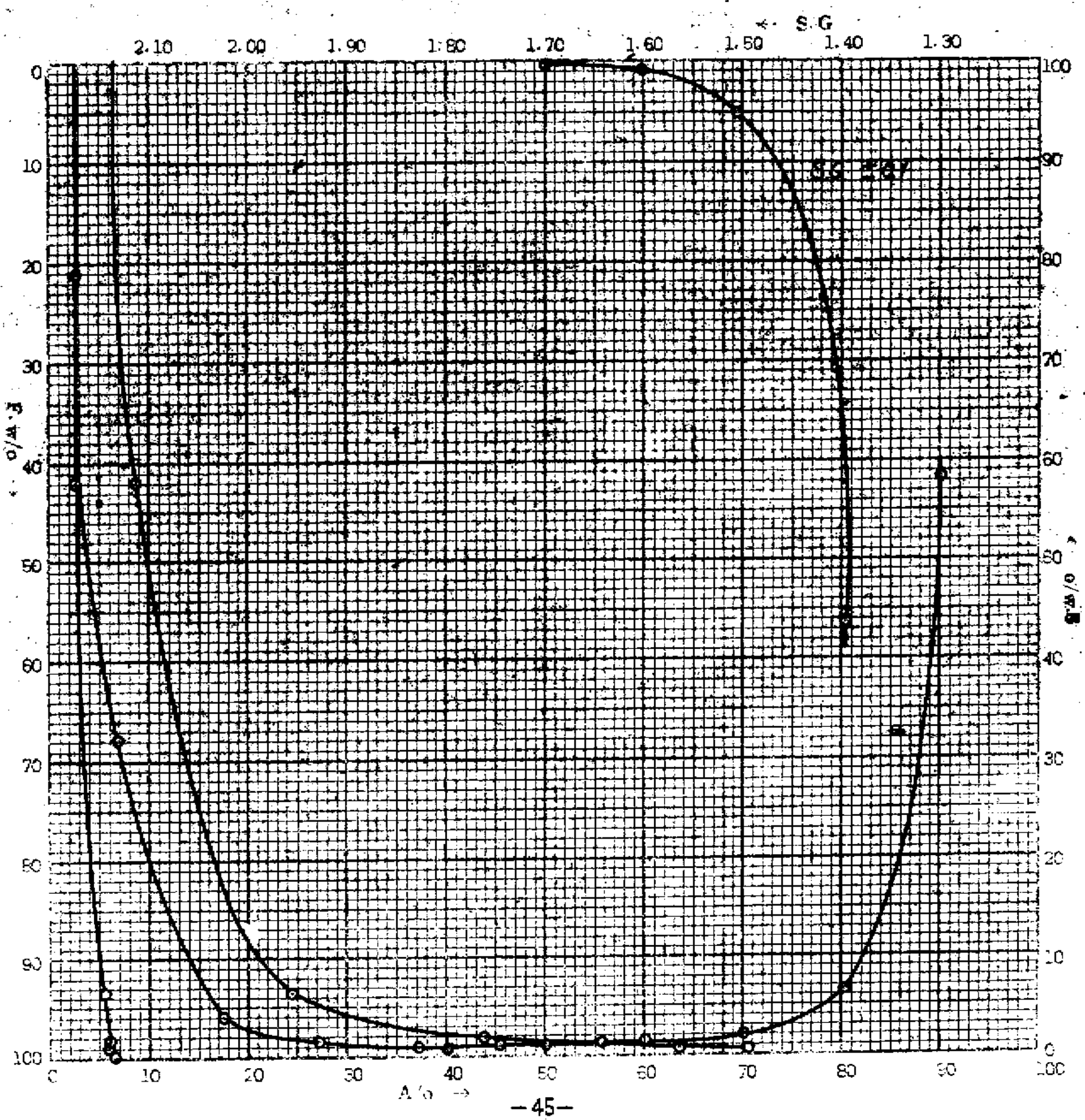
(1966)

TA-I A SEAM (Lower)

Size	W/o	A/o
+0.5mm	79.6	6.3
−0.5mm	20.4	6.1
Σ	100.0	6.3

S G	W/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100\varepsilon - \Sigma WA}{100 - \Sigma W}$
−1.3	41.9	2.9	21.0	121.5	121.5	41.9	2.9	8.8
1.4	51.9	6.9	67.9	358.1	479.6	93.8	5.1	24.5
1.5	4.5	17.3	96.1	77.9	557.5	98.3	5.7	43.7
1.6	0.7	27.1	98.7	18.9	576.4	99.0	5.8	55.4
1.7	0.3	36.9	99.2	11.1	587.5	99.3	5.9	63.3
1.8	0.2	45.4	99.4	9.1	596.6	99.5	6.0	70.4
+1.8	0.5	70.4	99.8	35.2	631.8	100.0	6.3	
Σ	100.0	6.3						

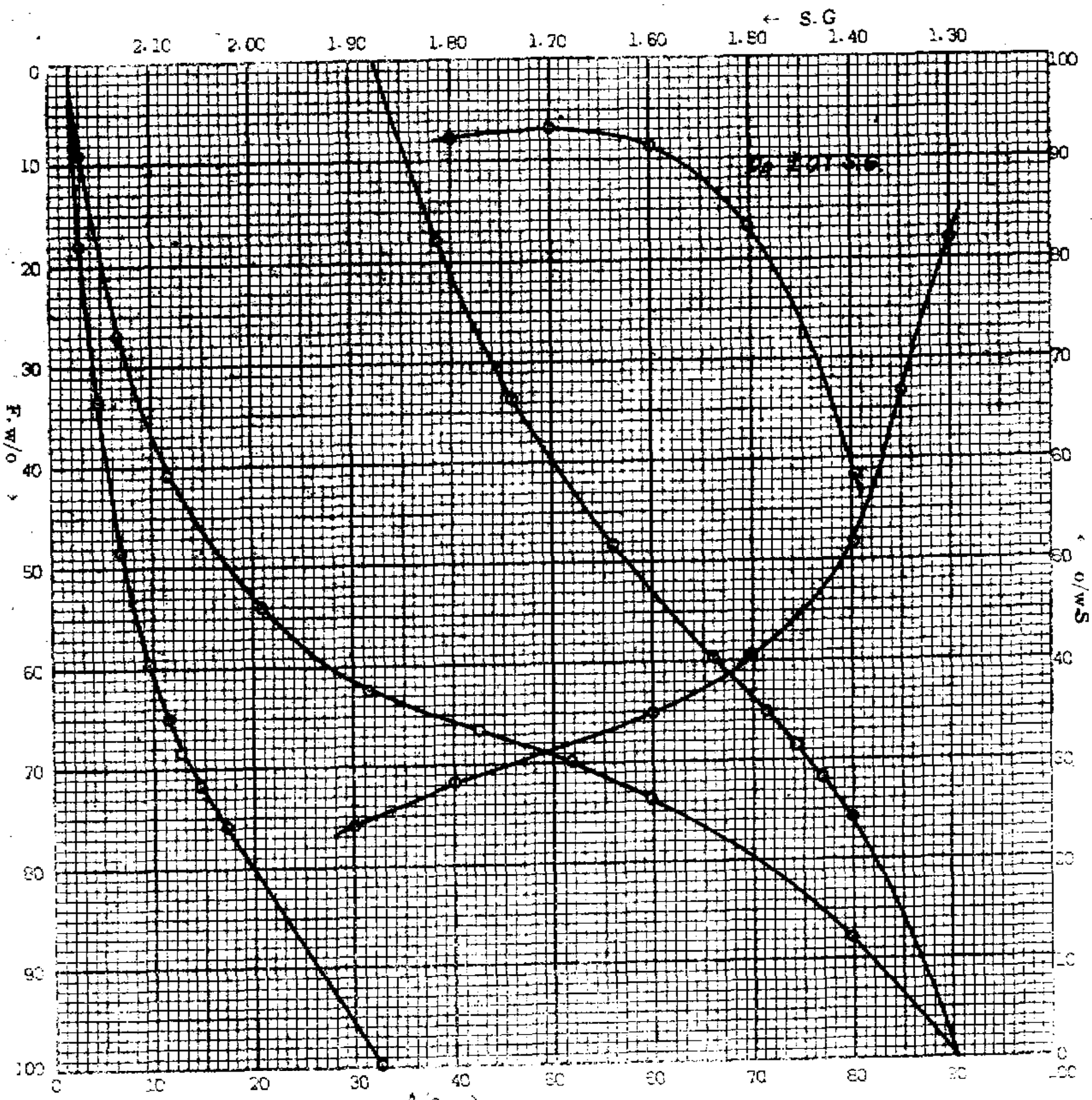


(1967)

TA-2 A SEAM (Upper)

Size	wt%	Ash%
20 ~ 0.5 mm	78.9	32.3
−0.5 mm	21.1	14.1
Total	100.0	28.5

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	Σ W	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100st - \Sigma WA}{100 - \Sigma W}$
−1.3	18.0	2.8	9.0	50.40	50.40	18.0	2.8	38.7
1.3~1.35	15.2	6.7	25.6	101.84	152.24	33.2	4.6	46.0
1.35~1.4	14.9	11.4	40.7	169.86	322.10	48.1	6.7	55.9
1.4~1.5	11.4	20.9	53.8	238.26	560.36	59.5	9.4	65.8
1.5~1.6	5.5	31.4	62.3	172.70	733.06	65.0	11.3	71.2
1.6~1.7	3.3	42.5	66.7	140.25	873.31	68.3	12.8	74.2
1.7~1.8	3.4	51.7	70.0	175.78	1049.09	71.7	14.6	76.9
1.8~1.9	4.1	59.8	73.8	245.18	1294.27	75.8	17.1	79.8
+1.9	24.2	79.8	87.9	1931.16	3225.43	100.0	32.3	



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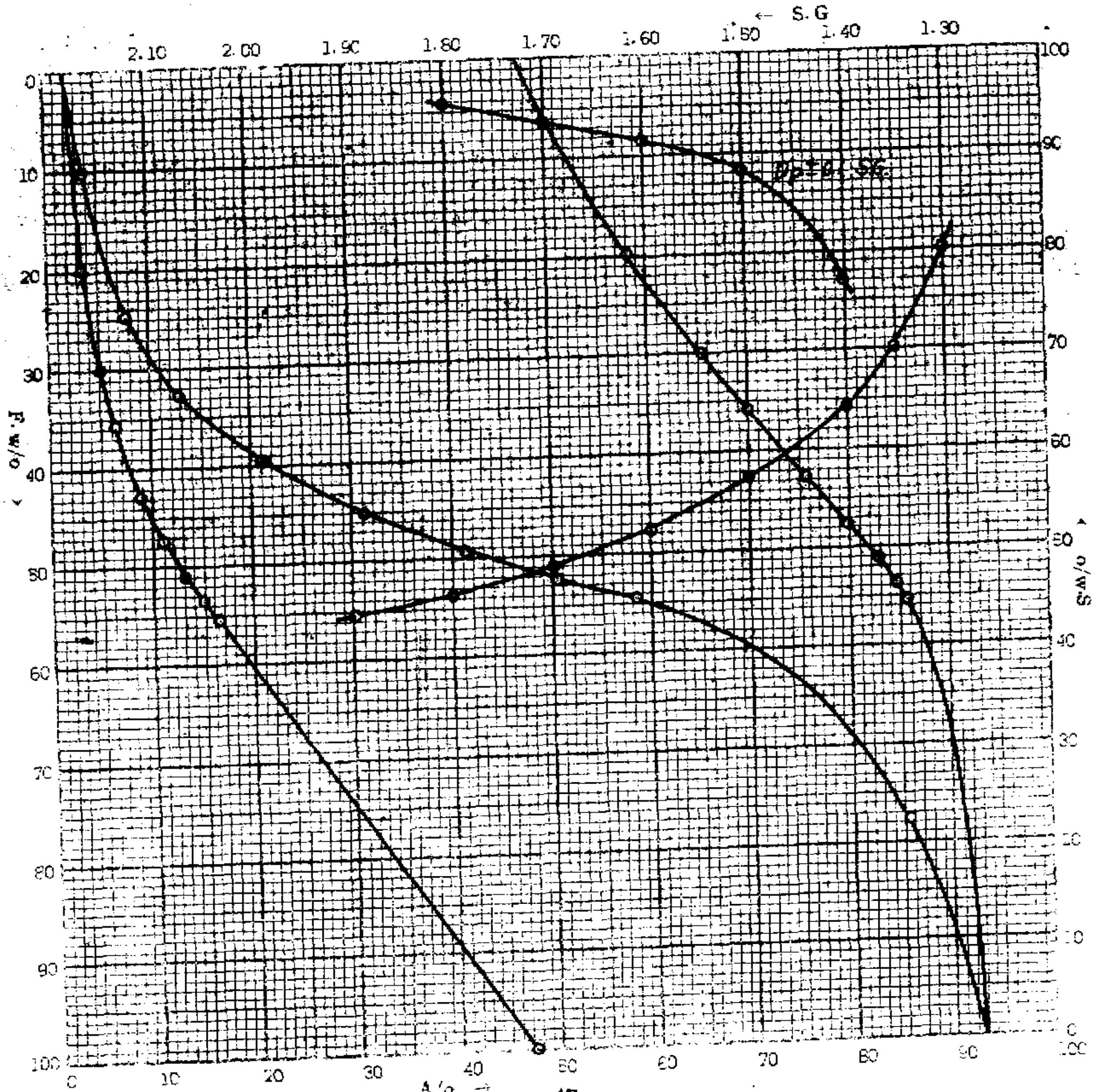
(1967)

TA-2 A SEAM (Lower)

Size	wt %	Ash%
20 ~ 0.5 mm	89.5	47.1
-0.5 mm	10.5	21.0
Total	100.0	44.4

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af-\Sigma WA}{100-\Sigma W}$
-1.3	19.7	3.5	9.9	68.95	68.95	19.7	3.5	57.9
1.3 ~ 1.35	10.2	7.8	24.8	79.56	148.51	29.9	5.0	65.1
1.35 ~ 1.4	5.8	12.8	32.8	74.24	222.75	35.7	6.2	69.9
1.4 ~ 1.5	6.9	21.0	39.2	144.90	367.65	42.6	8.6	75.7
1.5 ~ 1.6	4.8	31.2	45.0	149.76	517.41	47.4	10.9	79.8
1.6 ~ 1.7	3.6	41.1	49.2	147.96	665.37	51.0	13.0	82.6
1.7 ~ 1.8	2.5	50.4	52.3	126.00	791.37	53.5	14.8	84.4
1.8 ~ 1.9	1.6	58.5	54.3	93.60	884.97	55.1	16.1	85.3
+1.9	44.9	85.3	77.6	3829.97	4714.94	100.0	47.1	

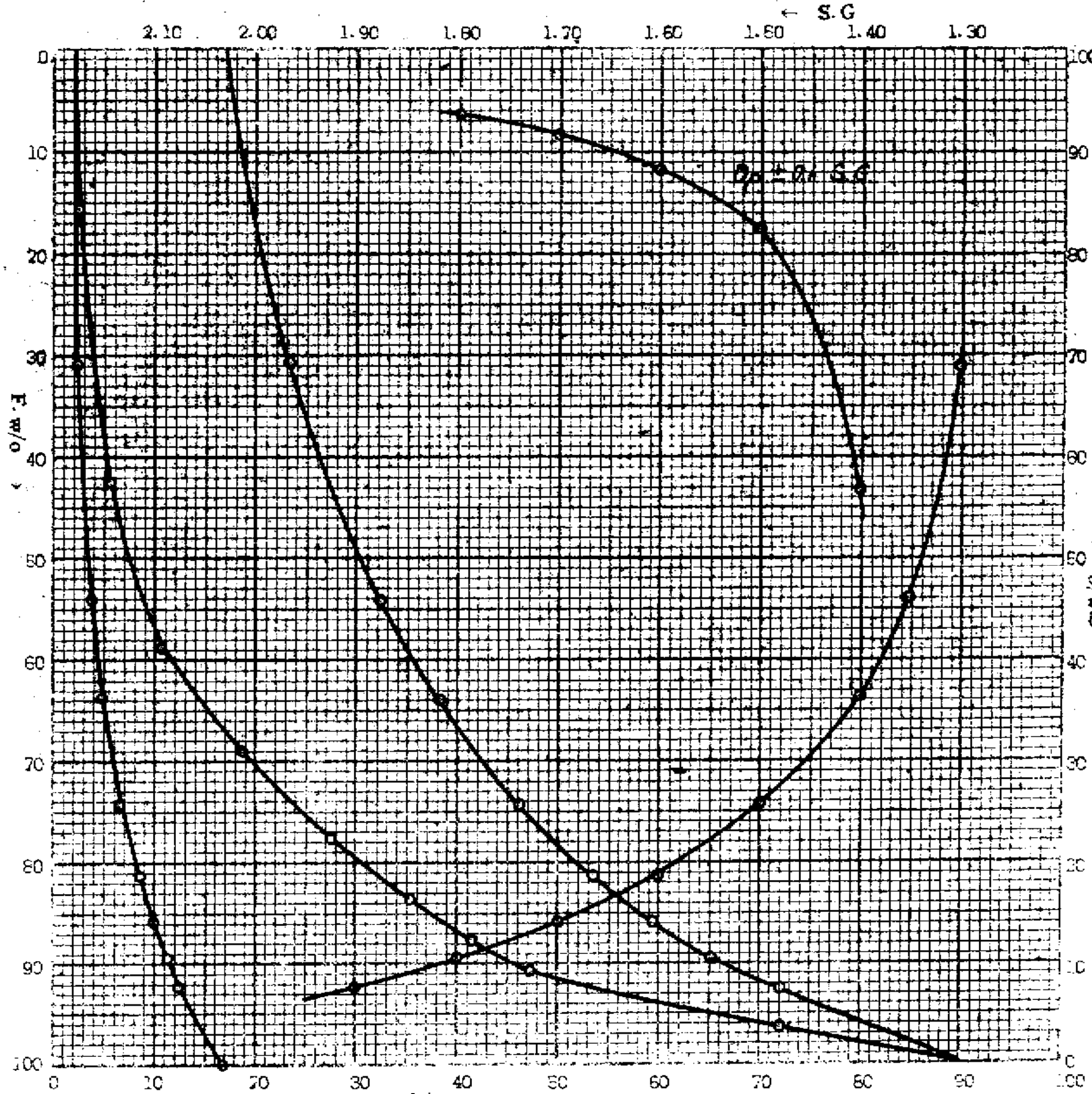


(1967)

TA-3. A SEAM (2~L)

Size	wt%	Ash%
20~0.5mm	72.7	16.9
-0.5mm	27.3	11.9
Total	100.0	15.5

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100\Sigma(-\Sigma WA)}{100-\Sigma W}$
-1.3	30.9	2.3	15.5	71.07	71.07	30.9	2.3	23.4
1.3~1.35	23.1	5.4	42.5	124.74	195.81	54.0	3.6	32.4
1.35~1.4	9.7	10.7	58.9	103.79	299.60	63.7	4.7	38.2
1.4~1.5	10.4	18.6	68.9	193.44	493.04	74.1	6.7	46.1
1.5~1.6	7.1	27.3	77.7	193.83	686.87	81.2	8.5	53.2
1.6~1.7	4.7	35.1	83.6	164.97	851.84	85.9	9.9	59.3
1.7~1.8	3.5	41.3	87.7	144.55	996.39	89.4	11.1	65.2
1.8~1.9	2.9	47.3	90.9	137.17	1133.56	92.3	12.3	72.0
+1.9	7.7	72.0	96.2	554.40	1687.96	100.0	16.9	



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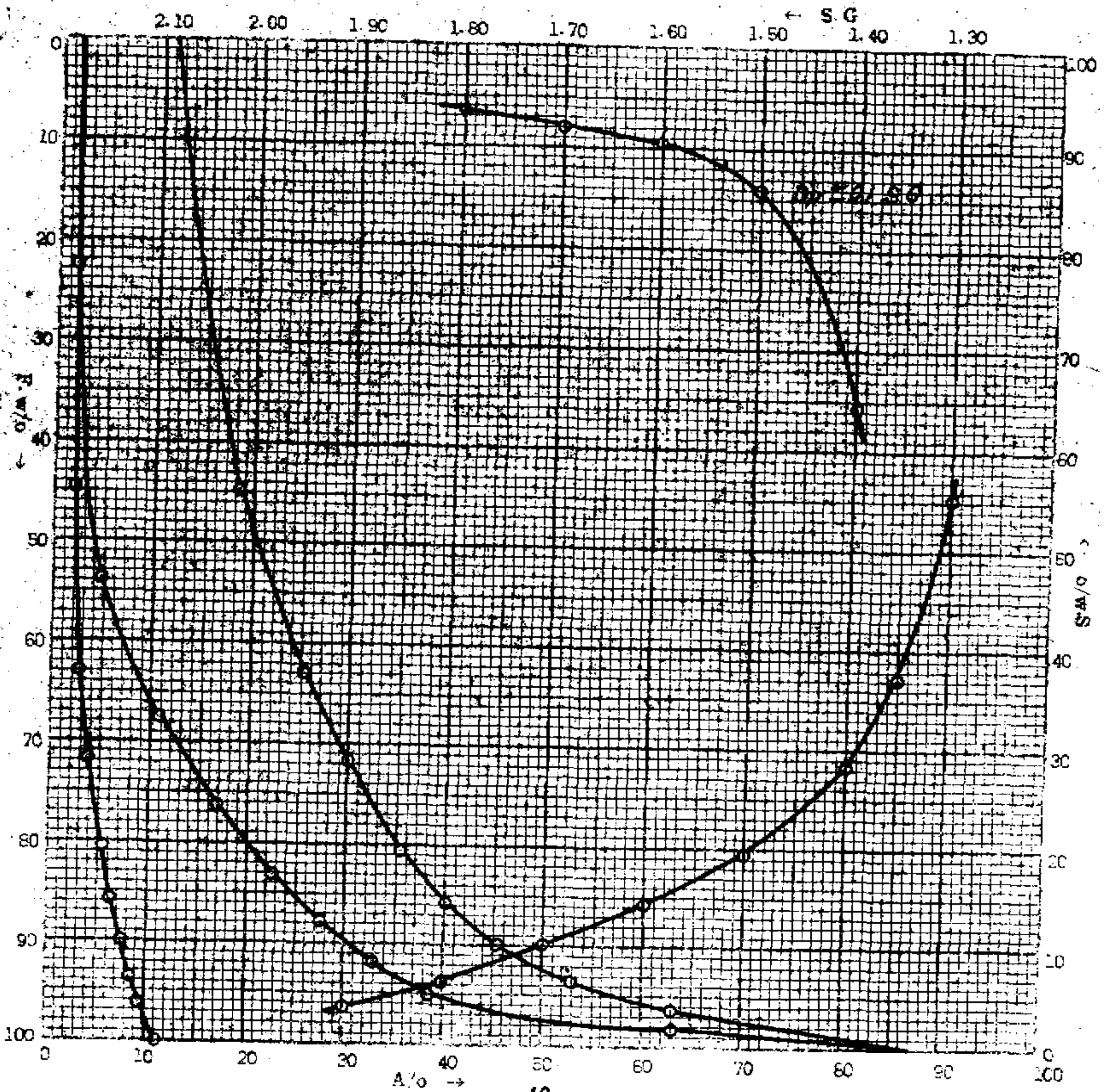
(1967)

TA-3 A SEAM
(2~2) + (2~3)

Size	wt %	Ash%
20 ~ 0.5 mm	73.3	11.1
−0.5 mm	26.7	7.7
Total	100.0	10.2

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	[illegible] / 100−ΣW
−1.3	44.8	2.0	22.4	89.60	89.60	44.8	2.0	18.5
1.3~1.35	18.0	4.8	53.8	86.40	176.00	62.8	2.8	25.1
1.35~1.4	8.9	10.6	67.3	94.34	270.34	71.7	3.8	29.7
1.4~1.5	8.7	16.9	76.1	147.03	417.37	80.4	5.2	35.4
1.5~1.6	5.3	22.6	83.1	119.78	537.15	85.7	6.3	40.1
1.6~1.7	4.2	27.4	87.8	115.08	652.23	89.9	7.3	45.4
1.7~1.8	3.8	32.9	91.8	125.02	777.25	93.7	8.3	52.9
1.8~1.9	2.6	38.5	95.0	100.10	877.35	96.3	9.1	63.0
+1.9	3.7	63.0	98.2	233.10	1110.45	100.0	11.1	

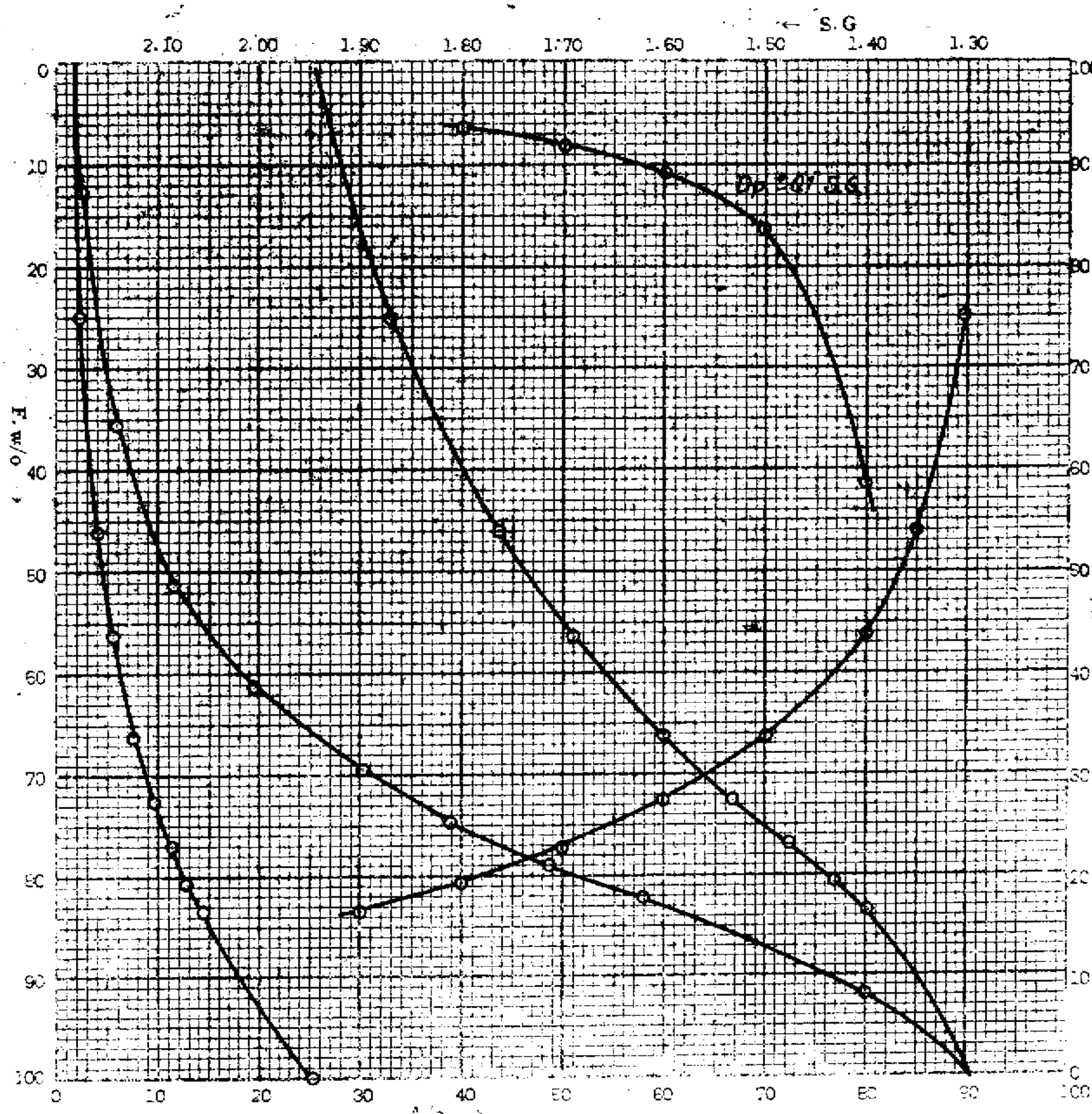


(1967)

TA-3 A SEAM
(2~4)+(2~5)

Size	wt%	Ash%
20 ~ 0.5 mm	71.9	25.2
-0.5 mm	28.1	16.1
Total	100.0	22.6

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100M - \Sigma WA}{100 - \Sigma W}$
1.3	25.0	2.3	12.5	57.50	57.50	25.0	2.3	32.9
1.3~1.35	21.0	5.9	35.5	123.90	181.40	46.0	3.9	43.4
1.35~1.4	10.3	11.6	51.2	119.48	300.88	56.3	5.3	50.9
1.4~1.5	9.8	19.7	61.2	193.06	493.94	66.1	7.5	59.9
1.5~1.6	6.4	30.2	69.3	193.28	687.22	72.5	9.5	66.8
1.6~1.7	4.5	38.9	74.8	175.05	862.27	77.0	11.2	72.3
1.7~1.8	3.7	48.6	78.9	179.82	1042.09	80.7	12.9	76.8
1.8~1.9	2.8	57.9	82.1	162.12	1204.21	83.5	14.4	80.0
+1.9	16.5	80.0	91.8	1320.00	2524.21	100.0	25.2	



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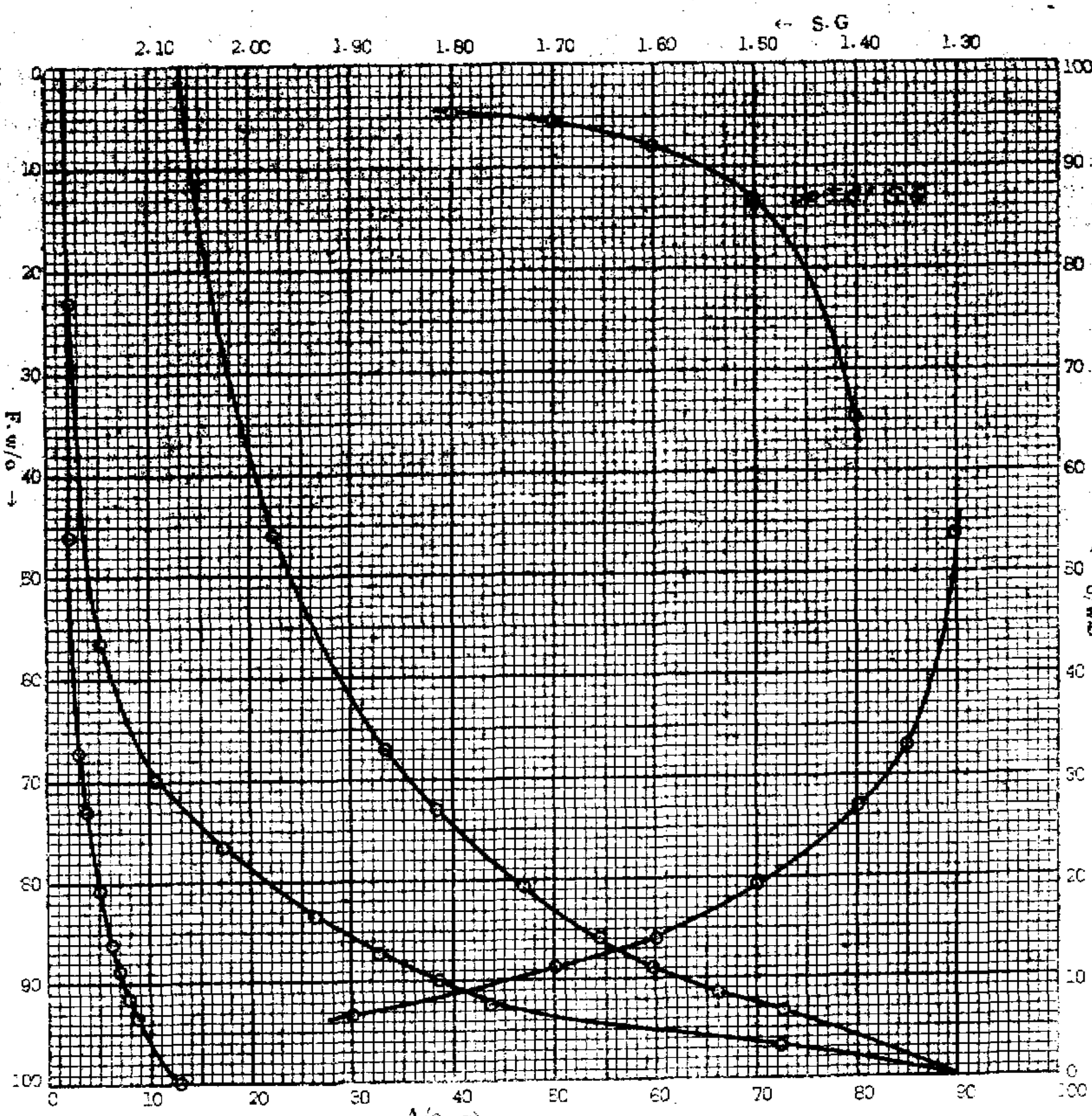
(1967)

TA-4 A SEAM
(1~1) + (1~2)

Size	wt%	Ash%
20 ~ 0.5 mm	61.9	13.0
-0.5 mm	38.1	8.0
Total	100.0	11.1

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af - \Sigma WA}{100 - \Sigma W}$
-1.3	45.9	2.1	23.0	96.39	96.39	45.9	2.1	22.2
1.3~1.35	21.0	5.0	56.4	105.00	201.39	66.9	3.0	33.2
1.35~1.4	6.0	10.5	69.9	63.00	264.39	72.9	3.6	38.2
1.4~1.5	7.8	17.2	76.8	134.16	398.55	80.7	4.9	46.7
1.5~1.6	5.2	26.1	83.3	135.72	534.27	85.9	6.2	54.3
1.6~1.7	2.8	32.5	87.3	91.00	625.27	88.7	7.0	59.7
1.7~1.8	2.6	38.3	90.0	99.58	724.85	91.3	7.9	66.1
1.8~1.9	1.9	43.5	92.3	82.65	807.50	93.2	8.7	72.4
+1.9	6.8	72.4	96.6	492.32	1299.82	100.0	13.0	



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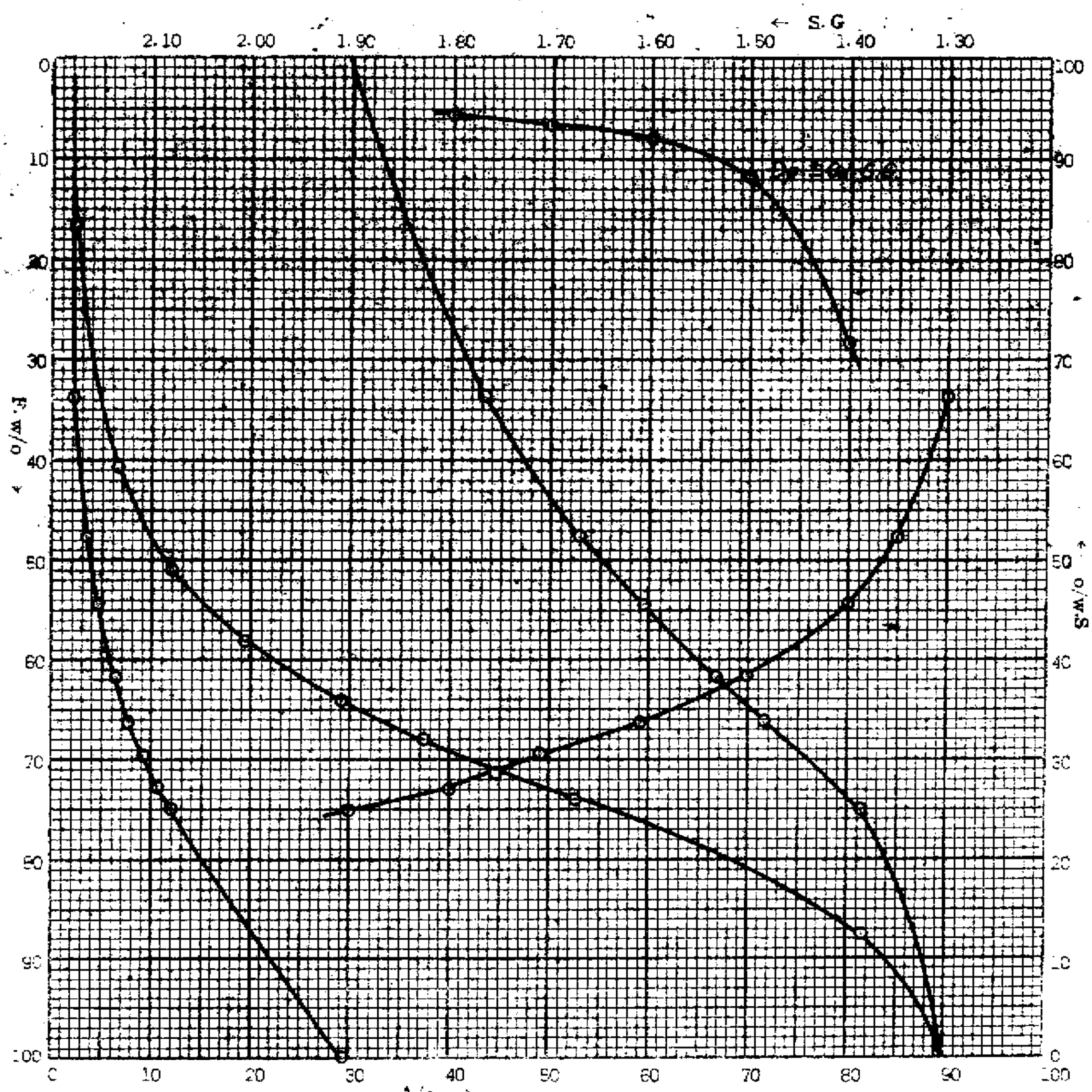
(1967)

TA-4 A SEAM
(1~3) + (1~4)

Size	wt%	Ash%
20 ~ 0.5 mm	75.6	29.4
− 0.5 mm	24.4	14.2
Total	100.0	25.7

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Sl - \Sigma WA}{100 - \Sigma W}$
−1.3	33.6	2.2	16.8	73.92	73.92	33.6	2.2	43.1
1.3~1.35	14.0	6.3	40.6	88.20	162.12	47.6	3.4	52.9
1.35~1.4	6.8	11.9	51.0	80.92	243.04	54.4	4.5	59.6
1.4~1.5	7.4	19.5	58.1	144.30	387.34	61.8	6.3	66.7
1.5~1.6	4.3	29.0	64.0	124.70	512.04	66.1	7.7	71.5
1.6~1.7	3.5	37.2	67.9	130.20	642.24	69.6	9.2	75.4
1.7~1.8	3.2	44.5	71.2	142.40	784.64	72.8	10.8	79.1
1.8~1.9	2.2	52.7	73.9	115.94	900.58	75.0	12.0	81.4
+1.9	25.0	81.4	87.5	2035.00	2935.58	100.0	29.4	

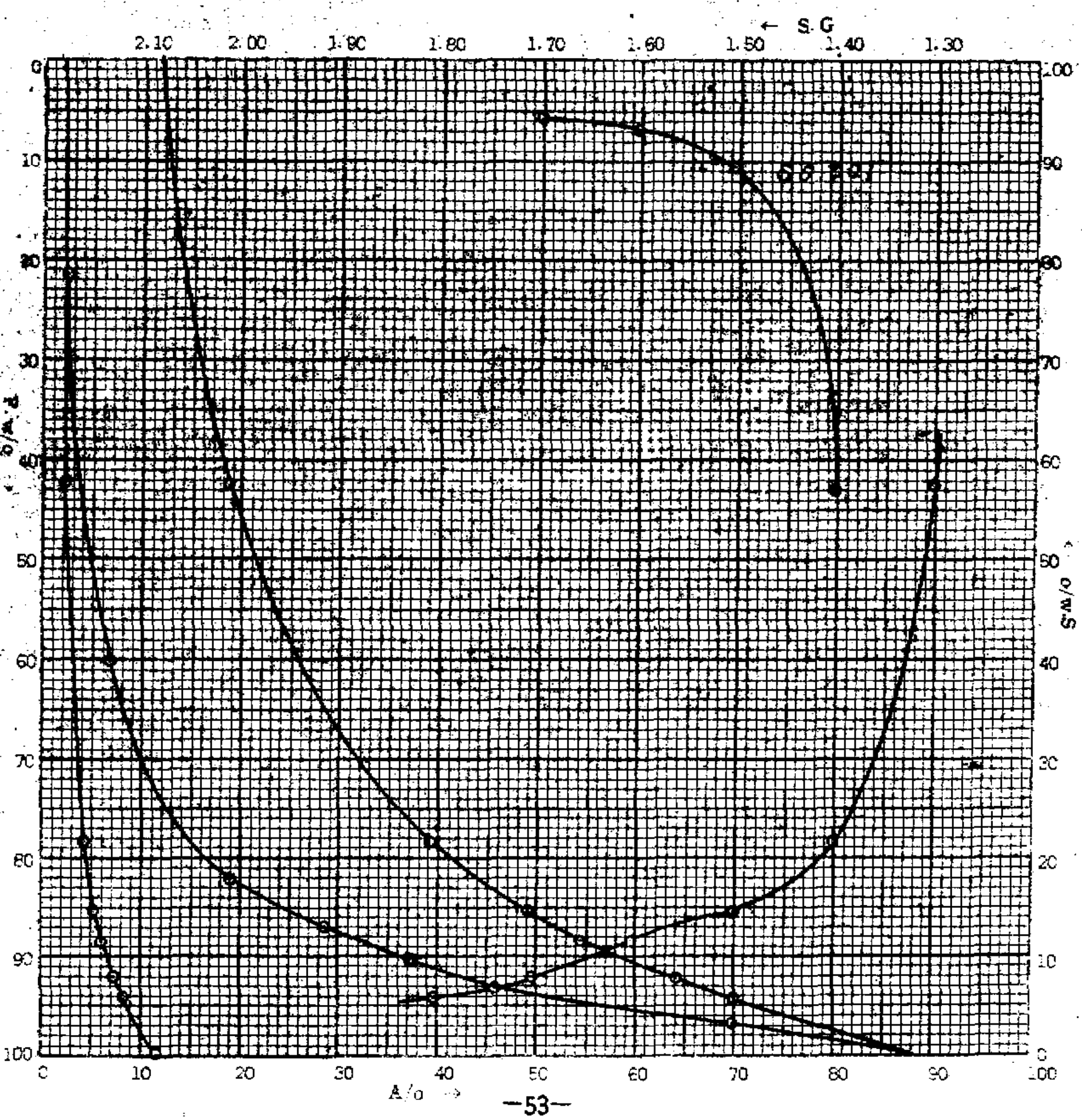


(1966)

TA-4 A SEAM (M-1)

S G	w/o	A/o	ΣWn−1 + Wn/2	W.A	ΣWA (Af)	ΣW	ΣWA/ΣW	(100Σf − ΣWA)/(100 − ΣW)
−1.3	42.5	2.4	21.3	102.00	102.00	42.5	2.4	18.9
1.4	36.0	6.7	60.5	241.20	343.20	78.5	4.4	39.3
1.5	7.1	19.1	82.1	135.61	478.81	85.6	5.6	49.2
1.6	3.2	28.9	87.2	92.48	571.29	88.8	6.4	55.0
1.7	3.8	37.3	90.7	141.74	713.03	92.6	7.7	64.1
1.8	1.8	45.9	93.5	82.62	795.65	94.4	8.4	69.9
+1.8	5.6	69.9	97.2	391.44	1187.09	100.0	11.9	
Σ	100.0	11.9						

Size	w/o	A/o
+0.5mm	61.0	11.9
−0.5mm	39.0	7.0
Σ	100.0	10.0

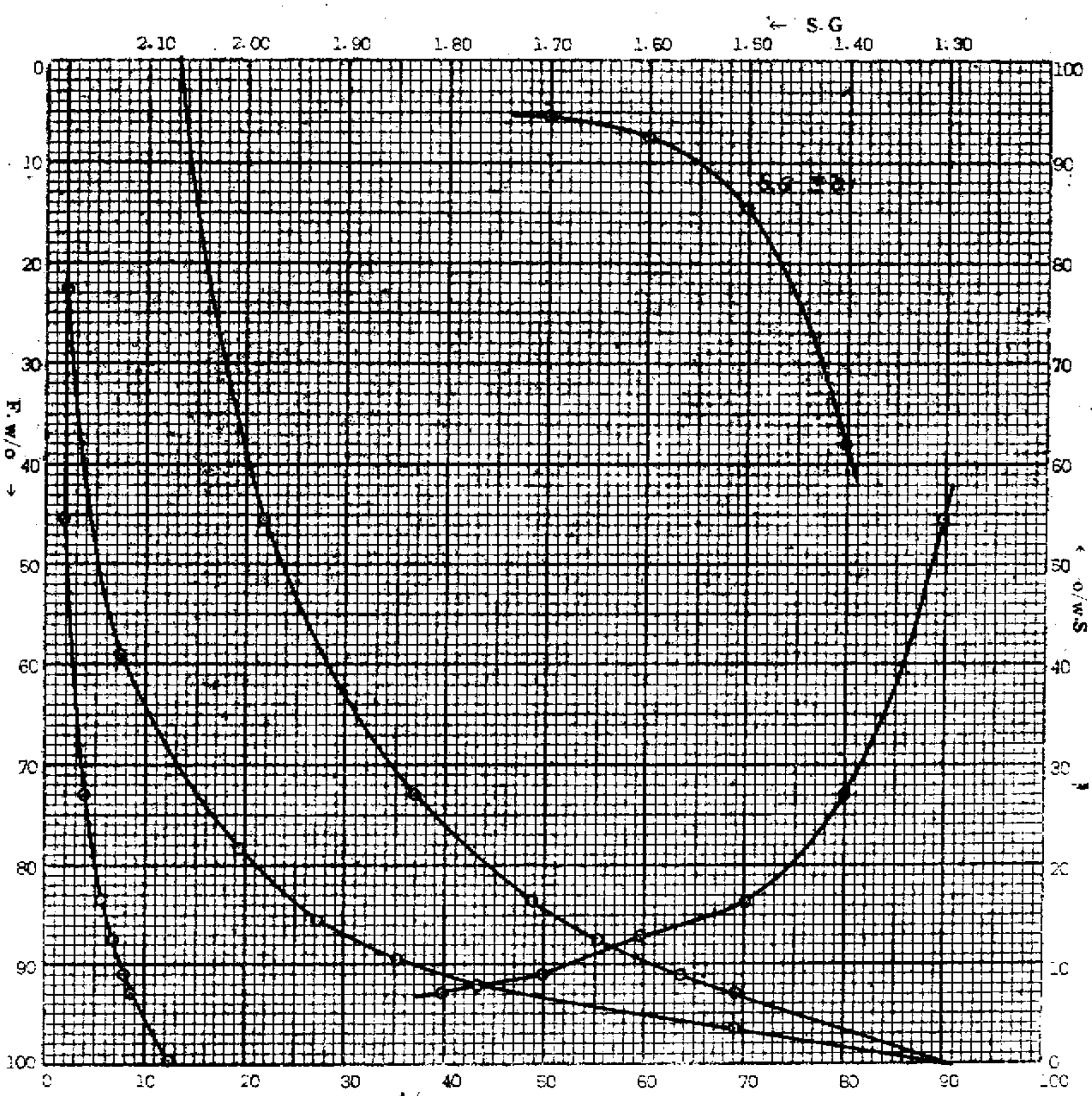


(1966)

TA-4 A SEAM (M-2)

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100\bar{A} - \Sigma WA}{100 - \Sigma W}$
-1.3	45.7	2.2	22.9	100.54	100.54	45.7	2.2	22.0
1.4	27.5	7.5	59.5	206.25	306.79	78.2	4.2	36.9
1.5	10.7	19.5	78.6	208.65	515.44	83.9	6.1	48.5
1.6	3.9	27.3	85.9	106.47	621.91	87.8	7.1	55.2
1.7	3.6	35.3	89.6	127.08	748.99	91.4	8.2	63.6
1.8	1.9	43.7	92.4	83.03	832.02	93.3	8.9	69.2
+1.8	6.7	69.2	96.7	463.64	1295.66	100.0	13.0	
Σ	100.0	13.0						

Size	w/o	A/o
+0.5mm	65.7	13.0
-0.5mm	34.3	10.6
Σ	100.0	12.2

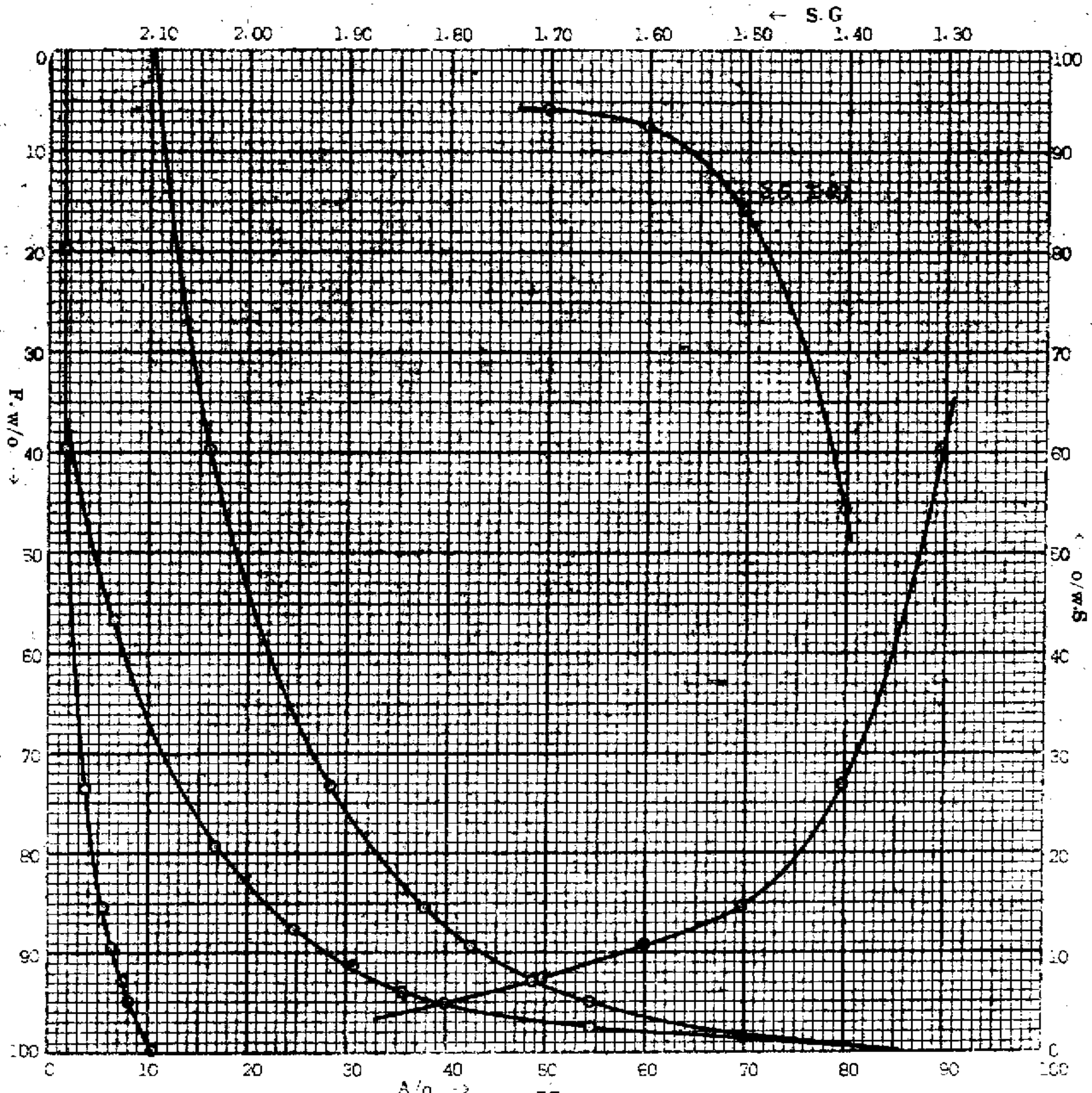


(1966)

TA-4 A SEAM (M-3)

Size	w/o	A/o
+0.5 mm	64.4	10.4
−0.5 mm	35.6	4.8
Σ	100.0	8.4

S G	w/o	A/o	$\frac{\Sigma W_{n-1} + W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af - \Sigma WA}{100 - \Sigma W}$
−1.3	39.7	1.7	19.9	67.5	67.5	39.7	1.7	16.1
1.4	33.7	6.6	56.6	222.4	289.9	73.4	3.9	28.2
1.5	12.2	16.7	79.5	203.8	493.7	85.6	5.8	38.0
1.6	3.7	24.7	87.5	91.3	585.0	89.3	6.6	42.6
1.7	3.7	30.8	91.2	114.0	699.0	93.0	7.5	48.8
1.8	2.1	35.7	96.1	105.0	774.0	95.1	8.1	54.4
+1.8	4.9	54.4	97.6	266.5	1040.5	100.0	10.4	
Σ	100.0	10.4						

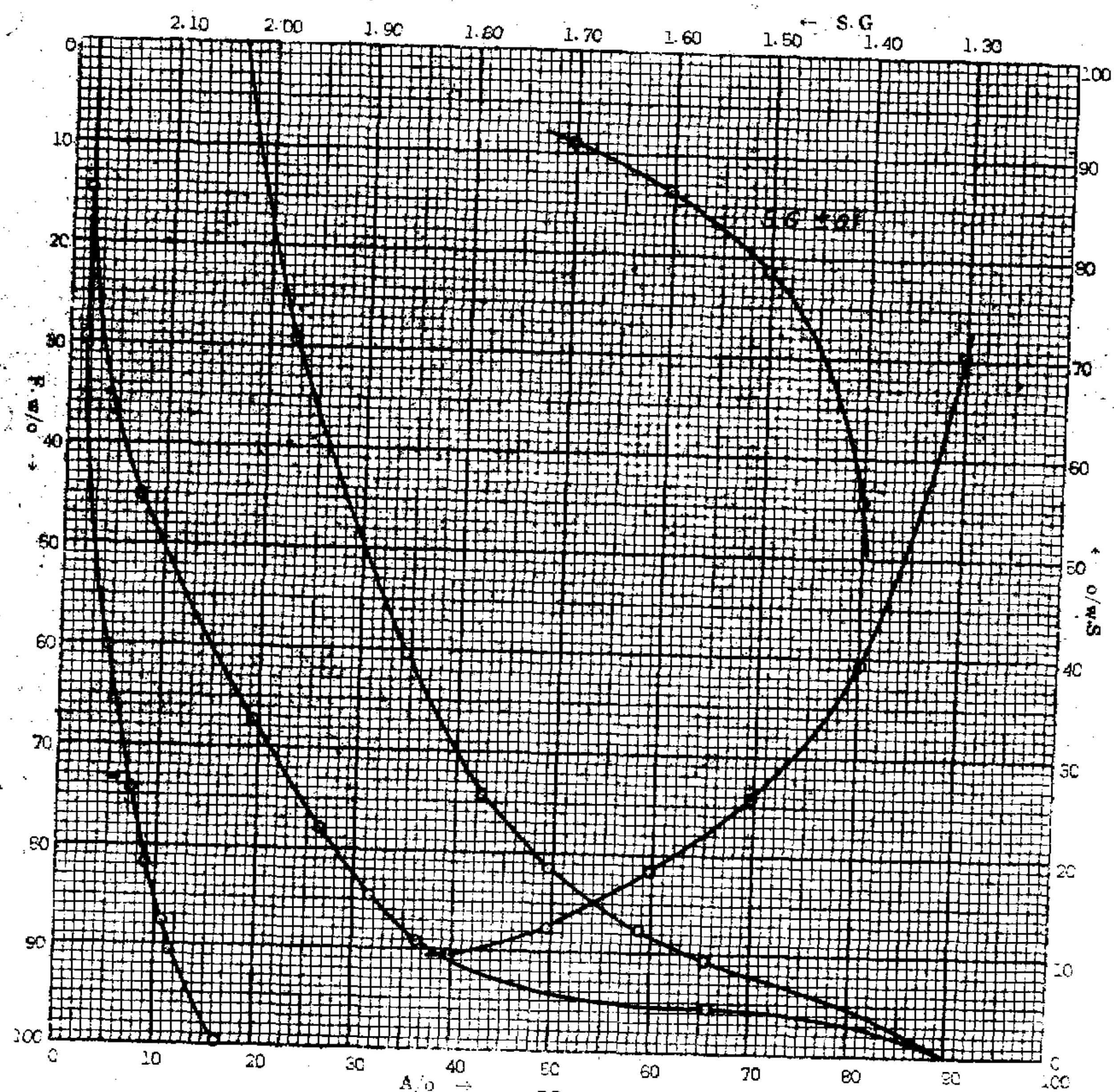


(1966)

TA-4 A SEAM (M-4)

Size	w/o	A/o
+0.5mm	65.9	16.7
−0.5mm	34.1	8.1
Σ	100.0	18.8

S G	w/o	A/o	$\frac{\Sigma W_{n-1} + W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100 Af - \Sigma WA}{100 - \Sigma W}$
−1.3	29.5	2.0	14.8	59.0	59.0	29.5	2.0	22.9
1.4	31.0	7.6	45.0	235.6	294.6	60.5	4.7	34.9
1.5	13.6	19.5	67.3	265.2	559.8	74.1	7.6	43.0
1.6	7.7	26.3	78.0	202.5	762.8	81.8	9.3	50.1
1.7	6.0	31.8	84.8	190.8	953.1	87.8	10.9	59.0
1.8	2.9	36.7	89.3	106.4	1059.5	90.7	11.7	66.0
+1.8	9.8	66.0	95.4	613.8	1678.3	100.0	16.7	

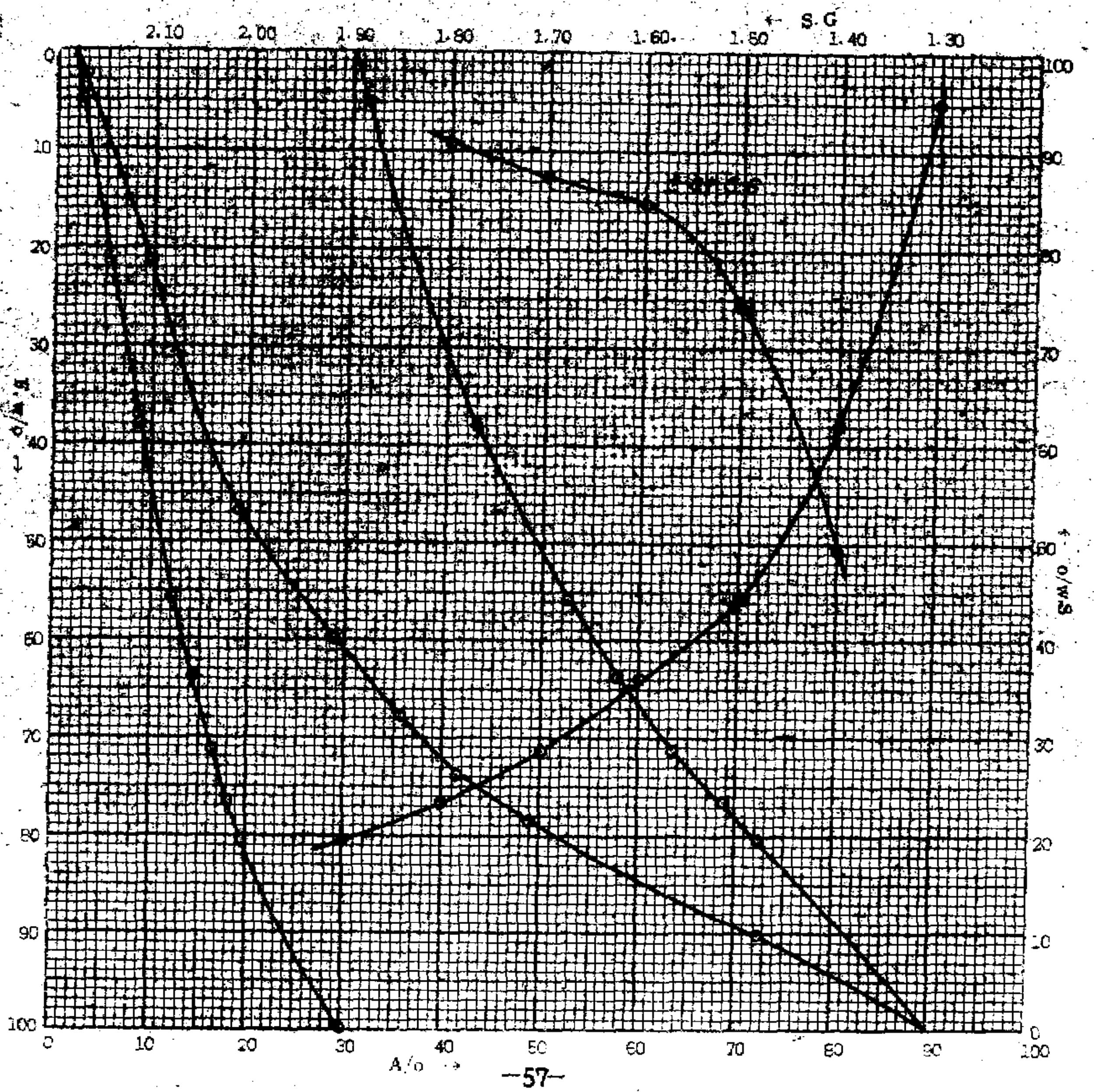


(1965)

K-I SEAM (Upper)

Size	w/o	A/o
+ 0.5 mm	86.0	29.8
− 0.5 mm	14.0	15.9
Σ	100.0	27.9

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100 \cdot \Sigma f - \Sigma WA}{100 - \Sigma W}$
−1.3	5.0	2.7	2.5	13.5	13.5	5.0	2.7	31.3
1.4	33.0	9.6	21.5	316.8	330.3	38.0	8.7	42.8
1.5	17.8	18.8	46.9	334.6	664.9	55.8	11.9	52.4
1.6	8.1	28.8	59.9	233.3	898.2	63.9	14.1	57.7
1.7	7.3	35.4	67.6	258.4	1156.6	71.2	16.2	63.8
1.8	5.4	41.4	73.9	223.6	1380.2	76.6	18.0	68.5
1.9	3.8	48.8	78.5	185.4	1565.6	80.4	19.5	72.3
+1.9	19.6	72.3	90.2	1417.1	2982.7	100.0	29.8	
Σ	100.0	29.8						



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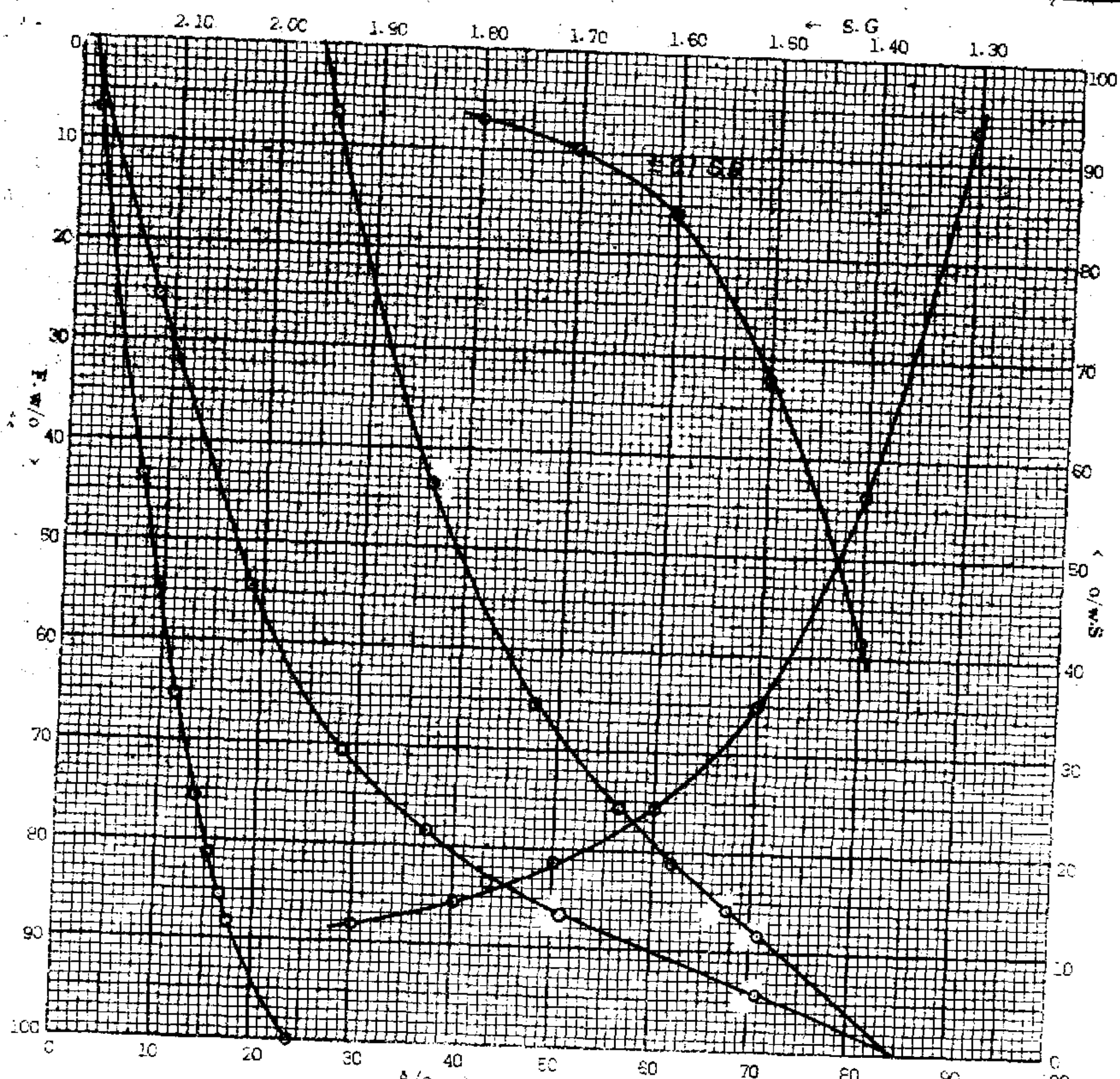
(1965)

K-1 SEAM (Lower)

S G	w/o	A/o	$\frac{\Sigma W_{n-1} - W_n}{2}$	W.A	ΣWA (Af)	Σ W	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af - \Sigma WA}{100 - \Sigma W}$
-1.30	6.9	1.8	3.5	12.4	12.4	6.9	1.8	25.6
1.40	36.7	8.6	25.3	315.6	328.0	43.6	7.5	36.7
1.50	21.6	18.9	54.4	408.2	736.2	65.2	11.3	47.7
1.60	10.6	28.2	70.5	298.9	1035.1	75.8	13.7	56.3
1.70	5.3	37.1	78.5	196.6	1231.7	81.1	15.2	61.7
1.80	4.6	43.3	83.4	199.2	1430.9	85.7	16.7	67.6
1.90	2.4	51.0	86.9	122.4	1553.3	88.1	17.6	70.9
+1.90	11.9	70.9	94.1	843.7	2397.0	100.0	24.0	—
Σ	100.0	24.0						

Size	W/o	A/o
+0.5 mm	83.0	24.0
−0.5 mm	17.0	14.9
Σ	100.0	22.5



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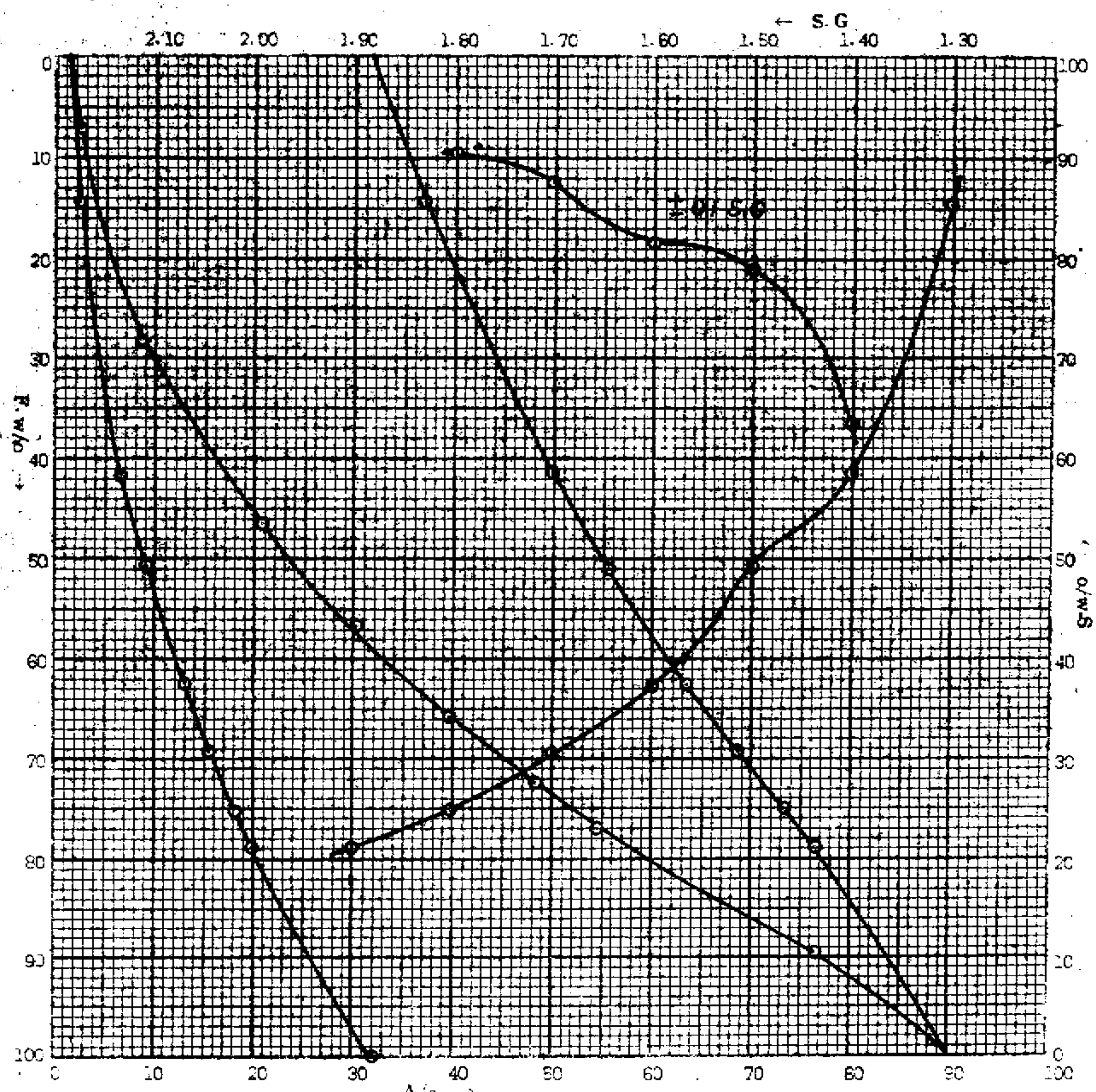
(1965)

K-5 SEAM (Upper)

Size	w/o	A/o
+ 0.5 mm	89.3	31.9
− 0.5 mm	10.7	18.9
Σ	100.0	30.5

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100\Sigma(- \Sigma WA}{100-\Sigma W}$
−1.30	14.4	2.3	7.2	33.1	33.1	14.4	2.3	36.9
1.40	27.1	8.7	28.0	235.8	268.9	41.5	6.5	49.9
1.50	9.3	20.8	46.2	193.4	462.3	50.8	9.1	55.4
1.60	11.7	30.2	56.7	353.3	815.6	62.5	13.0	63.3
1.70	6.7	39.6	65.9	265.3	1080.9	69.2	15.6	68.4
1.80	5.9	48.2	72.2	284.4	1365.3	75.1	18.2	73.2
1.90	3.8	54.4	77.0	206.7	1572.0	78.9	19.9	76.6
+1.90	21.1	76.6	89.5	1616.3	3188.3	100.0	31.9	−
Σ	100.0	31.9						

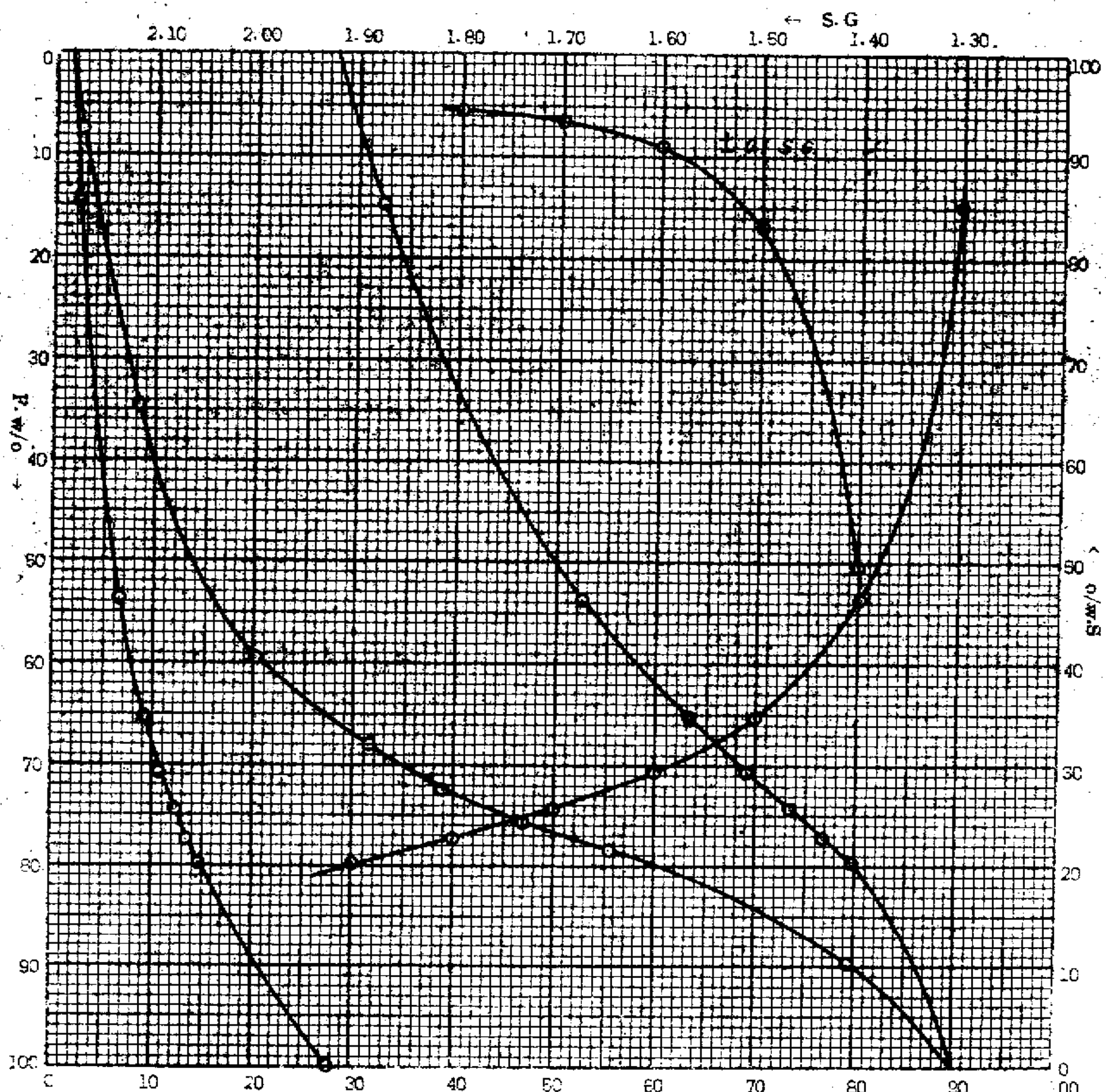


(1965)

K-5 SEAM (Lower)

Size	w/o	A/o
+0.5 mm	82.6	27.8
−0.5 mm	17.4	14.2
Σ	100.0	25.4

S G	w/o	A/o	$\Sigma W_{n-1}+\frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100Af-\Sigma WA}{100-\Sigma W}$
−1.3	14.9	2.4	7.5	35.8	35.8	14.9	2.4	32.2
1.4	38.9	8.2	34.4	319.0	354.8	53.8	6.6	52.5
1.5	11.5	20.3	59.6	233.5	588.3	65.3	9.0	63.1
1.6	5.4	31.3	68.0	169.0	757.3	70.7	10.7	69.0
1.7	3.6	38.6	72.5	139.0	896.3	74.3	12.1	73.3
1.8	3.0	46.9	75.8	140.7	1037.0	77.3	13.4	76.8
1.9	2.5	55.4	78.6	138.5	1175.5	79.8	14.7	79.4
+1.9	20.2	79.4	89.9	1603.9	2779.4	100.0	27.8	
Σ	100.0	27.8						



E) List of Total Amount of Raw Coal, Amount Disposed, Amount of Clean Coal, etc.

Year	Coal Seam	Number of Drum	Raw Coal (kg)	Target Ash(%)	Heavy Medium or Flotation	Raw Coal Disposed(kg)	Clean Coal(kg)	Actual Ash(%)	Recovery (%)	Clean Coal sent to Mills (kg)	Clean Coal Stored (kg)	Raw Coal Stored (kg)
1967	TB-2	Upper 15	4,413	6.5	H	2,464	1,906	6.6	77.4	1,400	900	0
					F	538	338	6.7	62.8			
					Total	3.002	2,244	6.6	74.8			
		Lower 10		7.5	H	966	752	7.6	77.8	520	400	141
					F	225	177	7.5	78.7			
					Total	1,191	929	7.6	78.0			
	TB-3	Upper 14	2,546	6.5	H	1,618	1,029	5.8	63.6	1,150	184	91
					F	594	311	7.4	52.4			
					Total	2,212	1,340	6.2	60.6			
	TB-3	Middle 7 Lower 4	2,267	6.5	H	184	58	6.1	31.5	0	70	1,940
					F	57	20	6.5	35.1			
					Total	241	78	6.2	32.4			
	TB-4	Upper 12	2,231	6.5	H	1,580	821	7.1	52.0	0	0	0
					F	374	171	6.6	45.7			
					Total	1,954	992	7.0	50.8			
		Lower 13	2,420	6.5	H	1,754	821	6.6	46.8	0	0	0
					F	476	247	6.6	51.9			
					Total	2,230	1,068	6.6	47.9			
		Total (Upper & lower)	4,651	6.5	H	3,333	1,642	6.9	49.3	1,550	480	0
					F	851	418	6.6	49.1			
					Total	4,184	2,060	6.8	49.2			
	TB-5	Upper 3	561	6.5	H	145	64	6.8	44.1	0	70	340
					F	42	14	6.6	33.3			
					Total	187	78	6.8	41.7			
	TB-5	Middle 11 Lower 11	4,111	6.5	H	3,314	1,384	6.3	41.8	1,150	580	0
					F	704	336	6.8	47.7			
					Total	4,018	1,720	6.4	42.8			
	TB-6	Upper 16	2.983	6.5	H	2,036	1,020	6.5	50.1	0	0	16
					F	673	342	7.9	50.8			
					Total	2,709	1,362	6.8	50.3			
		Lower 19	3,360	6.5	H	1,144	882	5.8	77.1	0	0	3
					*	2,174	2,174	6.5	100.0			
					Total	3,318	3,056	6.3	92.1			
		Total (Upper & lower)	6,343	6.5	H	3,180	1,902	6.2	59.8	1,550	2,860	0
					F	673	342	7.9	50.8			
					*	2,174	2,174	6.5	100.0			
					Total	6,027	4,418	6.5	73.3			
	TA-2	Upper 11	2,030	6.5	H	1,350	524	6.2	38.8	0	0	200
					F	389	145	6.3	37.3			
					Total	1,739	669	6.2	38.5			
		Lower 14	2,878	6.5	H	2,356	829	6.2	35.2	0	0	170
					F	349	140	6.3	40.1			
					Total	2.705	969	6.2	35.8			
		Total (Upper & lower)	4,908	6.5	H	3,707	1,353	6.2	36.5	0	1,630	0
					F	738	285	6.3	38.5			
					Total	4,445	1,638	6.2	36.8			
	TA-3	2-1, 11	1,953	6.5	H	170	95	6.8	55.9	0	120	1,700
					F	64	35	6.4	54.7			
					Total	234	130	6.7	55.6			
		2-2, 9 2-3, 9	3,167	6.5	H	1,959	1,240	7.0	63.3	1,900	140	140
					F	1,032	671	5.2	65.0			
					Total	2,991	1,911	6.4	63.9			
		2-4, 8 2-5, 3	2,046	6.5	H	143	64	6.6	44.8	0	76	1,800
					F	60	23	7.0	38.3			
					Total	203	87	6.7	42.9			
	TA-4	1-1, 10 1-2, 10	3,352	6.5	H	1,813	1,144	6.5	63.1	4	2,110	134
					F	1,171	973	6.0	83.1			
					Total	2,984	2,117	6.2	70.9			
		1-3, 10 1-4, 10	3,703	6.5	H	176	92	6.4	52.3	0	118	3,410
					F	71	36	5.0	50.7			
					Total	247	128	6.0	51.8			

F) Washability Test of Raw Coal from the Upper Part of TB-4 after -10 mm Crushing

a) Outline

Raw Coal of 0-20mm size was passed through a 10 mm screen, while raw coal of more than 10 mm (10 mm - 20 mm) size was crushed to less than 10 mm, and sieved by means of a 0.5 mm screen to obtain Sample A (0.5mm - 10.0mm) and B (less than 0.5 mm).

In the meantime, raw coal of less than 10 mm size was also passed through the 0.5 mm screen. Through this process, Sample C (0.5 - 10.0 mm) and D (less than 0.5 mm) were obtained.

After that, 0.5 - 10.0 mm size coal (Sample A + C) received a floatation test. Sample B and C underwent sieve tests, respectively.

b) Size Distribution of Raw Coal before Crushing

Size(mm)	W%	A%	Remarks
20 - 10	14.2		for crushing test
10 - 0.5	64.6		
- 0.5	21.2	16.3	
Total	100.0		

c) Size Distribution of Raw Coal after Crushing

Size(mm)	W%	A%	Remarks
10 - 0.5	77.6	19.2	A. 13.0% C. 64.6%
- 0.5	22.4	16.1	B. 1.2% D. 21.2%
Total	100.0	18.5	

d) Size Distribution and Ash Content of -0.5mm Raw Coal

Sample \ Size (mesh)		32 - 60	60 -100	100-200	200-325	-325	Total
B. Sample from crushing test	W%	47.6	20.8	20.0	3.9	7.7	100.0
	A%	11.7	10.3	10.8	14.2	17.1	11.7
D.	W%	48.9	20.3	14.6	4.9	11.3	100.0
	A%	15.4	15.5	17.2	17.4	20.3	16.3

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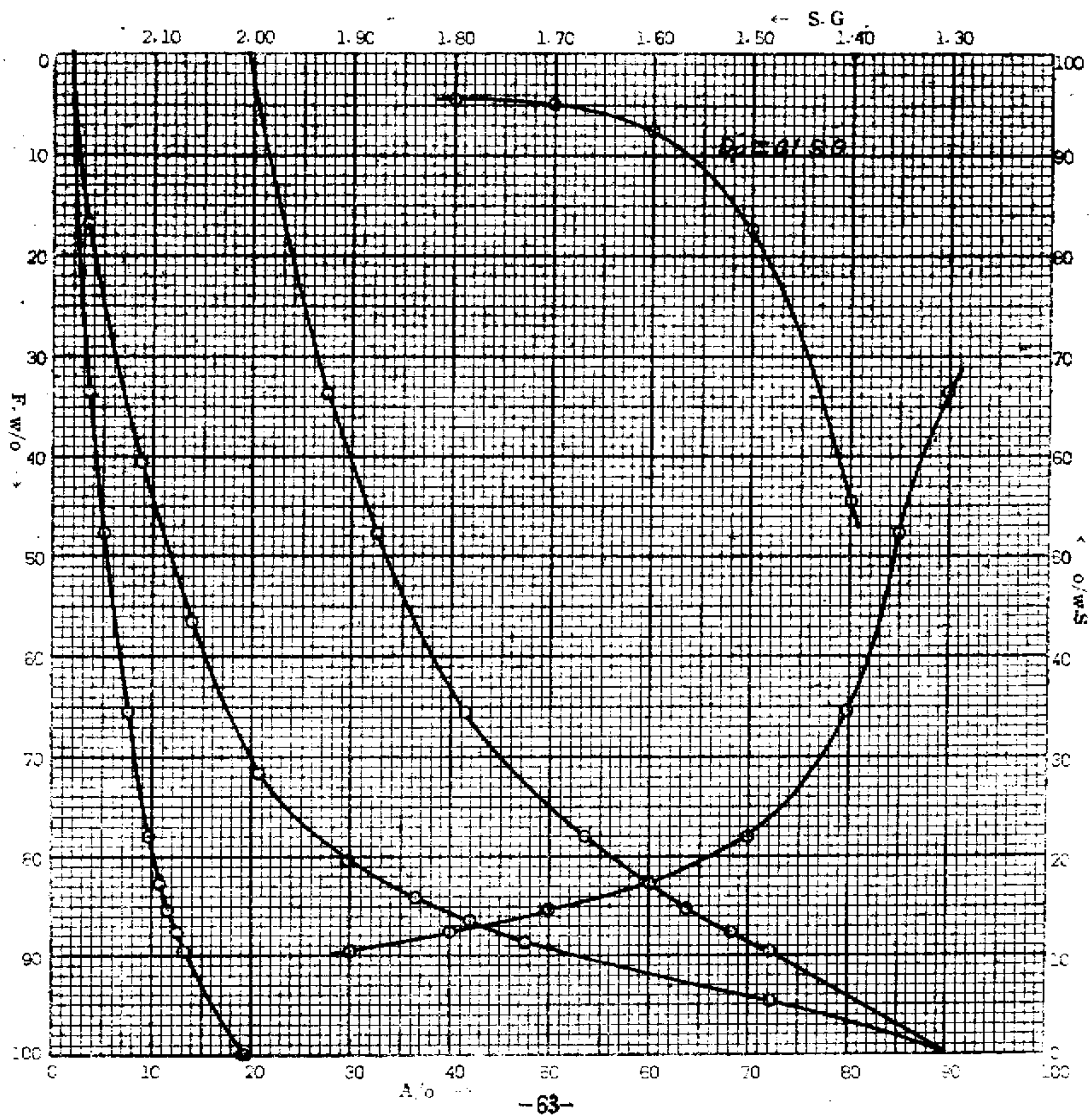
(1967)

TB-4 B SEAM (upper)

Size : 10mm ~ 0.5mm

Size	wt %	Ash %
1.0 ~ 0.5 mm	77.6	19.2
− 0.5 mm	22.4	16.1
Total	100.0	18.5

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100\Sigma f - \Sigma WA}{100 - \Sigma W}$
−1.3	33.5	3.5	16.8	117.25	117.25	33.5	3.5	27.2
1.3~1.35	14.1	8.7	40.6	122.67	239.92	47.6	5.0	32.2
1.35~1.4	17.8	13.9	56.5	247.42	487.34	65.4	7.5	41.5
1.4~1.5	12.5	20.7	71.7	258.75	746.09	77.9	9.6	58.3
1.5~1.6	4.8	29.8	80.3	143.04	889.13	82.7	10.8	59.9
1.6~1.7	2.5	36.3	84.0	90.75	979.88	85.2	11.5	63.9
1.7~1.8	2.4	41.9	86.4	100.56	1080.44	87.6	12.3	68.1
1.8~1.9	2.0	47.3	88.6	94.60	1175.04	89.6	13.1	72.1
+1.9	10.4	72.1	94.8	749.84	1924.88	100.0	19.2	



G) Proximate Analysis, Calorific Value, Total Sulphur and F.S.I. of **Raw Coal**

Year	Coal Seam	M%	A%	VM%	FC%	Cal	TS%	F.S.I.	Remarks
1967	TB-2 Upper & lower mixed	1.1	15.9	17.7	65.3	7,210	0.61	7	
	TB-3 Upper	1.5	28.1	17.9	52.5	6,080	0.45	6 ½	
	TB-3 Middle & lower mixed	1.1	42.3	16.2	40.4	4,680	0.41	3	
	*TB-3 Upper & lower mixed	1.9	27.5	16.7	53.9	5,990	0.38	1	
	TB-4 Upper	1.3	19.7	21.7	57.3	6,740	0.38	7	
	TB-4 Lower	1.3	18.6	19.9	60.2	6,840	0.33	6	
	TB-5 Upper	1.3	34.8	16.9	47.0	5,410	0.55	4	
	TB-5 Middle & lower mixed	0.8	20.7	19.3	59.2	6,680	0.41	6 ½	
	TB-6 Upper	1.6	24.3	19.3	54.8	6,380	0.35	7	
	TB-6 Lower	2.3	7.4	23.2	67.1	7,810	0.36	6 ½	
1966	TA-1 Upper	1.8	2.5	22.8	72.7	8,380	0.35		
	TA-1 Lower	1.7	5.6	20.9	71.8	7,990	0.31		
1967	TA-2 Upper	1.0	29.0	15.6	54.4	6,000	0.48	2 ½	
	TA-2 Lower	0.9	44.1	13.8	41.2	4,610	0.41	3 ½	
	TA-3, 2-1	1.0	15.6	19.2	64.2	7,020	0.37	3	
	TA-3, ($^{2-2}_{2-3}$ mixed	1.5	10.4	19.4	68.7	7,660	0.25	4 ½	
	TA-3, ($^{2-4}_{2-5}$ mixed	1.1	23.0	17.4	58.5	6,450	0.28	2 ½	
	TA-4, ($^{1-1}_{1-2}$ mixed	1.1	11.4	18.3	69.2	7,480	0.27	3	
	TA-4, ($^{1-3}_{1-4}$ mixed	1.2	25.4	15.9	57.5	6,180	0.28	3 ½	
1966	TA-4 M_1	1.8	9.6	17.7	70.9	7,700	0.40		
	TA-4 M_2	1.5	13.1	17.5	67.9	7,350	0.22		
	TA-4 M_3	1.6	13.0	18.4	72.0	7,810	0.24		
	TA-4 M4	1.5	14.9	18.3	65.3	7,120	0.21		
1965	K-1 Upper (T1)	1.1	28.0	14.5	56.4	5,920	0.41		
	K-1 Lower (B1)	0.9	23.2	14.7	61.1	6,380	0.51		
	K-5 Upper (T5)	1.2	30.3	15.4	53.0	5,740	0.44		
	K-5 Lower (B5)	1.2	25.6	14.6	58.6	6,280	0.51		

* Pending

H) Proximate Analysis, Calorific Value, Total Sulpher, etc. of Clean Coal

Year	Coal Seam	M%	A%	VM %	FC%	Cal	TS%	F.S.I.	P in Coal %	Remarks
1967	TB-2 Upper lower mixed	0.4	6.6	19.4	73.6	8,070	0.57	7 ½	0.184	
	TB-2 Upper lower mixed	0.4	7.6	19.0	73.0	7,960	0.53	7	0.182	
	TB-3 Upper	1.0	6.2	21.0	71.8	8,020	0.42	7 ½	0.135	
	TB-3 Middle lower mixed	0.9	6.0	20.9	72.2	8,000	0.57	8	0.235	
	*TB-3 Upper lower mixed	2.5	6.6	19.7	71.2	7,830	0.45	1		
	TB-4 Upper lower mixed	1.0	6.6	22.5	69.9	8,050	0.36	8	0.086	
	TB-5 Upper	0.8	6.4	21.9	70.9	8,070	0.58	8 ½	0.086	
	TB-5 Middle lower mixed	1.3	6.2	21.2	71.3	8,110	0.46	7 ½	0.121	
	TB-6 Upper	1.5	7.0	23.1.	68.4	7,990	0.41	8		
	TB-6 Lower	2.3	6.5	23.5	67.7	7,940	0.44	7		
	TB-6 Upper lower mixed	2.0	6.8	23.5	67.7	7,940	0.42	7 ½	0.080	
1966	TA-1 Upper	1.8	2.7	22.8	72.7	8,380	0.35	7 ½		
	TA-1 Lower	1.7	5.6	20.9	71.8	7,990	0.31	6 ½		
	TA-1 Upper lower mixed	1.8	4.2	21.9	72.1		0.33	7		
1967	TA-2 Upper lower mixed	1.2	6.2	19.7	72.9	8,090	0.56	7	0.235	
	TA-3, 2-1	0.9	6.5	19.8	72.8	7,940	0.39	6	0.038	
	TA-3, (2-2 2-3 mixed	1.1	6.3	19.9	72.7	7,990	0.26	4 ½	0.033	
	TA-3, (2-4 2-5 mixed	0.9	6.8	18.8	73.5	8,060	0.30	4 ½	0.036	
	TA-4, (1-1 1-2 mixed	1.1	6.5	18.1	74.3	7,990	0.33	3	0.037	
	TA-4, (1-3 1-4 mixed	1.0	6.2	17.7	75.1	8,070	0.28	3 ½	0.045	

Year	Coal Seam	M%	A%	VM%	FC%	Cal	TS%	F.S.I.	P in Coal %	Remarks
1966	TA-4 M1	1.7	5.5	18.2	74.6	8,080	0.51	5		
	TA-4 M2	1.7	7.3	17.6	73.4	7,930	0.30	3		
	TA-4 M3	1.7	6.5	18.7	73.1	8,050	0.31	4		
	TA-4 M4	1.7	6.5	18.0	73.8	8,020	0.30	4		
	TA-4 M1 M2 mixed	1.7	6.4	17.9	74.0		0.40	4		
	TA-4 M3 M4 mixed	1.7	6.5	18.4	73.4		0.31	4		
1965	K-1 Upper (-0.5mm)	1.3	9.2	15.1	74.4	7,800	0.51	3		
	K-1 Lower (-0.5mm)	1.0	6.4	15.7	76.9	8,140	0.64	4		Ash 7% sample
	K-1 Lower (-0.5mm)	1.4	8.2	16.0	74.5	7,930	0.62	4		
	K-5 Upper (-0.5mm)	1.5	6.4	15.8	76.4	8,100	0.60	4		Ash 7% sample
	K-5 Upper (-0.5mm)	1.4	8.7	16.0	73.9	7,840	0.59	5		
	K-5 Lower (-0.5mm)	1.3	9.3	15.9	73.5	7,760	0.69	3		

* Pending

P in coal is tested by Mitaka Laboratories, Nittetsu Mining Co., Ltd.

I) Melting Point of Ash of Clean Coal

Year	Coal Seam	Ash %	Softening point °C	Melting point °C	Fluidity °C
1967	TB-2 Upper, lower mixed	6.6	1,280	1,320	1,400
	TB-2 Upper, lower mixed	7.6	1,280	1,330	1,410
	TB-3 Upper	6.2	1,270	1,360	1,450 over
	TB-3 Middle, lower mixed	6.0	1,240	1,300	1,450 over
	TB-4 Upper, lower mixed	6.6	1,440	1,450 over	1,450 over
	TB-5 Upper	6.4	1,280	1,300	1,430

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Year	Coal Seam	Ash %	Softening point °C	Melting point °C	Fluidity °C
1967	TB-5 Middle, lower mixed	6.2	1,300	1,360	1,450 over
	TB-6 Upper	7.0	1,360	1,450 over	1,450 over
	TB-6 Lower	6.5	1,260	1,390	1,450 over
	TB-6 Upper, lower mixed	6.8	1,350	1,450	1,450 over
1966	TA-1 Upper	2.7		1,450 over	
	TA-1 Lower	5.6		1,450 over	
	TA-1 Upper, lower mixed	4.2		1,450 over	
1967	TA-2 Upper, lower mixed	6.2	1,250	1,290	1,440
	TA-3, 2-1	6.5	1,240	1,450 over	1,450 over
	TA-3,(2-2, 2-3 mixed	6.3	1,250	1,430	1,440
	TA-3,(2-4, 2-5 mixed	6.8	1,330	1,450 over	1,450 over
	TA-4,(1-1, 1-2 mixed	6.5	1,380	1,400	1,440
	TA-4,(1-3, 1-4 mixed	6.2	1,350	1,410	1,450 over
1966	TA-4 M_1	5.5		1,450 over	
	TA-4 M_2	7.3		1,450 over	
	TA-4 M_3	6.5		1,450 over	
	TA-4 M_4	6.5		1,450 over	
	TA-4 $M_1 + M_2$	6.4		1,450 over	
	TA-4 $M_3 + M_4$	6.5		1,450 over	
1965	K-1 Upper (-0.5mm)	9.2		1,290	
	K-1 Lower (-0.5mm)	6.4		1,250	
	K-1 Lower (-0.5mm)	8.2		1,280	
	K-5 Upper (-0.5mm)	6.4		1,280	
	K-5 Upper (-0.5mm)	8.7		1,290	
	K-5 Lower (-0.5mm)	9.3		1,285	

J) Heavy Medium Cyclone Test on TB-6 (Upper)

TB-6 (Upper) Coal 20 - 0.5mm (Crushed + 20 mm Coal and Mixed)

H.M. Cyclone Test, Sink and Flotation Test and Partition Number

Specific Gravity		-1.30	1.30-1.40	1.40-1.45	1.45-1.50	1.50-1.60	1.60-1.70	1.70-1.80	1.80-1.90	+1.90	Total
Clean coal	W%	55.57	41.82	1.74	0.33	0.25	0.09	0	0	0	100.00
	W% against raw coal	36.31	27.23	1.13	0.21	0.16	0.06	0	0	0	65.10
	Ash %	3.57	8.92	16.92	21.00	29.57	53.22	0	0	0	6.21
Refuse	W%	0.10	0.39	1.01	2.31	5.72	6.57	9.13	10.50	64.27	100.00
	W% against raw coal	0.03	0.14	0.35	0.81	2.00	2.29	3.19	3.66	22.43	34.90
	Ash %	3.41	13.71	19.68	25.18	32.54	41.69	50.49	57.22	77.02	65.55
Mixed raw coal	W%	36.34	27.37	1.48	1.02	2.16	2.35	3.19	3.66	22.43	100.00
	Σ W%	36.34	63.71	65.19	66.21	68.37	70.72	73.91	77.57	100.00	
	Ash %	3.57	8.94	17.57	24.32	32.32	41.98	50.41	57.22	77.02	26.92
Partition Number		0.08	0.51	23.65	79.41	92.59	97.45	100.00	100.00	100.00	

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Coal Preparation Results

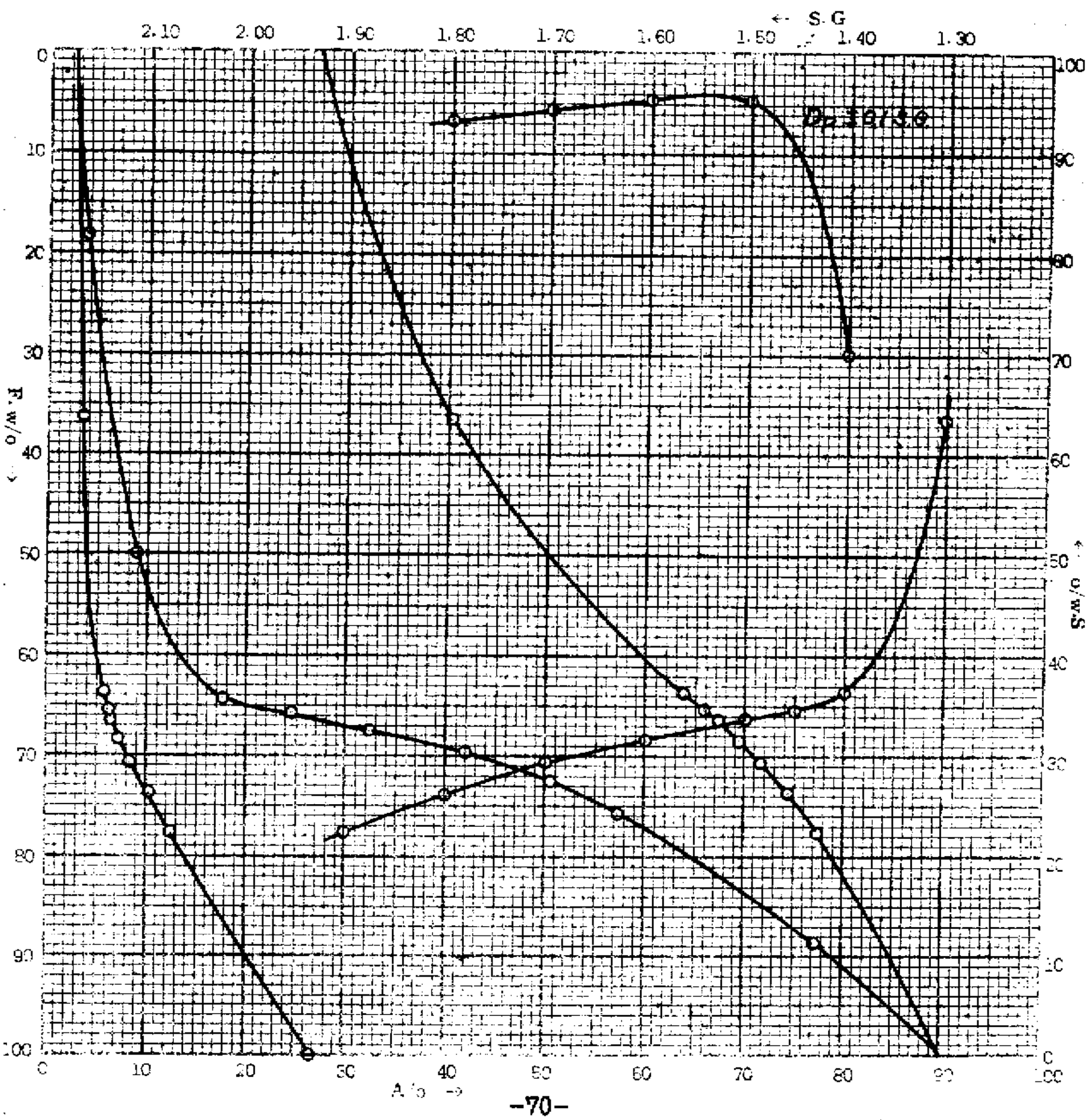
		TB6, (upper) 20 - 0.5mm
Clean coal	Recoverable ratio to raw coal %	65.10
	Ash %	6.21
Refuse	Recoverable ratio to raw coal %	34.90
	Ash %	65.55
Mixed raw coal	Recoverable ratio to raw coal %	100.00
	Ash %	26.92
Partition S. G.:	D P	1.449
	E P	0.02
Efficiency	Sunk coal in clean coal: S c	0.45
	Floated coal in refuse: Fr	0.51
	M (Sc + Fr)	0.96
	Theoretical yield: V c %	65.44
	Degree of difficulty (Dp ± O.I.S.G.)	10
	Efficiency of yield %	99.48

(1967)

TB-6 B SEAM (Upper)

20 ~ 0.5 mm

S G	w/o	A/o	$\Sigma W_{n-1} + \frac{W_n}{2}$	W.A	ΣWA (Af)	ΣW	$\frac{\Sigma WA}{\Sigma W}$	$\frac{100\text{s}(-\Sigma WA}{100-\Sigma W}$
-1.3	36.34	3.57	18.17	129.73	129.73	36.34	3.57	40.24
1.3 ~ 1.4	27.37	8.94	50.03	244.69	374.42	63.71	5.88	63.85
1.4 ~ 1.45	1.48	17.57	64.45	26.00	400.42	65.19	6.14	65.82
1.45 ~ 1.5	1.02	24.32	65.70	24.81	425.23	66.21	6.42	67.07
1.5 ~ 1.6	2.16	32.32	67.29	69.81	495.04	68.37	7.24	69.44
1.6 ~ 1.7	2.35	41.98	69.55	98.65	593.69	70.72	8.39	71.65
1.7 ~ 1.8	3.19	50.41	72.32	160.81	754.50	73.91	10.21	74.24
1.8 ~ 1.9	3.66	57.22	75.74	209.43	963.93	77.57	12.43	77.02
+1.9	22.43	77.02	88.79	1727.57	2691.50	100.00	26.92	.



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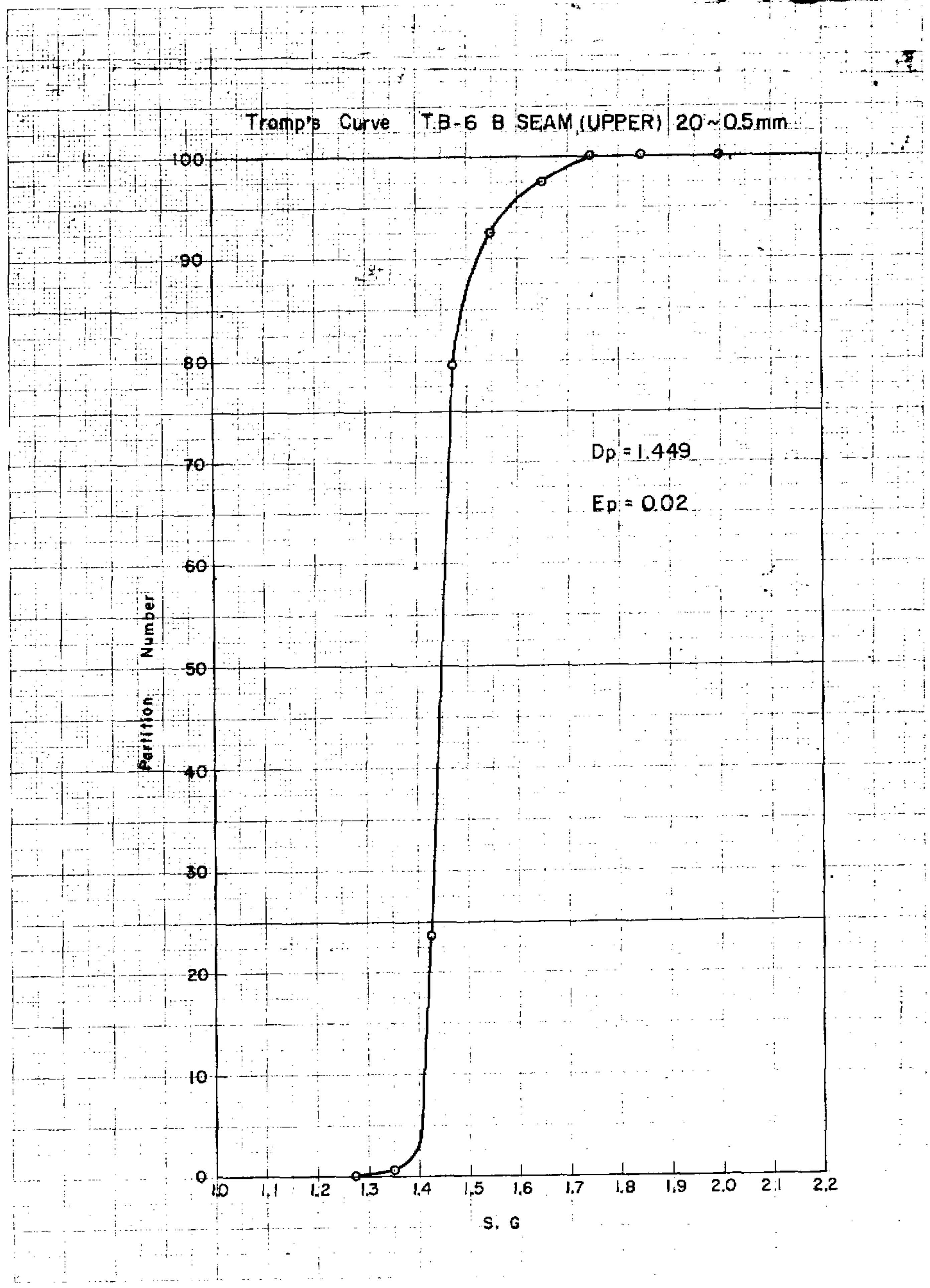

Tromp's Curve T.B-6 B SEAM (UPPER) 20~0.5mm
Dp = 1.449
Ep = 0.02
Partition Number
100
90
80
70
60
50
40
30
20
10
0
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
S. G

JIS A 4

(2) Tests Results at Steel Mills

The steel makers which conducted quality tests on Fernie coal from Seams B, A, K-1 and K-5 submitted the following tests results. They stated opinions from their respective standpoints and debated from various angles.

A) Seam B Coal

A large amount of samples was obtained this time from five tunnels driven into Seam B, which has been considered the most promising for exploitation.

The various steel mills were asked to carry out a good many tests on coking quality. As a result, the following was learned:

i) The volatile matter content varies within the scope of 19 to 23 percent going down toward Morrissey Creek.

ii) The total sulphur content is about 0.5 percent, and it does not pose any problem in the use of coal.

iii) The phosphorus content in coal runs at a generally high level of 0.07 to 0.08 percent. Coal near Morrissey Creek shows particularly high values.

iv) The F.S.I. ranges from 7 to 9 and has little difference by size.

v) The fluidity is the highest in the middle of the area (TB-4) and is low in the Morrissey Creek side (TB-2), but not so low as to disqualify it.

vi) All samples show more than 92 percent in single shatter strength, and even when used in combination with Japanese semicoking coal, the strength is over 90 percent, except blending with Onoura coal (which were tested at Yawata Iron & Steel).

On the basis of the above findings, it can be said that Seam B is superior coking coal, and the following specification is conceivable as a guaranteed coal quality for Seam B when it is mined:

Total moisture	6%		
Guaranteed ash content	7%	Tolerance	0.5%
Guaranteed total sulphur content	0.5%	Tolerance	0.05%
Volatile matter content	19-22%		

TEST RESULTS ON SEAM B COAL BY SIX STEEL MILLS

Sample No.			Company Name	Proximate Analysis M%	A%	VM%	FC%	TS%	Cal Kcal/kg	FSI	P	Size -0.6mm weight %	Fluidity by Giesceler Plastmeter Max. Fluidity Div./Min.	D.T. by Rotation 15 Fernie Coal 100%	(Fernie Coal %) Domestic Coal %		
TB-2	Coking Test	Low Ash Content	Y.	1.2	6.6	20.1	72.1	0.57		7 ½				94.7	Ohnoura	(30) 70	90.5
			F.	1.2	6.4	19.3	73.1	0.60	7,980	6 ½	0.150	23.2 (-0.54)	32	92.6	*Hokkaido	(30) 70	91.6
			N.	0.6	7.0	19.2	73.2	0.54	8,090	7 ½	0.177	22.5	2.9	92.1	Oyubari	(30) 70	89.6
			Ka.	1.1	6.9	19.1	72.9	0.56	8,010	7 ½		28.3	113	91.4	Yubari-Toku	(30) 70	92.8
			S.	1.4	7.0	18.4	73.2	0.55		7			46	93.2	Akahira	(40) 60	93.1
		High Ash Content	F.	1.2	7.9	19.0	71.9	0.60	7,890	6 ½	0.135	27.8 (-0.54)	26	92.5	*Hokkaido	(30) 70	91.7
			N.	0.6	8.9	19.0	71.5	0.56	7,890	7	0.188	28.1	4.1	91.7	Oyubari	(30) 70	88.6
	Test by Specific Gravity	SG<1.4	N.	0.4	4.56	19.34	75.70		8,280				1.9				
		SG 1.4 - 1.6	N.	0.4	21.76	17.44	60.40		6,420				-				
		SG>1.6	N.	0.4	5.94	19.16	74.52		8,040				1.2				
TB-3	Coking Test		Y.	1.3	6.0	20.8	71.9	0.52	8,060	7 ½	0.120	32.2	2.67	94.4	Ohnoura	(30) 70	80.1
			F.	1.4	6.2	20.6	71.8	0.52	7,950	7	0.119	31.2	52	93.8	*Hokkaido	(30) 70	90.8
			Ka.	1.5	6.4	20.5	71.6	0.49	8,220	8		35.2	220	93.4	Yubari-Toku	(30) 70	93.0
			S.	1.7	6.2	20.2	71.9	0.49		7 ½			67	94.3	Akahira	(40) 60	93.8
			Ko.		6.35	20.91	72.74	0.50		7 ½			54				
	Test by Specific Gravity	SG<1.4	N.	0.42	4.88	21.10	73.60		8,280				5				
		SG 1.4 - 1.6	N.	0.42	24.16	18.00	57.42		6,420				-				
		SG>1.6	N.	0.42	7.53	20.16	71.89		8,040				3				
TB-4	Coking Test		Y.	1.1	6.8	22.1	70.00	0.42	8,030	9			3.60	94.8	Ohnoura	(30) 70	93.3
			F.	1.2	6.8	22.0	70.00	0.42	7,930	8 ½	0.077	26.8	632	93.3	*Hokkaido	(30) 70	90.7
			Ka.	1.2	6.9	21.3	70.5	0.38	8,080	9		28.9	1,235	94.4	Yubari-Toku	(30) 70	92.5
			S.	1.5	6.6	21.4	70.5	0.39		8			390	94.0	Akahira	(40) 60	93.7
			Ko.		6.81	22.80	70.39	0.39		9			574	94.9	Takashima	(30) 70	91.9

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Sample No.			Company Name	Proximate Analysis: M%	A%	VM%	FC%	TS%	Cal Kcal/kg	FSI	P	Size -0.6m/m weight %	Fluidity by Gieseler Plastmeter Max. Fluidity Div./Min.	D.T. by Rotation 15: Fernie Coal 100%	Domestic Coal	(Fernie Coal %) Domestic Coal %	D.T.
TB-4	Test by Specific Gravity	SG<1.4	N.	0.38	6.80	21.86	70.96		8.130				57				
		SG 1.4 -1.6	N.	0.40	22.36	19.20	58.04		6.500				2.5				
		SG>1.6	N.	0.44	10.38	21.38	67.80		7.770				30				
TB-5	Coking Test		Y.	1.2	6.1	21.1	71.6	0.50	8.080	9				94.8	Ohnoura	(30) 70	91.6
			F.	1.2	6.2	20.9	71.7	0.53	7.990	8	0.101	29.6	206	93.5	* Hokkaido	(30) 70	90.8
			Ka.	1.2	6.3	21.2	71.3	0.49	8.140	9		37.9	758	94.3	Yubari-Toku	(30) 70	92.7
			S.	1.7	6.1	20.1	72.1	0.48		8			342	93.5	Akahira	(40) 60	92.1
			Ko.		6.73	21.71	72.09	0.51		8 ½			376				
	Test by Specific Gravity	SG<1.4	N.	0.4	6.75	20.74	72.11		8.150				14.5				
		SG 1.4 -1.6	N.	0.4	24.35	18.56	56.69		6.310				-				
		SG>1.6	N.	0.4	12.22	19.91	67.47		7.570				3.7				
TB-6	Coking Test		Y.	1.8	6.8	23.2	68.2	0.44	7.900	8 ½	0.078	31.1	3.03	94.6	Ohnoura	(30) 70	89.8
			F.	1.8	6.7	23.1	68.4	0.49		7 ½	0.069	31.2	124	93.1	* Hokkaido	(30) 70	91.9
			Ka.	1.7	6.8	23.7	67.8	0.45	8.070	8 ½		42.5	412	93.0	Yubari-Toku	(30) 70	91.6
			S.	1.9	7.2	22.3	68.6	0.56		7 ½			141	93.5	Akahira	(40) 60	91.8
			Ko.		6.73	24.06	69.21	0.46		7 ½		(-1.0) 48.5	66	95.4	Takashima	(30) 70	91.8
	Upper	SG<1.95	N.		18.3	21.1			7.540	9	0.10		28.5				
	Lower	SG<1.34	N.		3.8	24.2			8.610	9			16.0				
Composite sample of TB-3/4/5/6			N.	0.8	6.4	21.6	71.2	0.42	8.150	9	0.10		29	92.3	Oyubari	(30) 70	89.9

Company Name:
- Y.: Yawata Iron & Steel Co., Ltd.
- F.: Fuji Iron & Steel Co., Ltd.
- N.: Nippon Kokan Kabushiki Kaisha
- Ka.: Kawasaki Steel Corporation
- S.: Sumitomo Metal Industries Ltd.
- Ko.: Kobe Steel Ltd.

* Soft Coking Coal produced in Hokkaido

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A summary of opinions of 6 steel makers

* The volatile content varies from 19 to 23 percent according to sections. Values are low at TB-2 and TB-3 in the Morrissey Creek side. The F.S.I. which ranges from 7 to 9 also tends to go down in the Morrissey Creek side.

* There is no question about the sulphur content which is about 0.5 percent, but the phosphorous content is on a generally high level of 0.07 to 0.18 percent, with TB-2 and TB-3 in the Morrissey Creek side showing particularly high values. This requires attention when using Fernie coal.

* TB-4 shows the highest Gieseler fluidity, followed by TB-5, TB-6 and TB-3 in that order. TB-2 belongs to the low fluidity category.

* All samples show single shatter strength of more than 92 percent, and the strength of all assortments with Japanese coal is more than 90 percent except those mixed up with Onoura coal. Thus Fernie coal is valuable as superior coking coal.

(Remarks)

All samples differ little in the F.S.I. in accordance with granularity and are homogeneous.

B) Seam A Coal

Up until now, the coking test has been completed on TA-1 and TA-4 samples (collected in 1966) and TA-3 samples (collected in 1967).

The steel makers are not yet to finish the various tests on TA-2 and TA-4 samples (collected in 1967). (We collected TA-4 samples again because there was some problem in the concentration of samples collected the year before.)

We are thus not in a position to draw a definite conclusion, but surmising from the available data, it can be said that carbonization has progressed too much for Canadian coal in the Morrissey Creek sections (TA-3 and TA-4), and this is a problem for the coal to be superior coking coal.

Seam A in the western part of the claim is low in volatile matter content as well as in the F.S.I. and fluidity, and its single shatter strength is between 60 and 70 percent, like that of semicoking coal.

However, since TA-1 samples show more or less the same values as Seam B samples, superior coking coal equal to Seam B coal can be expected from the eastern part, pipeline area (including TA-2 whose samples have not been completely tested), as we stated last year.

(Note)

The steelmakers' comments on TA-1 Test results in 1966 are given below as reference.

Although slightly inferior in fluidity compared with Vicary coal, TA-1 Coal is excellent with the percentages of ash, volatile and sulphur contents respectively. The lower ash content has particular merit.

This coal showed a shatter strength (drum index) of 90% to 94% as single of 90% to 93% as blended with other types of coal except at Yawata.

(Yawata Iron & Steel Co. uses Chikuho coal (Onoura coal) which has low fluidity as its base coal while the other makers depend on Hokkaido coal or Nishi-Sonogi coal (Takashima coal) with generally high fluidity).

These figures are no worse than other Canadian coking coal (Balmer coal and Vicary coal and so on).

Among other characteristics, Fernie coal has a slightly high ~~phosphorous~~ P_2O_5 content compared with other Canadian coal of which the average contents are 1 to 1.6 percent.

But this is no drawback except in the case of manufacturing low-phosphorous coke.

With the decline in the output of low fluidity Chikuho coal in Kyushu, Japanese mills are being forced to switch over to high-fluidity Nishi-Kyushu, Miike and Hokkaido coals in future. In view of this trend in soft coking coal in Japan, considerable demand is expected to arise for Fernie coal for blending purposes.

Tests on TA-4 samples from Seam A in the Morrissey Creek Area were held at five mills, excluding the Kobe Steel, Ltd. The five concerns differed slightly on the evaluation of the samples from the seam.

Generally speaking, while it is very interesting that the coal has low ash and sulphur contents and is a type with low volatile matter, its fluidity is lower than Seam A coal.

As a result, when it is used singly, the shatter strength is quite low (there were major differences among test results at the five mills).

The Seam ~~B~~ A coal did not show measurable degree in coking characteristics in Yawata and Nippon Kokan tests. But it showed a good compatibility with soft coking coal with high fluidity as in the case of Seam A-1 coal. Its drum index was 90 to 93% (shatter strength).

With the coal failed to show measurable coking character when used by itself, Nippon Kokan expressed it as not so much appropriate for steel making. Nevertheless, the other companies said that in view of its good compatibility with soft coking coal of high fluidity it is possible to use it in limited blending ratio.

C) Mixed Coal Sample of TB-2 and TA-3

Due to circumstances on the part of the steelmakers, samples of this coal were tested at only one of their plants. Its quality was described as equal to or slightly better than TA-3 coal, Seam A coal in the Morrisey Creek Area.

But Seam B coal toward Morrissey Creek (TB-2 and other sections) tends to be slightly low in fluidity.

Since TB-2 is relatively low in fluidity, this result suggests that when Seam A coal is mixed with Seam B coal from the central part of the claim where the fluidity becomes higher, coking character of the mixed coal may be good enough for use.

This will give a greater value to Seam A in the western part of the claim, and will eventually increase the amount of the minable coal reserve.

D) Seam K-1 and Seam K-5 coal

Opinions of four steelmakers (Yawata Iron & Steel, Fuji Iron & Steel, Nippon Kokan and Kawasaki Steel) on the two seams coal are as follows:

i) The coal is too much carbonized and has the drawback of being high in phosphorus content.

ii) The F.S.I. stands at a low of 3 to 5, and the Gieseler fluidity is also very low. But the dilatation pressure runs up close to U.S. low volatile coking coal.

iii) Poor in single shatter strength. The value is particularly bad in the case of samples from lower Seam K-1.
The results of tests vary considerably among the steelmakers concerned, but this apparently has something to do with the fact that the size of submitted samples greatly affects shatter strength-- (a fact proved in tests at Fuji Iron & Steel, i.e., finely ground coal does not coke when used singly.)

iv) When K-1 and K-5 coal were blended up with Japanese high fluidity coal at a ratio of 3 against 7, their shatter strength were good, but when blended with Japanese low fluidity coal, they were poor particularly so with lower Seam K-1 coal.

v) The possibility is slim that coking character of the lower K-1 and upper K-5 coals will be improved greatly even by re-washing them to 6 percent ash content.

reference: table for coal quality comparison between Fernie coal and other coal.

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TEST RESULTS ON SEAM A COAL AND OTHERS BY SIX STEEL MILLS

Year	Seam	Sample	Company Name	Proximate Analysis: Moisture (%)	Ash (%)	Volatile matter (%)	Fixedcarbon (%)	Total Sulpher (%)	(Kcal/kg) Cal	F. S. I.	Caking element index (%)	Coking character — Gieseler Plastmeter: Softening Point (℃)	Melting Point (℃)	Max Fluidity: Temp (℃)	Log (Div/min)	Hardening Point (℃)	Final Temp (℃)	Range (℃)	Dilatometer: Softening Point (℃)	Max Contraction: Temp (℃)	Ratio (%)	Maximum Dilatation: Temp (℃)	Ratio (%)	Dilatation Pressure: 1st	2nd	Final
1966	Seam A	TA-1	Y	1.4	4.6	21.0	73.0	0.41	8,150	7½		411	435	458	19.5	470	483	35	407	453	21	483	(−)11			
			F	1.4	4.7	21.8	72.1	0.40	8,060	6		440		485	17	515								0	0.52	0.47
			N		4.8	21.3	72.9	0.40	8,130	6½		442		467	*3.1	478										
			Ka	1.0	4.3	21.6	73.1	0.38	8,230	6		409	448	466	22.5	487	498	39								
			S	1.5	4.6	20.8	73.1	0.42		6½		420		472	24	500										
			Ko	1.49	4.15	22.25	73.6	0.42	8,322	7		436		456	12	475	484									
1967		TA-3	F	1.4	6.4	20.9	71.3	0.27	7,920	3½		440		480	9	510								0	0.45	0.43
			N		6.6	19.5	73.9	0.29	8,230	3½			G1	7		EP	0.385									
			Ka	0.8	6.6	19.5	78.1	0.27	7,900	4					*2.4											
1966		TA-4 upper	Y	1.4	6.5	17.2	74.9	0.44	7,970	3½		456		468	*1.48	−	492	→	439	538	17	−	−			
			F	1.2	6.4	17.4	75.0	0.50	7,990	3		465		490	6	515								0	0.39	0.36
			N		6.6	17.5	75.0	0.41	7,930	4		None Coking property														
			Ka	0.8	6.8	17.7	74.7	0.45	7,970	3		434		476	20	−	498	−								
			S	1.6	6.6	17.4	74.4	0.44		4½		486		475	16	499										
		TA-4 Lower	Y	1.4	6.3	17.5	74.9	0.34	8,020	3½		485		463	*1.60	−	489	−	439	450	17	−	−			
			F	1.3	6.0	17.6	75.1	0.40	8,010	3		465		490	7	515								0	0.71	0.66
			N		5.1	17.4	76.7	0.34	8,050	4½		None Coking property														
1967	A.B	TA-3+TB-2	N		6.8	19.4	73.8	0.43	8,170	5½			G1	9		EP	0.500									
1965	K-1	Lower 8.5A/o	Y	1.19	8.54	14.50	75.77	0.61	7,830	3½	73.2	457		477	*1.30	−		0	457	518	16	−	0			
			F	1.0	8.3	14.4	76.3	0.60	7,852	3		430		500	8	530								0	0.12	0.08
			N	0.5	8.5	14.4	76.6	0.60	7,840	4			G1	6		EP	1.625									
			Ka	1.1	8.5	14.3	76.1	0.63	7,870	3½		442		470	18	490		−								
		Lower 7.0A/o	Y	1.32	6.92	14.53	77.23	0.61	8,000	3½	81.0	453		476	*1.48	−		0	453	517	21	−	0			
	K-5	upper 8.5A/o	Y	1.03	8.88	16.18	73.97	0.53	7,760	4½	85.6	443		464	*1.85			17	443	510	21	−	0			
			F	1.0	8.8	16.1	74.1	0.60	7,759	3½		460		495	13	525								0	0.78	0.74
			N	0.6	8.6	16.2	74.6	0.58	7,870	5			G1	7		EP	0.950									
			Ka	0.7	8.8	16.0	74.5	0.57	7,800	4		429		563	35	483		−								
		upper 7.0A/o	F	1.0	9.0	16.6	73.4	0.70	7,710	2½		465		500	5	525								0	0.57	0.52
			N	0.6	6.4	16.3	76.7	0.58	8,030	5½			G1	8		EP	1.325									

Year	Seam	Sample	Company Name	D. T. by Rotation 30 >15mm: Single	Blended (see Blend ratio)	Quality difference by size: >10mm Yield (%)	Ash (%)	F. S. I.	10~3mm Yield (%)	Ash (%)	F. S. I.	3~0.6mm Yield (%)	Ash (%)	F. S. I.	<0.6mm Yield (%)	Ash (%)	F. S. I.	Phosphorous in Coal (%)	Remarks (Blend ratio)
1966	Seam A	TA-1	Y	89.9	88.7	21.4	6.3	3	28.7	4.4	7	19.4	4.2	7½	30.5	4.6	7½		Onoura 70%
			F	92.1	90.6	15.6	4.5	6	31.6	5.0	7	32.6	4.0	6½	20.2	5.2	6½	0.068	Heiwa 35%, Mojiri 35%
			N	90.0	89.1 89.5	17.7	5.1	3½	27.4	4.8	6	22.4	4.0	8	32.5	4.6	7	0.082	Ooyuubari 70% Ooyuubari 60%
			Ka	92.1	91.0 91.6	16.8	5.8	4½	33.8	4.3	7	34.4	4.0	6½	15.0	4.9	5~5½	0.070	Yuubari special fine 70% Newdell 70%
			S	93.1	92.8 92.9														Akahira 70% Akahira 60%
			Ko	94.4	93.6 92.6	13.1	5.93	4½	28.9	4.5	6~7½	35.0	4.0	7~7½	23.0	4.8	5~7½	0.088	Toyosato 70% Takashima 70%
1967		TA-3	F	50.0	91.5 92.8	4.7	9.4	1	16.0	7.6	2½	64.6	5.8	4	14.7	5.7	4	0.029	Heiwa 5% Mojiri 30% Liddell 60% Takashima 20%
			N	63.9	87.7 89.5	5.9	11.3	1½	55.5	7.0	4	(38.6	5.9	4½)				0.76	Oyubari 70% Newdell 70%
			Ka	60.1	92.8 89.4	7.2	11.8	1½											Yubari special 70% Newdell 70%
1966		TA-4 upper	Y	70.2	87.7	1.6	6.1	1	12.8	6.1	1½	33.3	5.2	3	52.3	7.5	8½		Onoura 70%
			F	50.3	90.0	2.1	8.2	1½	14.2	6.3	1½	32.0	5.2	3	51.7	7.6	3	0.052	Heiwa 35%, Mojiri 35%
			N		90.1 91.6	2.1	8.2	1	12.8	6.0	1	32.3	5.8	2				0.076	Ooyubari 70% Ooyubari 60%
			Ka	39.7	93.6 87.3	2.7	7.4	1½	15.1	7.8	1½~2	44.2	5.2	3½~4	38.0	8.1	3	0.070	Yuubari special fine 70% Newdell 70%
			S	36.0	92.0 93.0														Akahira 70% Akahira 60%
		TA-4 Lower	Y	−	84.0	1.1	7.3		10.0	6.0	3	30.7	5.7	3½	58.2	6.8	3		Onoura 70%
			F	44.2	91.2	0.9	8.0		10.8	6.0	3½	28.3	5.4	3½	60.0	6.6	3	0.085	Heiwa 35%, Mojiri 35%
			N		89.1 92.0	1.3	9.9	1½	9.8	5.9	2	29.4	5.7	1½	59.5	6.7	1½	0.040	Ooyubari 70% Ooyubari 60%
1967	A.B	TA-3+TB-2	N	74.2	86.1 90.7	11.4	8.5	5½	59.7	6.8	6	(28.9	6.7	6½)				1.80	Ooyubari 70% Newdell 70%
1965	K-1	Lower 8.5A/o	Y	53.9	59.9 82.8	11.4	12.7	3	22.0	8.7	4	30.3	7.6	4	36.3	7.8	3	0.074	Onoura 70% Onoura 60%, Takashima 10%
			F	54.4	90.0 90.8 91.5	8.9	11.0	2½	21.5	8.5	3½	30.6	8.4	3	39.0	8.3	3	0.067	Soft coking coal from Hokkido 85% 〃 70% 〃 60%
			N	−	92.3	12.1		3½	19.7		4	36.4		4½	31.8		4	0.080	Ooyubari 70%
			Ka	−	74.8	10.3	12.3	3½	21.1	8.6	3	38.5	7.5	3½	35.1	8.5	3½	0.080	Yuubari special fine 70%
		Lower 7.0A/o	Y	75.2	79.7 86.6	17.7	10.1	2½	25.7	6.7	4½	35.4	5.9	4	21.2	6.1	4	0.072	Onoura 70% Onoura 60%, Takashima 10%
	K-5	upper 8.5A/o	Y	92.1	85.4 88.1	28.6	11.8	2	28.6	8.3	4	26.8	6.5	6	16.0	8.7	5	0.086	Onoura 60% Onoura 60%, Takashima 10%
			F	88.7	89.9 91.3 91.7	24.4	11.2	2½	28.9	8.4	3½	28.7	7.5	4	18.0	8.5	4	0.089	Soft coking coal from Hokkaido 85% 〃 70% 〃 60%
			N	76.1	90.4	22.5		3	16.3		4½	38.1		5½	23.1		5½	0.086	Ooyuubari 70%
			Ka	81.5	94.2	17.5	13.5	3	37.4	8.3	4	28.1	6.4	4½	17.0	9.0	3½	0.093	Yuubari special fine 70%
		upper 7.0A/o	F	64.9	91.1	17.0	10.3	1½	31.8	8.4	2	26.8	7.2	3	24.4	9.8	3½	0.067	
			N	85.5	91.8													0.078	Ooyuubari 70%

Year	Seam	Sample	Company name	Elementary Analysis (%): Ash	C	H	O	N	Combustible S	Analysis of ash (%): SiO_2	Al_2O_3	Fe_2O_3	MnO	P_2O_5	SO_3	CaO	MgO	TiO_2
1966	Seam A	TA-1	F	4.8	84.7	4.8	4.1	1.2	0.4	47.20	32.44	4.23	0.03	3.30	1.42	2.76	1.42	1.55
		TA-4	F	6.4	83.6	4.6	3.7	1.2	0.5	46.20	29.12	7.51	0.04	1.88	1.92	3.69	1.70	3.31
		TA-4	F	6.1	84.3	4.7	3.3	1.2	0.4	43.60	26.52	8.06	0.04	1.31	4.84	5.53	2.27	3.12

Company name
- Y : Yawata Iron & Steel Co., Ltd.
- F : Fuji Iron & Steel Co., Ltd.
- N : Nippon Kokan Kabushiki Kaisha
- Ka : Kawasaki Steel Corporation
- S : Sumitomo Metal Iudustries Ltd.
- Ko : Kobe Steel Ltd.

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SPC

COAL QUALITY COMPARISON BETWEEN FERNIE COAL AND OTHAR COAL

Country	Brand			M.	Proximate analysis (%d) A.	Proximate analysis (%d) V. M.	Proximate analysis (%d) F. C.	V. M. of Pure coal	T. S.	Coking Character P. S. I.	Caking Index	Giesseler, Plastmeter Softening point (℃)	Max. fluidity Temp. (℃)	Max. fluidity Log Div/Min	Final Temp. (℃)	Range (℃)	Dilatometer Contraction (max) Temp (℃)	Contraction (max) Rate (%)	Expansion (max) Temp (℃)	Expansion (max) Rate (%)	Drum test for shatter strength Single	Blended coal	elementary analysis (% d.a.f.) C	H	N	S	O	Macoral Analysis (Vol. %) Vitrite	Declarite	Exinite	Micrinite	Semifusinite Fusinite	Mineral	Note: * Coal blended with Onoura Coal (semi-coking coal) sharing 70% except specified below
Canada	Fernie	Seam B	TB-2	1.2	6.6	20.1	72.1	21.80	0.57	7½		480	478	3.05	503	28					94.7	90.5 92.4 93.1												
			J-1	1.8	6.0	21.0	71.2	22.72	0.89	8	90.6	408	468	2.38	489	45	455	26	488	-7			83.59	3.85	1.37	0.21	4.98	65.6	0	0	4.2	26.2	4.0	Blended: Upper Onoura 70%; Middle Onoura 60%, Takashima 10%; Lower Onoura 35%, Takashima 35%
			TB-3	1.3	6.0	20.8	71.9	22.43	0.52	7½	88.8	414	468	2.67	495	53	445	17	482	-25	94.4	80.1 87.5 92.2	84.4	4.5	1.2	0.5	8.4	73.4	0	0	1.0	22.2	3.4	
			TB-4	1.1	6.8	22.1	70.0	23.99	0.42	9	92.2	406	473	3.60	503	49					94.8	93.3 94.0												
			TB-5	1.2	6.1	21.1	71.6	22.76	0.50	9		410	474	2.88	502	44					94.8	91.6 91.4 91.8												
			TB-6	1.8	6.8	23.2	68.2	25.38	0.44	8½	89.4	399	465	3.03	492	69	443	20	483	29	94.6	89.8 91.5 92.0	79.8	4.9	1.3	0.4	6.7	86.9	0	0	0.4	9.0	3.7	
		Seam A	TA-1	1.4	4.6	21.0	78.0	22.34	0.41	7½	85.8	411	458	1.95	483	35	458	21	483	-11	89.9	88.7	85.5	4.8	1.2	0.4	4.2 3.5	63.0	0	0	1.6	32.3	2.2	
			TA-3	1.8	6.0	21.0	71.8	22.81	0.39	8	90.6	408	468	2.38	489	45	455	26	488	-7	67.5	89.6 91.4 91.6												
			TA-4 upper	1.4	6.5	17.2	74.9	18.68	0.44	3½		456	468	1.48	493	–	538	17	–	–	70.2	87.7												
			TA-4 Lower	1.4	6.3	17.5	74.9	18.06	0.34	3½		485	468	1.60	489	–	450	17	–	–	–	84.0												
		K-1	Lower 7.0A/o	1.3	6.92	14.5	77.5	15.80	0.61	3½	81.0	453	476	1.48		0	517	21			75.2	79.7 86.6 93.5	84.78	3.96	1.27	0.60	2.44							Blended: Upper Onoura 70%; Middle Onoura 60%, Takashima 10%; Lower Onoura 35%, Takashima 35%
			Lower 8.5A/o	1.2	8.54	14.5	75.8	16.06	0.61	3½	73.2	457	477	1.80		0	518	16			58.9	59.9 82.8 93.2	83.09	3.96	1.21	0.59	2.51							
		K-5	upper 8.5A/o	1.08	8.8~~2~~ 8	16.2	74.0	17.97	0.58	4½	85.6	443	464	1.85		17	510	21			92.1	85.4 88.1 93.0	82.76	3.96	1.22	0.57	2.58							
	Balmer			1.37	9.20	19.38	71.42	21.34	0.25	7½	88.2	413	468	2.48	491	48	445	23	480	2	92.9	87.3	89.03	4.84	1.33	0.17	4.63	70.1	0.0	0.0	1.2	27.3	1.4	
	Vicary			1.44	8.79	22.25	68.96	24.39	0.52	4½	89.6	411	456	2.11	479	35	458	24	472	-22	91.6	82.8	87.77	4.86	1.39	0.53	5.55	64.5	0.0	0.3	3.8	30.2	1.2	
	Smoky			1.13	6.02	18.22	74.63	19.62	0.42	5	90.4	411	462	1.85		22	458	26	483	-8	94.1	90.4	85.11	4.36	1.20		2.86	75.6	0.0	0.0	3.4	20.0	1.0	
U. S. A.	Itmann			1.2	6.2	17.4	75.2	18.87	0.78	8½	90.9	422	480	2.98	502	56	451	22	485	43	98.8	89.3	90.10	4.63	1.28	0.54	3.45	78.5	0.0	0.0	6.8	13.9	0.8	
	Cunard			1.38	5.06	22.08	72.86	23.26	0.81	8½	89.8	384	459	3.87	491	83	423	26	477	99	93.7	88.4	88.91	4.39	1.62	0.83	3.75	77.8	0.0	0.7	4.1	16.4	1.5	
	Arkansas			1.85	7.79	21.54	70.67	23.86	0.68	9	91.9	400	463	3.03	490	53	438	21	480	47	89.5		88.44	4.85	1.89	0.44	4.38	83.7	0.0	0.0	1.6	10.9	3.8	(Howe)
Australia	Coal Cliff			1.51	10.60	20.44	68.96	22.89	0.35	5½	86.8	397	448	1.90	477	33	500	18	fail to expand		94.0	88.9	88.51	5.15	1.58	0.30	4.46	36.1	0.0	0.0	1.4	61.4	1.1	
U. S. S. R.	K-10			1.81	8.71	20.69	70.60	22.67	0.42	6½	91.0	411	468	2.28	481	47	477	17			88.5	88.1	88.07	4.82	2.61	0.25	4.25	57.4	0.0	0.0	3.7	35.9	3.0	
	KJ-14			1.79	8.99	22.22	68.79	24.42	0.41	6½	92.3	379	444	2.42	466	52	449	22	468	-18	92.8	88.2	86.99	4.93	2.27	0.18	5.63	63.4	0.0	0.0	4.7	23.8	8.1	
	OS			1.42	7.80	13.98	76.80	15.40	0.50	1		444	471	1.48	495		520	7	–	-	--		84.44	3.86	1.73	0.39	1.67							(Single: Fail to Coke)
China	Fong Fong			1.1	9.6	19.9	69.4	22.50	0.68	9											94.1	88.5												

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2. Sample taken from Drill Cores

Samples taken from the core through drills J-1 (Seam B) and J-3 (Seam A) were prepared at Mitaka Laboratories of Nittetsu Mining Co., Ltd. and sent to the laboratories of Yawata Iron & Steel Co., Ltd. for quality tests.

(1) Test results at Mitaka Laboratories

(A) Drill J-1 (Seam B)

Result of Sink and Float Test

Specific gravity	Weight (%)	Ash (%)
- 1.32	82.3	3.58
+ 1.32	17.7	19.17
Σ	100.0	6.34

On the basis of the sink and float test, the core samples were prepared. The quality of the samples which were sent to Yawata Works is as follows.

(Unit: %)

Proximate analysis				Volatile matter (daf)	F.S.I.	Total sulphur	Yield
Moisture	Ash	Volatile matter	Fixed carbon				
0.79	6.22	21.40	71.59	23.01	7	0.40	98.1

(B) Drill J-3 (Seam A)

The quality of samples presented to Yawata Works.

(Unit: %)

Mark	Proximate analysis				Volatile matter (daf)	F.S.I.	Total sulphur	Theoretical yield	Ash content of raw coal
	Moisture	Ash	Volatile matter	Fixed carbon					
J-3 top	1.12	6.51	18.85	73.52	20.43	4	0.36	77.0	17.32
J-3 middle	1.19	7.48	17.75	73.58	19.48	3 ½	0.38	90.0	10.05
J-3 bottom	1.14	7.40	19.08	72.38	20.86	3	0.28	77.8	16.26

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(2) Test results at Yawata

(A) Drill J-1

i) Samples

The tests were held on about one kilogram of coal samples collected from the Seam B core through drill J-1. The samples were prepared to an ash content of 6 percent at Nittetsu Mitaka Laboratories.

ii) Test results

a) Analysis

(Unit: %)

Item / Sample description	Moisture	Proximate analysis		Volatile matter (daf)	Fuel ratio	Cal/g (daf)	Elementary analysis (daf)				
		Ash	Volatile matter				C	H	N	S	O
J-1	1.81	5.95	20.98	22.31	3.48	8,678	88.59	3.85	1.37	0.21	4.98

b) Sulphur

Item / Sample	Total sulphur (%d)	Form of sulphur (%d)			Crusible Coke sulphur (%)
		Sulphate	Pyrite	Organic sulphur	
J - 1	0.39	0.00	0.04	0.35	0.39

c) Texture

Texture / Sample	Virinite	Degradinite	Exinite	Micrinite	Semifusinite	Fusinite	Mineral
J - 1	65.6	0.0	0.0	4.2	5.7	20.5	4.0

d) Coking quality

Item / Sample	F.S.I.	Coking element index (%)	Gieseler Plastmeter					Dilatometer				
			Softening point (°C)	Max. fluidity		Final Temp. (°C)	Range (°C)	Softening point (°C)	Maximum contraction		Maximum dilatation	
				(°C)	log (Div/min)				(°C)	Ratio (%)	(°C)	Ratio (%)
J - 1	8.0	90.6	408	468	2.38	489	45	410	455	26	488	-7

iii) General comments by Yawata

Fernie coal from Seam B obtained through drill J-1 has a volatile matter of 22 percent pure coal basis which represents a considerably lesser carbonized quality compared with Fernie coal from K-1 and K-5 seams.

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In addition, the former is higher in F.S.I., fluidity and dilatation. Judging from these characteristics, Fernie coal which came under the purview of the current survey has qualities similar to Balmer coal which is also mined in Canada, except that the fluidity and dilatation of the present samples are slightly lower.

Consequently, this Sample can be presumed to have properties of strong coking coal and it can be concluded that it is sufficiently worthwhile to have more detailed tests on it.

3. Tests at Mitaka Laboratories

The majority of tests at Mitaka Laboratories of Nittetsu Mining Co. consisted of proximate analysis of samples of various coal seams collected from the outcrops.

Proximate analysis was also carried out on samples of coal pillars derived from tunnels and drills. Sink and float tests were held on part of the samples.

Tests on samples from tunnels and drills have been completed at Kobukuro and steelmakers. Since they represent coal seams which have generally been spared weathering, conclusions reported above could be drawn on their quality.

But samples from the outcrops, being conspicuously weathered, are not appropriate to judge the natural quality of coal they represent. Nevertheless, it is surmised tentatively that they can be classified as coking coal.

Analysis values, being printed in attached coal pillar diagrams, have been skipped here.