The desliming rate of the plant is 18.1%, which means the percentage of the clay removed from the plant feed tonnage.

19-6 Current Coal Quality Control

1) Outline

Coal quality control has been intensively performed from the pit operation to the shiploading with all employee's quality consciousness under the supervisions.

Prior to the mining operations, the geological group performs an extensive sampling at the mining faces as well as the bench floors. Based on the analytical results of the samples, mainly calorific value, mine plan is laid out so as to obtain as uniform characteristics as attainable in the product coal. As mutually agreed between SCC and NAPOCOR, the product coal shall have a minimum calorific value of 8,500 Btu/lb on air dry basis at the coal stockpile area to be approved for shipment, so that special attention is paid on the calorific value.

The main seam which occupies more than 80% of total coal reserves in the Unong pit consists of 14 plies. The seven plies from the top to the bottom are classified to the Upper Main Seam and the rest of the plies is the Lower Main Seam.

In the selective mining currently performed, #2, #8 and #10 plies are segregated as waste coal, which is virtually mudstone, and hauled to the waste dump. The operator of bucket wheel excavator concentrates to avoid the contamination from the mudstone plies and overburden, receiving the instructions from the foreman who is watching the plies in the coal seam and the wheel movement, standing beside the running wheel of the excavator. The foreman is responsible for the quality assurance at the pit and informs the affiliated sections such as quality control division, mine manager's office and others, what ply is being extracted.

The #11 ply and contaminated coal at each contact of the plies to be removed are recovered as washable coal to be processed at the pilot coal preparation plant.

In general, the Upper Main Seam has a higher calorific value than the Lower Main Seam, which are approximately 9,300 and 8,600 Btu/lb respectively, excluding #11 ply in the Lower Main Seam, which is about 7,700 Btu/lb. The overall calorific value of the product coal is maintained as uniform as possible by controlling the blending ratio of the two portions of the Main Seam. The average blending ratio is about 60% for the Upper Main Seam and 40% for the Lower Main Seam.

The excavated coal is transported to the stockpile area on the western side of the island through the overland coal conveyors K1 and K2, which total length is approximately 4,600 m, running across the center part of the island.

At the stockpile area, the coal quality control division is responsible for blending the coal from the pit to obtain as homogeneous product coal as possible meeting with the contracted specifications.

During shiploading at the Dapdap pier, representative coal samples of each shipment are taken according to ISO standard by using the automatic sampler installed at the discharge of SB-5 belt conveyor as specified in the "Coal Supply Agreement". Refer to Fig. 19-3.

2) Stockpiling and Coal Blending Program

Fig. 19-3 shows the layout of coal stockpile area and coal handling facilities.

There are two yards in the stockpile area, one on each side of the SB-1 and SB-2 conveyors running in the center of the stockpile area. Each yard has a stocking capacity of about 130,000 tons. The one on the north has been already saturated with low-grade coal for the captive power plant and washable coal to be processed at the pilot coal preparation plant. The installed reclaimer system is designed to operate only in the south yard and is unable to reach to the north yard. Accordingly, the product coal is stockpiled in the south yard with 40 m wide and 540 m long.

The yard is conceptually divided into 12 sections, each of which is 45 m long, having 5,000 to 6,000 tons capacity considering enough capacity for one shipment to the power plant.

The product coal is stacked as indicated in Fig. 19-4 shifting the stacker at constant speed. Low-grade coal from the lower main seam is piled in the center part of the pile at the ratio of about 40% of the total volume of 5,000 to 6,000 tons. High-grade coal from the upper main seam is overlapped on top

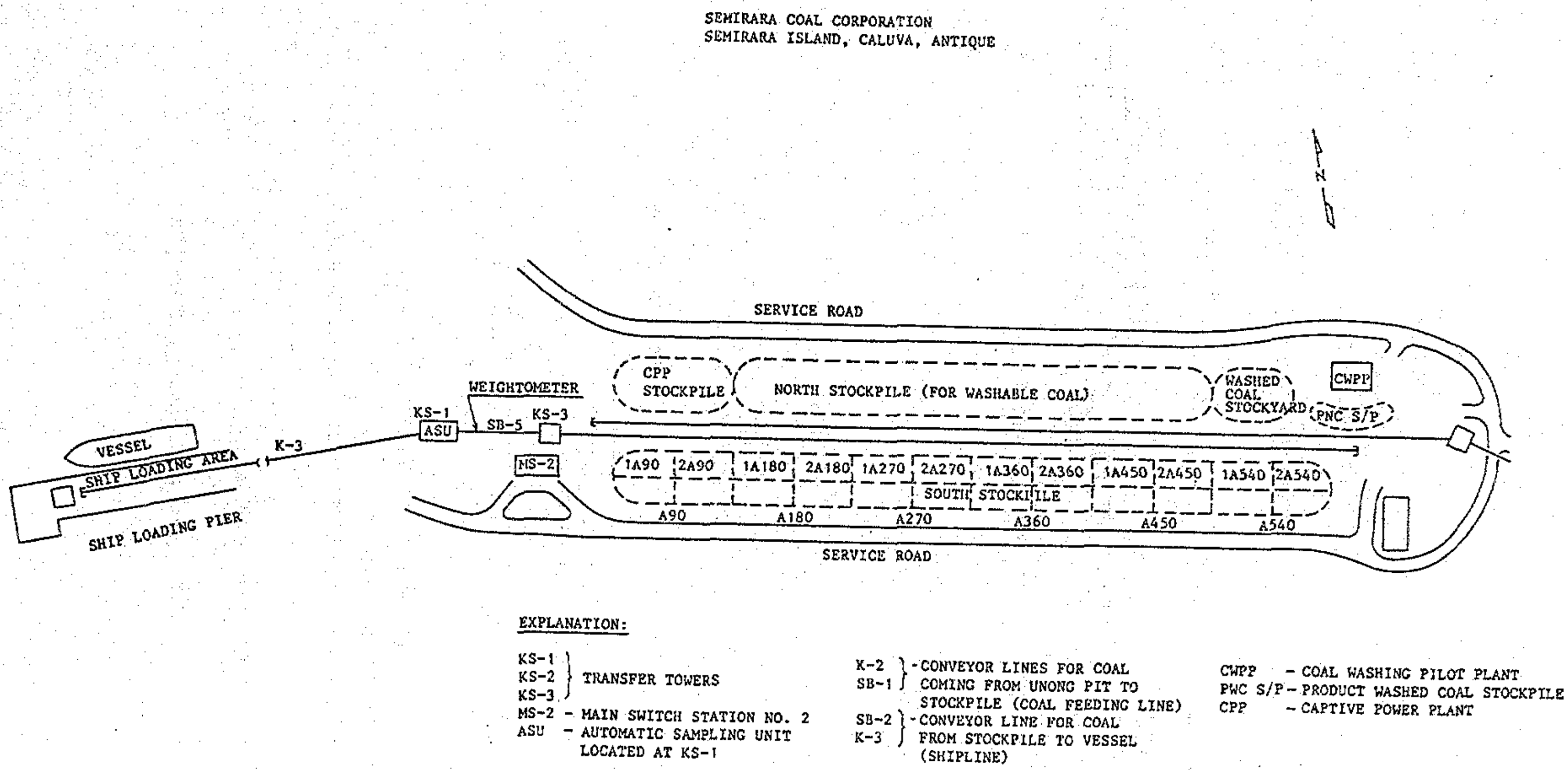
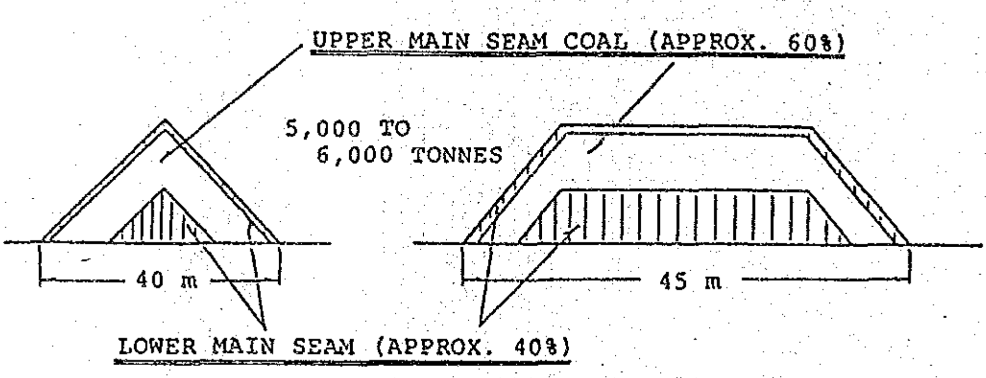
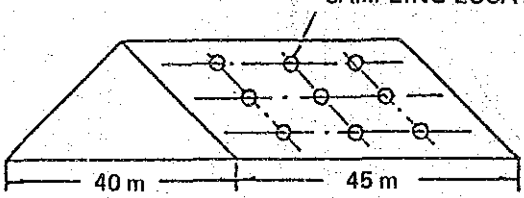


Fig. 19-3 Location Map of Coal Stockpile Area and Coal Handling Facilities



STOCKPILE STACKING PROGRAM



18 LOCATIONS EVERY 250 TONS
5 kg PER INCREMENT
4 x 90 kg TOTAL SAMPLE (360 kg sample/1,000 tons)

STOCKPILE SAMPLING

Fig. 19-4 Stockpile Stacking and Sampling

of the low-grade coal pile at the ratio of about 60% and some amount of low-grade coal is overlapped again on the surface of the pile. This procedure is carried out very carefully, keeping close contacts with the bucket wheel excavator foreman at the mining face, so as to attain as homogeneous product coal as possible, meeting with the contracted specifications.

During the course of the stacking, samplings are conducted at 18 locations of the pile every 250 tons of stack, by using prescribed sampling device. Every 1,000 tons stack, one representative sample is made by combining with all samples taken every 250 tons stack. On the representative sample, proximate analysis and calorific value determination are conducted. The analysis results of the representative samples, 5 or 6 depending upon the aggregate tonnage of the pile, are composed to determine the final specifications of the stockpile for one shipment. The samplings and analyses are all witnessed by NAPOCOR site representatives who are authorized to reject the stockpile with lower than 8,500 Btu/lb. After the specifications of the stockpile is endorsed with the certificate issued by NAPOCOR site representatives, the stockpile becomes ready for shiploading.

One of the major peculiarities of the Semirara coal is its susceptibility to spontaneous combustion, as a result, the longest allowable time duration for the coal to be stockpiled in the yard is approximately 2 weeks according to the past experience, thus it is almost unable to perform a blending by storing low-grade and high-grade coals separately.

Another negative factor hindering from better coal blending is the overland coal conveyor system capacity of 1,020 tons per hour in theory which is not sufficient to load 2 bucket wheel excavators' output, thus the blending with simultaneous loading by 2 bucket wheel excavators, each wins different quality portion of the coal seam, is unable to do.

The estimated product coal tonnage produced at one location of the mining bench amounts to as much as 12,000 tons, for instance, assuming 15 m bench height, 30 m width, 21 m coal seam thickness and 1.3 specific weight of the coal. Considering the current mining conditions with fairly high stripping ratio of around 1 to 10, the abovementioned blending with two bucket wheel excavators is almost impossible, unless advancing waste stripping far ahead. However, the present bucket wheel excavator system does not allow to proceed only waste stripping, leaving coal seam behind, it means that product coal quality delivered to the stockpile area is decided by the in-situ coal quality at the particular location being mined by the bucket wheel excavator. Therefore, the lower-grade coal accidentally encountered during the course of mining operations is to send to the stockpile area for the captive power plant fuel or for processing at the pilot coal preparation plant.

As to the samplings at the stockpile, samples are taken on the surface of the stacks which tends to have courser particles, thus the installation of an automatic sampler is recommended for better quality control management.

The currently conducted windrow stacking at the Calaca plant coal yard is considered to be contributing to achieve better coal blending, supplementing the insufficiency, even though the best possibly SCC can do, at the mine site.

3) Shiploading and Sampling

The stockpiles approved by NAPOCOR site representatives for shipment are ready for loading on a coal boat anytime. As specified in the "Coal Supply Agreement" representative samples are taken by SCC for each shipment during loading according to ISO standard. The sampling is done by using the automatic sampler installed at the discharge end of SB-5 belt conveyor on which weightometer is installed. Refer to Figs. 19-5 and 19-6.

The automatic sampler is a cross cut bucket type of which sampling bucket travels every 4 minutes to take more than 65 increment per 1,000 tons of lot. The volume of the sample taken per the bucket travel is approximately 60 kg, which is reduced down to four 5 kg samples after crushed down to -9.50 mm.

One of the four samples is used for the analyses of calorific value and proximate analysis which are conducted at SCC Assay Laboratory being witnessed by NAPOCOR site representatives.

The analysis is done in accordance with ASTM standard and a certificate of analysis is issued by SCC. The remaining two samples go to NAPOCOR and SCC for their respective analysis and the last one sample is stored in a container for the third party analysis in the event of dispute on the difference of the analysis results between NAPOCOR and SCC.

The shiploading takes approximately 5 to 6 hours as the capacity of the shiploading conveyor is 1,000 tons per hour.

.AUTOMATIC SAMPLER

INSTALLED ON
THE CONVEYOR
TO SHIPLOADING.

SAMPLE APPROX. 60 kg.
↓
FUNNEL
↓
FEEDER
↓
IRON TRAP
↓
TWIN ROLLER CRUSHER
↓
CHUTE
↓
BUCKET ELEVATOR
↓
VIBRATING FEEDER
↓
ROTARY TUBE DIVIDER
↓
JAW CRUSHER
↓
VIBRATING FEEDER
↓
DIVIDER
↓
FINAL SAMPLE FOR ANALYSIS

4 - 5 kg SAMPLES

1 - SCC ANALYSIS FOR CERTIFICATE
1 - SCC ANALYSIS
1 - NPC ANALYSIS
1 - THIRD PARTY LABORATORY ANALYSIS WHEN DISPUTE ARISED BETWEEN NPC AND SCC.

Fig. 19-5 Material Flow of Automatic Sampler

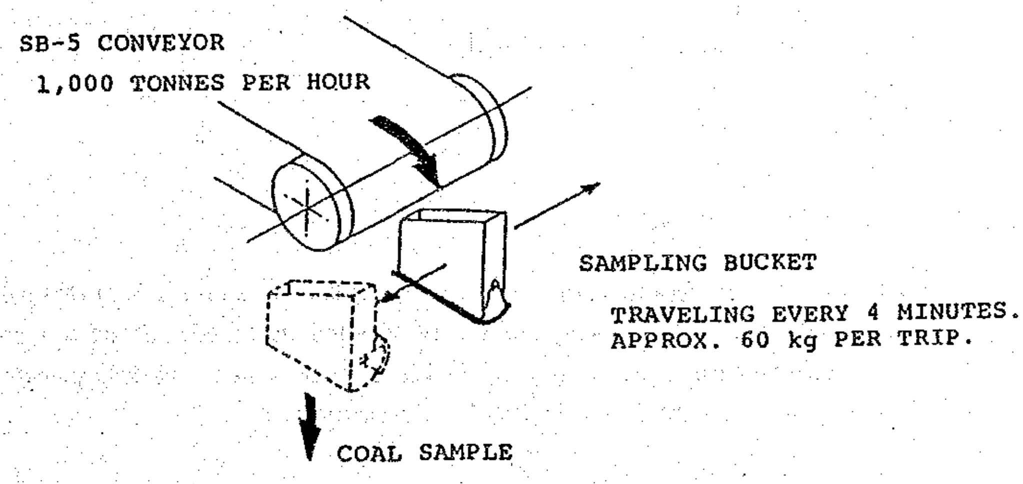


Fig. 19-6 Automatic Sampler (Cross Bucket Type)

It must be noted that tremendous dust generation was observed at the point of shiploading and sampling as well as stacker and reclaimer.

It may be only during the dry season, however, it is recommended to provide with effective water spray systems to suppress the coal dust generation considering wind loss of valuable product coal and environmental pollution to inhabitants.

As the water spray increases moisture in the product coal, it might create some conflict with the coal buyers, however the moisture increase would not be so significant as to cause troubles in the system as long as the spray system is designed and installed to attain maximum effect with minimum water consumption.

Manpower engaged in the product coal handling is as follows:

Product General Foreman	1
Sr. Product Engineer	1
Quality Control Engineer	1
Shift Supervisor	6
Main Switch Operator	4
Reclaimer Operator	3
Shiploader Operator	3
Stacker Operator	3
Draftsman/Draft Surveyor	1
Conveyor Tender	7
Sampler	18
Vessel Spotter/Conveyor Tender	2
Total	50

4) Assay Laboratory

All coal analyses required for the coal mining operations on the Semirara island are conducted at the Assay Laboratory situated inner side of the industrial area where major mine supporting facilities such as main workshop, captive power plant and others, considering less dust exposure.

The building is concrete structure with large roof to avoid direct sunshine and rainfall which would affect the results of analyses, and the floor dimensions are approximately 17 m x 12 m.

Fig. 19-7 shows the floor plan of the building.

The office is located in the center of the building and the west side is used for sample storage and sample preparation such as crushing, sizing, drying, etc., and chemical and proximate analysis room is located on the east side of the building.

It is prudent to separate the sample preparation room where dust generation occurs, completely from the analysis room which should be as much dust-free as possible.

The laboratory is equipped with various apparatuses as listed below:

a. Sample preparation room

- Air drying oven
- Crusher
- Pulverizer
- Ring grinder
- Sieve shaker
- Split-o-matic
- Riffler
- Top loading scale

b. Analysis room

- Minimum free space oven
- Natural convection oven
- Furnace
- Calorimeter
- Hot plate
- Analytical balance
- Desiccator

It is fairly well equipped laboratory for a coal mine operation.

Routine work of the laboratory ranges fairly wide area from product coal to geological coal sample analyses. The major routine work is the analysis of the product coal loading onto a coal boat as well as at the stockpiling area, on which official coal quality certificates are issued. Besides those, analyses of the mining face samples and boring core samples, on which mining plans and coal quality control schedule are established, are another major stream of the work.

Manpower at the laboratory is as follows:

Superintendent	1
Chief Analyst	1
Supervisor	3
Analyst	4
Sampler	8
Typist	1
Helper	2
Total	20

Miscellaneous analyses of such as ash from the captive power plant, plant feed, product and sludge coals of the pilot coal preparation plant, etc., are also conducted at this laboratory.

Considering the wide range of coal quality fluctuation in the pit, coal sampling has been extensively conducted at the mining faces, so that the volume of total samples is considerably large. The sample preparation is currently done manually, but an introduction of additional equipment should be considered to cope with the increasing number of samples. And also chemical analytical apparatuses for sodium, potassium and sulfur contents must be introduced considering the peculiarity of the Semirara coal. Those apparatuses must be practically operative on the island with a smooth supply of necessary parts and supporting material.

The sampling and analysis of the product coal to be shipped out to the Calaca power plant are witnessed by representatives from NAPOCOR, who are only authorized to witness sampling, weighing and analysis.

During the course of the JICA survey, the analysts at the laboratory expressed the earnest desire that JICA would provide them with an integrated training of sampling and analysis as well as necessary analytical appratuses.

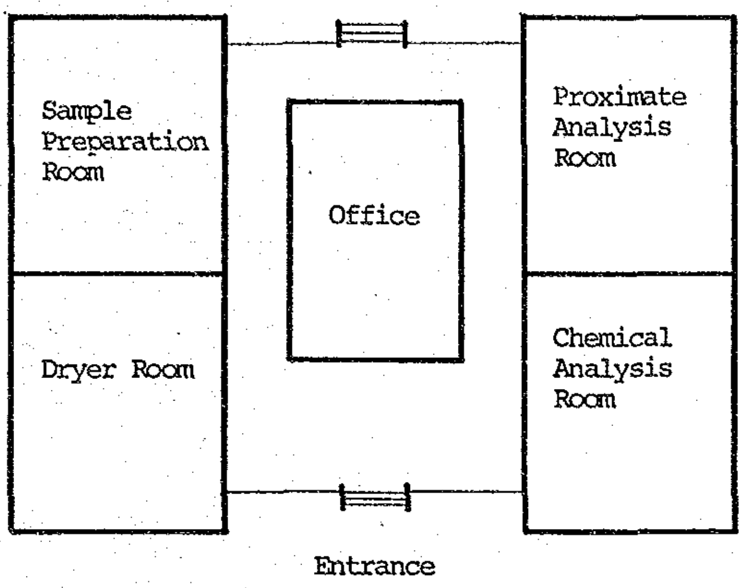


Fig. 19-7 Assay Laboratory

20. Coal Sampling and Analyses

20-1 Coal Sampling

20-2 Sample Analyses

20. Coal Sampling and Analyses

20-1 Coal Sampling

During the first site survey, coal samplings had been conducted extensively at the exposed coal seams in the Unong pit to evaluate the quality and characteristics of the coal produced in the pit. The sampling locations were limited by the availability of the favorably exposed coal seams without disturbing the mining operations.

In order to estimate the quality of coal to be produced, boring core samples which cover whole area of the pit must be obtained, however such core samples were not available.

The coal analysis data on each boring core recovered in the past was not available for our scrutiny.

Considering those facts, face samplings were conducted by JICA team to cover as wide area as possible within the allowable limit.

1) Sampling Locations

The sampling locations are indicated in Figs. 20-1 to 20-4. The main seam samples were taken at the faces of No. 4, and No. 5 conveyor lines, the 1st minor seam at No. 4 conveyor line and the 2nd minor seam at the north-eastern slope of the pit. (Refer to Fig. 13-3 to 13-5 Columnar Sections at the Sampling Faces.)

2) Sampling Method

As shown in Table 20-1 Coal Sample List, the appropriate volume of samples were taken by the sampling crew, which kindly provided by SCC for this particular task, under the supervisions of JICA survey team.

After removing approximately 10 cm of surface coal, sample coal was taken by cutting a channel of about 20 cm in width from the top to the bottom of each seam. In the main seam, samples were taken from each ply, including mudstone plies and were packed in plastic bags with sample identification tags.

Those samples were crated at the Assay Laboratory on the island and shipped out on the first available coal boat to the NAPOCOR Calaca Power Plant from where the samples were sent to Japan for detail analyses.

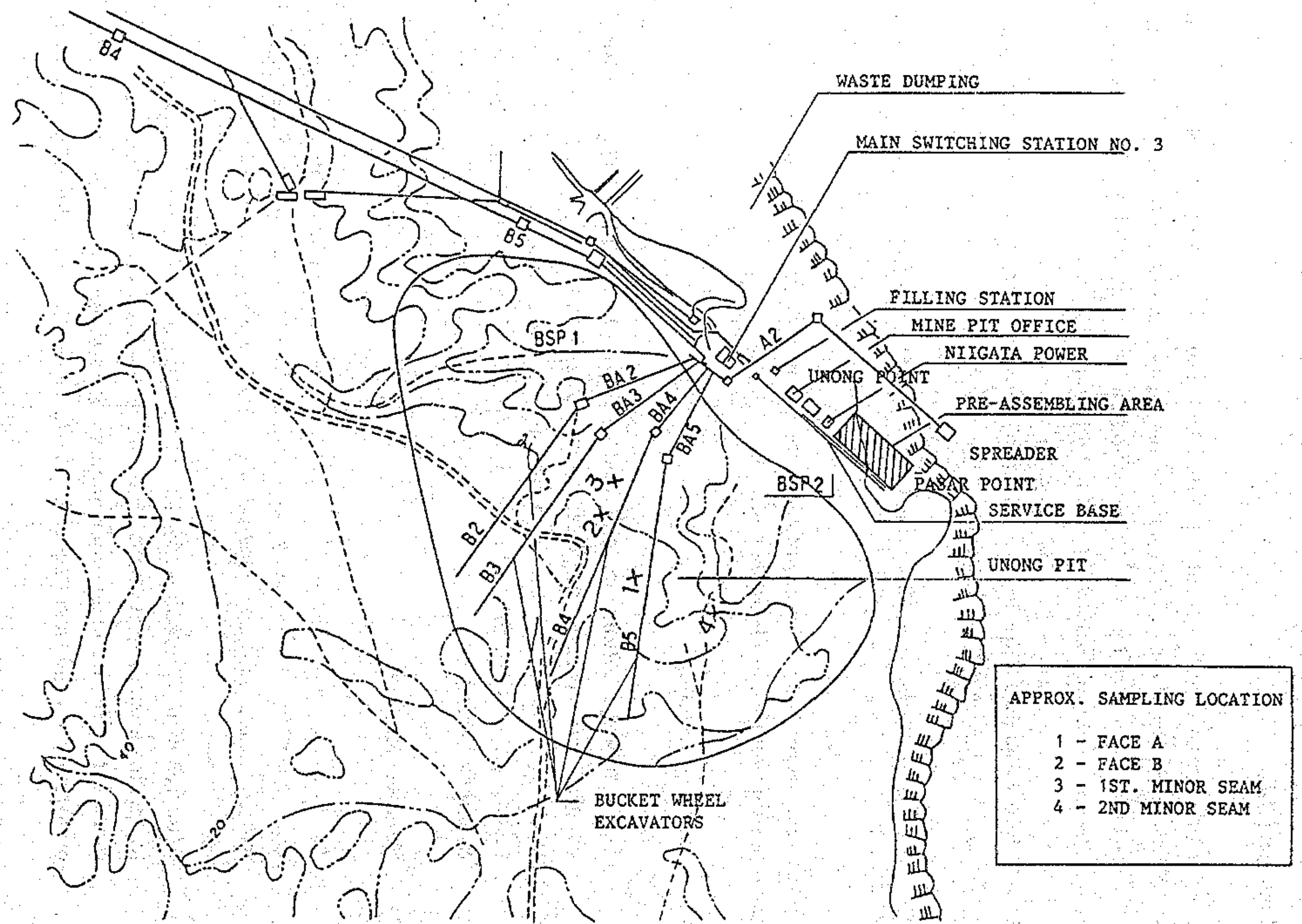
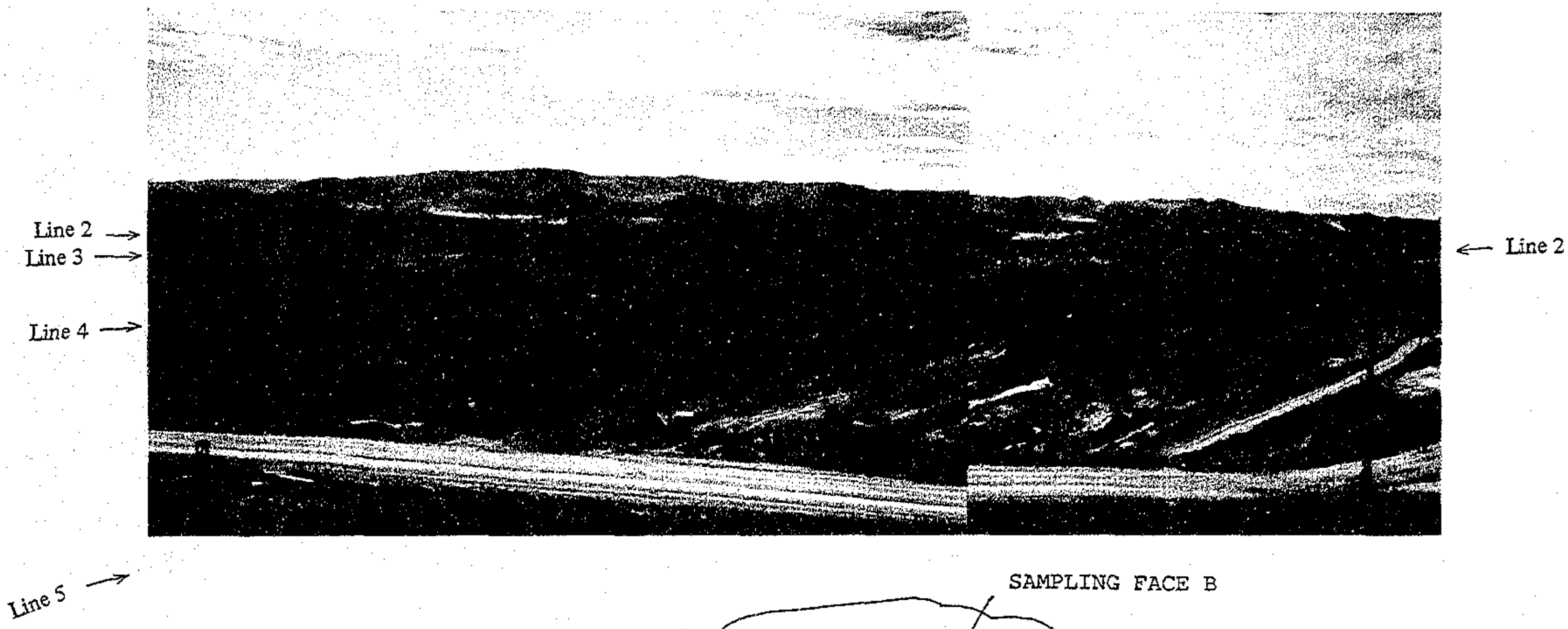


Fig. 20-1 Unong Pit Sampling Location



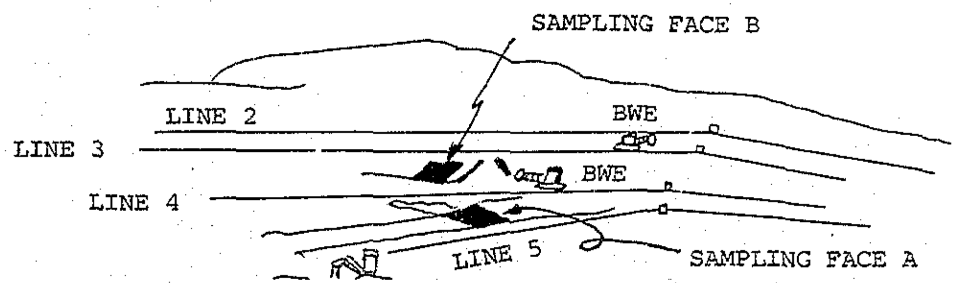


Fig. 20-2 Unong Pit Sampling Location

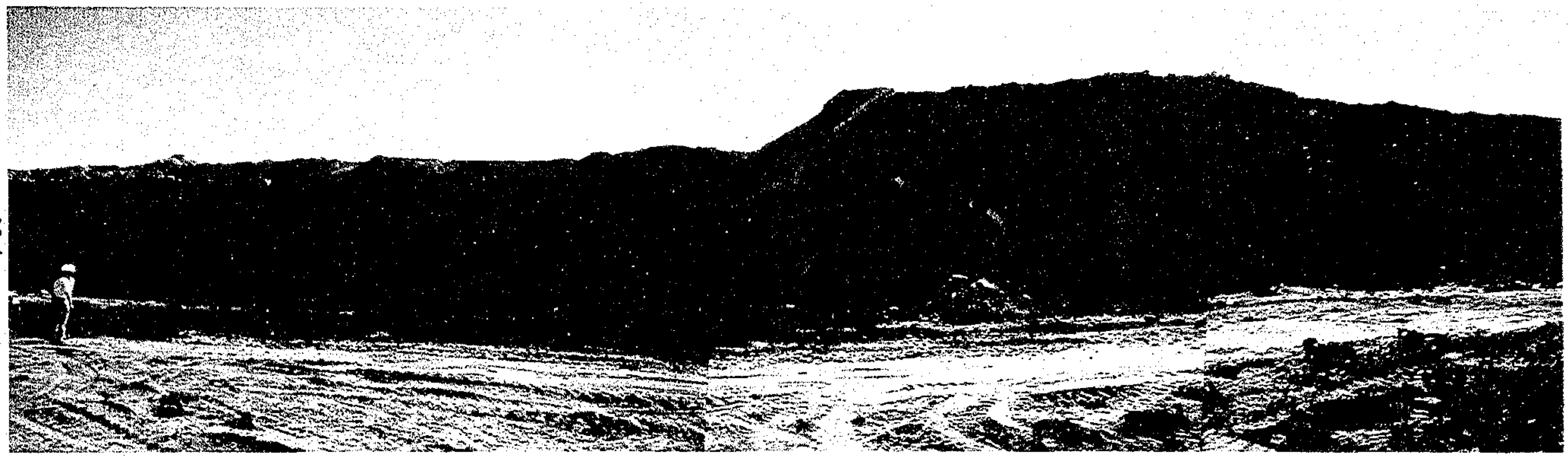


Fig. 20-3 Sampling Face B

Fig. 20-4 Sampling Face B

Table 20-1 Coal Sample List

Location	Type of Coal	No. of Samples	No. of bags	Note
Calaca Thermal Power Plant	Semirara Unong selectively mined. Size distributed.	6	10	
	Power plant feed			
	Unong selected	1	2	
	Imported	1	2	
	Blended (1) (2) (3)	3	6	
Subtotal		11	20	
Semirara Unong Mine Pit	Face A (Line 5)	15	28	Upper main 7 plies Lower main 7 plies
	Face B (Line 4)	5	10	No. 3 – No. 6 No. 7 No. 9 No. 11 No. 12 – No. 14
	1st Minor seam	1	2	
	Face C			
	2nd Minor seam	1	2	Northeast side of the pit
Pilot Washing Plant	Plant feed coal	4	4	
	Product coal	4	4	
	Carbonaceous mudstone	1	1	Rejected by hand at plant feed conveyor.
Shiploading Belt Conveyor	Selectively mined coal to be shipped out.	6	6	At automatic sampler during shiploading.
Subtotal		37	57	
Total		48	77	

Note: Samples for combustion test are not included.

20-2 Sample Analyses

There are 48 samples obtained during the cause of th first site survey completed at the end of March 1987, including samples at the Calaca Power Plant, Semirara Unong pit, pilot washing plant and shiploading conveyor. Those samples are listed in Table 20-1. Besides those samples, 7 samples were taken from the specially delivered coal for the combustion test conducted in July and August 1987 and provided by NAPOCOR Calaca Power Plant, prior to the said combustion test. During the combustion test, further samplings were done on the coal being fed into the power plant to identify the characteristics of the particular coal to be burned.

1) Coal Analyses

All analyses were performed in accordance with Japanese Industrial Standard (JIS), except the items not specified in the standard or to be considered not appropriate to apply the standard. On those special items, suitable standards were applied.

The results of the analyses on the samples taken at the Calaca Power Plant ship-unloading conveyor are summarized in Tables 20-2 to 20-4.

Table 20-2	Proximate Analysis by Size Fraction
Table 20-3	Hard Grove Index by Size Fraction
Table 20-4	Ash Analysis by Size Fraction

The results for the Unong pit samples are summarized in Tables 20-5 to 20-9.

Table 20-5	Proximate Analysis by Ply
Table 20-6	Hard Grove Index by Ply
Table 20-7	Specific Gravity by Ply
Table 20-8	Chlorine Contents by Ply
Table 20-9	Ash Analysis by Ply

The desliming test results are summarized in Table 20-10 and Fig. 20-5 by ply for the Unong pit samples, pilot coal preparation plant feed and product as well as selective mining coal sample taken on the shiploading conveyor.

Based on the results indicated in those tables, characteristics of the Semirara coal are summarized as follows:

a. Volatile matter:

Relatively high volatile matter content ranging from around 30 to 50%.

b. Fuel ratio (FC/VM):

Fairly low fuel ratio of less than 1.0, which indicates easier combustion due to high volatile matter content.

c. Sulfur:

Fairly high total sulfur content of over 1.0%. It increases the slagging index indicated by,

(Base/Acid) x Sulfur content

d. Ultimate analysis results:

The results of the ultimate analysis are not affected by ash content, for instance, the #9 ply with higher ash content shows almost same results as the others.

e. Chlorine:

#1 ply shows a little higher chlorine content of 170 ppm. High chlorine causes corrosion in a boiler. Attached chlorine content could be a scale to estimate the content of sodium from seawater, for example, it is estimated that 100 ppm of chlorine content is accompanied with 68 ppm sodium from the mole ratio, assuming that they exist at the equivalent ratio, as is usually the case. The higher attached chlorine content of 170 ppm is observed in #1 ply, but the value falls in the range that usually found in the soil close to the ocean.

f. True and apparent specific gravities:

The volumetic voids are calculated based on the measured true and apparent specific gravities to estimate the theoretical maximum inherent moisture, assuming that the all voids are filled with moisture. The calculated maximum inherent moisture is around 20% for coal plies, 7 to 15% for waste and low-grade coal plies.

g. Hard grove index:

The hard grove index is around 40 for coal plies and 100 for waste plies. It is low in larger size fraction of over 100 mm.

h. Desliming test:

The desliming test was done to evaluate coal preparation method and its efficiency. It is observed that not much weight reduction occurs as the progression of time, in the coal ply samples, on the other hand tremendous weight reduction occurs in the waste ply samples. It means that the coal plies contain very small amount of water soluble material and the waste plies consist of considerably high water soluble material. In #2, #10 plies almost 80% is leached with water and 70% for #8 ply, 50% for #4, #6, #13 which are relatively thin plies. It is noted that the ply #11 which currently washed at the pilot coal preparation plant shows not much weight reduction, it is interpreted that the #11 ply contains not much water soluble material to be reduced by the coal washing.

i. Free swelling index:

Free swelling index was measured on the samples taken at the Calaca power plant, which was selective mining coal, only for a reference. The index is zero, which is favorable to a boiler use.

j. X-ray diffraction test of low temperature ash

In order to identify the mineral component contained in this coal, X-ray diffraction test was performed on the low temperature ash formed at about 150°C by using a plasma reactor. The sample taken from #7 ply at the Unong pit was used for this particular test.

The results indicate that the mineral components contained in the coal are mainly Gypsum, Quartz, Boehmite and Gibbsite. A part of the Gypsum has been changed to Hemihydorate Gypsum by losing water of hydration during the formation of low temperature ash, as indicated below:

$$CaSO_4 \cdot 2H_2O \xrightarrow{128^\circ C} CaSO_4 \cdot 1/2H_2O \xrightarrow{163^\circ C} CaSO_4$$

2) Ash Analyses

a. Ash fusibility

The initial deformation temperatures are lower in the waste and low-grade coal plies than those in the coal plies, around 1,200°C and a little over 1,300°C respectively, in the upper main seam. On the other hand, they are higher in the waste plies than the coal plies, around 1,450°C and 1,200–1,300°C respectively, in the lower main seam.

In general, the rest of fusibilities such as softening, hemisphere and flow temperatures are lower in the coal plies than the waste plies.

b. Ash composition

The SiO_2 contents are lower in the coal plies than the waste plies. Especially, the coal plies #3, 5, 7, 14 are ranging from 6 to 12%. In general, the SiO_2 contents are much lower than those in the standard coal, which shows over 60%. It may be considered that SiO_2 has been lost by dissolution due to high amount of heat and rain which are typical in the tropical weather.

The Al_2O_3 contents are around 30%, showing lower value in the upper main seam coal plies, which is similar tendency as the SiO_2 contents.

The Fe_2O_3 contents are abnormally higher in #5 ply and the upper portion of #7 ply than those in the other plies.

The CaO contents are high in the coal plies except #9 ply. It is observed that CaO and MgO contents become higher in the portion where SiO_2 and Al_2O_3 contents are lower.

The Na_2O contents are higher in the plies where the SiO_2 contents are lower, for example, in the lower portion of the #7 ply, where SiO_2 content is low, Na_2O content shows as high as 7.5%.

The K_2O contents are higher in the waste and low-grade coal plies than those in the coal plies.

Table 20-2 SSC Coal Analysis by Size Fraction

Size Fraction mm		+100	100 - 50	50 - 11.2	11.2 - 4.0	4.0 - 1.4	1.4 - 0.5	0.5 - 0.15	0.15 - 0.045	-0.045
proximate Analysis										
Ash	%	9.3	22.8	19.4	15.7	19.1	21.4	25.4	32.5	32.6
Volatile Matter	%	47.1	40.9	42.7	44.2	42.5	41.4	39.2	36.2	36.2
Fixed Carbon	%	43.6	36.3	37.9	40.1	38.4	37.2	35.4	31.3	31.2
Fuel Ratio		0.926	0.888	0.888	0.907	0.904	0.899	0.903	0.865	0.862
Total Sulfur	%	0.5	0.7	0.7	0.7	0.9	0.9	1.0	1.5	1.5
Calorific Value										
Kcal/Kg		6,760	5,380	5,650	5,920	5,590	5,330	5,020	4,590	4,470
Btu/lb		12,160	9,690	10,180	10,660	10,070	9,590	9,040	8,270	8,040
Ultimate Analysis										
Ash	%	9.3	22.8	19.4	15.7	19.1	21.4	25.4	32.5	32.6
Carbon	%	70.7	56.1	58.6	61.1	59.0	56.8	53.4	47.5	46.2
Hydrogen	%	4.9	4.4	4.5	4.6	4.4	4.3	4.1	3.9	3.7
Sulfur	%	0.2	0.5	0.5	0.4	0.6	0.6	0.7	1.3	1.1

Table 20-3 SSC Hard Grove Index by Size Fraction

Size Fraction mm		+100	100 - 50	50 - 11.2	11.2 - 4.0	4.0 - 1.4
Ash	%	9.3	22.8	19.4	15.7	19.1
H.G.I.		39	47	48	46	52

Table 20-4 SSC Ash Analysis by Size Fraction

Size Fraction mm		+100	100 - 50	50 - 11.2	11.2 - 4.0	4.0 - 1.4	1.4 - 0.5	0.5 - 0.15	0.15 - 0.045	-0.045
Ash	%	9.3	22.8	19.4	15.7	19.1	21.4	25.4	32.5	32.6
Ash Fusibility Test										
Initial Deformation	C	1,340	1,180	1,190	1,230	1,230	1,190	1,200	1,210	1,210
Softening	C	1,400	>1,450	1,340	1,270	1,360	1,360	1,420	>1,450	1,430
Hemispher	C	>1,450		1,370	1,280	1,370	1,370	1,430		1,440
Flow	C			1,420	1,400	1,430	1,420	>1,450		>1,450
Ash Component										
SiO_2	%	29.60	55.80	51.60	48.10	49.70	51.20	53.70	55.20	53.90
Fe_2O_3	%	6.81	3.07	3.76	3.99	5.95	5.85	5.97	7.30	6.73
CaO	%	12.41	3.02	4.40	6.37	4.88	4.16	3.26	2.57	3.09
MgO	%	9.18	2.85	3.66	4.57	3.87	3.44	2.84	2.35	2.30
Na_2O	%	5.23	1.37	1.68	2.04	1.77	1.54	1.27	1.03	1.01
K_2O	%	1.58	1.77	1.78	1.68	1.77	1.81	1.85	1.87	1.85
P_2O_5	%	0.28	0.16	0.31	0.41	0.42	0.27	0.24	0.19	0.17
TiO_2	%	0.72	1.44	1.22	1.16	1.14	1.14	1.12	1.07	1.07

Table 20-5 Coal Analysis by Ply

Ply No.	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
Proximate Analysis														
Ash %	9.8	73.1	4.4	57.0	3.8	52.5	4.2	69.1	25.8	73.5	41.0	8.5	70.3	4.7
Volatile Matter %	48.6	20.9	51.0	28.8	50.2	27.8	48.3	20.8	38.0	20.4	34.1	48.4	21.7	47.8
Fixed Carbon %	41.6	6.0	44.6	14.2	46.0	19.7	47.5	10.1	36.2	6.1	24.9	43.1	8.0	47.5
Fuel Ratio	0.856	0.287	0.874	0.493	0.916	0.709	0.983	0.486	0.953	0.299	0.730	0.890	0.369	0.994
Total Sulfur %	0.7	0.3	0.7	0.4	0.5	0.4	0.5	0.3	0.6	0.4	0.7	1.0	0.4	1.4
Calorific Value														
Kcal/Kg	6,350	1,410	6,890	2,820	6,740	2,880	6,600	1,660	5,010	1,250	3,860	6,360	1,760	6,610
Btu/lb	11,430	2,530	12,390	5,070	12,140	5,190	11,880	2,990	9,020	2,250	6,950	11,450	3,170	11,910
Ultimate Analysis														
Ash	9.8		4.4	57.0	3.8	52.5	4.2		25.8		41.0	8.5	70.3	4.7
Carbon	66.3		71.0	28.8	70.2	30.8	69.6		53.0		40.5	74.5	17.8	69.5
Hydrogen	5.2		5.4	3.1	5.1	2.9	5.0		4.3		3.5	5.8	2.3	5.0
Sulfur	0.3		0.3	0.3	0.2	0.4	0.2		0.5		0.5	0.8	0.4	0.8

Table 20-6 Hard Grove Index by Ply

	Ply No.	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
Ash	%	9.8	73.1	4.4	57.0	3.8	52.5	4.2	69.1	25.8	73.5	41.0	8.5	70.3	4.7
H.G.I.		47	107	40	107	37	91	42	96	49	93	64	48	78	41

Table 20-7 Physical Property Analysis by Ply

Ply No.	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
Ash %	9.8	73.1	4.4	57.0	3.8	52.5	4.2	69.1	25.8	73.5	41.0	8.5	70.3	4.7
True Specific Gravity	1.492	2.253	1.432	1.954	1.477	1.970	1.503	2.196	1.662	2.325	1.829	1.496	2.147	1.487
Apparent Specific Gravity	1.327	1.853	1.300	1.589	1.310	1.780	1.278	2.007	1.488	2.064	1.620	1.376	1.980	1.321
Volumetric Voids %	26.7	24.0	25.8	26.6	25.4	18.5	29.2	15.3	25.2	17.6	22.4	24.0	13.8	28.1
Theoretical Max. Inherent Moisture%	19.7	12.3	19.5	15.7	18.7	10.3	21.6	7.6	16.9	8.4	13.6	17.4	6.9	20.8

Table 20-8 Chlorine Content by Ply

Ply No.	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
Ash %	9.8	73.1	4.4	57.0	3.8	52.5	4.2	69.1	25.8	73.5	41.0	8.5	70.3	4.7
Inherent Cl. ppm	360	240	320	110	320	180	320	130	330	120	280	410	80	260
Attached Cl. ppm	170	50	30	40	30	60	40	30	30	30	40	30	30	30

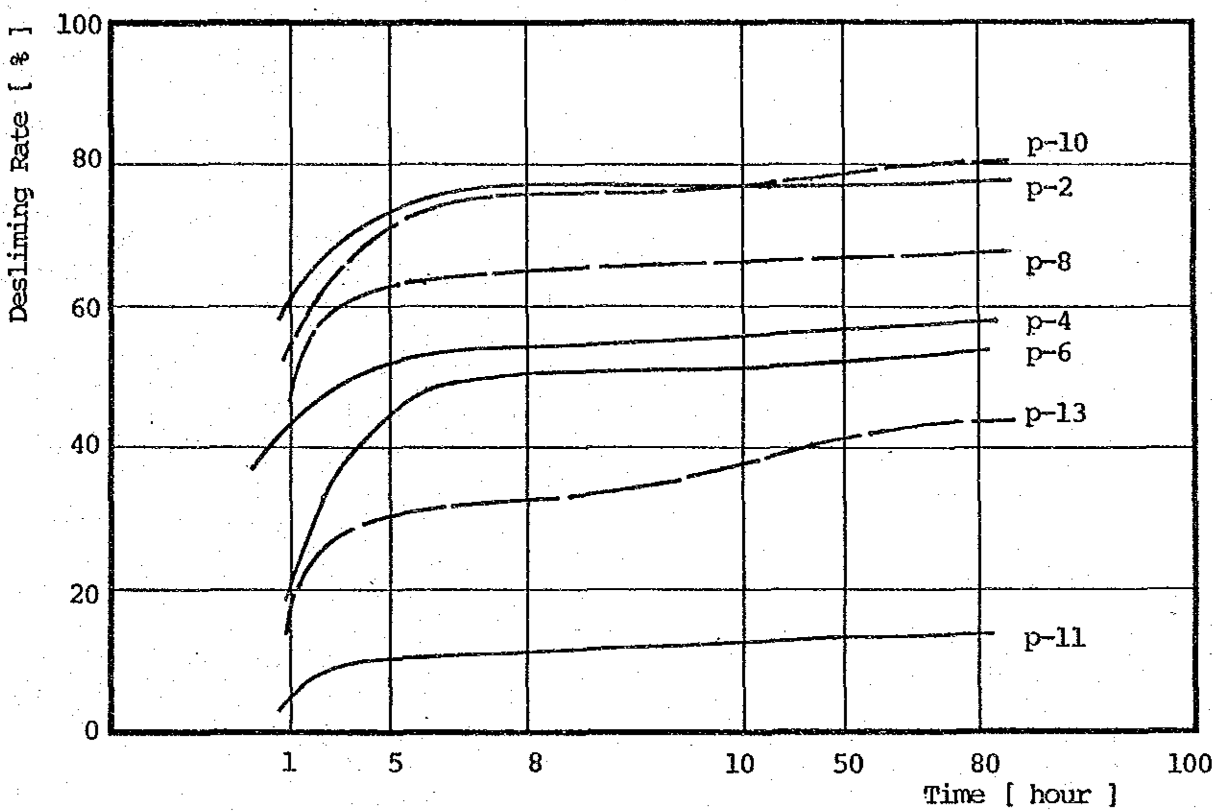
Table 20-9 Ash Analysis by Ply

Ply No.		#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
Ash	%	9.8	73.1	4.4	57.0	3.8	52.5	4.2	69.1	25.8	73.5	41.0	8.5	70.3	4.7
Ash Fusibility															
Initial Deform.	℃	1,200	1,200	1,370	1,190	1,330	1,200	1,300	>1,450	1,230	>1,450	1,320	1,160	1,190	1,330
Softening	℃	1,210	>1,450	1,410	>1,450	>1,450	>1,450	>1,450		>1,450		>1,450	1,230	>1,450	1,340
Hemispherical	℃	1,210		>1,450									1,230		1,340
Fluid	℃	1,400											1,330		>1,450
Ash Composition															
SiO_2	%	44.60	61.80	6.90	59.50	6.20	57.20	6.00	58.70	56.80	56.80	52.90	35.20	63.60	12.00
Fe_2O_3	%	2.23	2.16	6.61	2.22	17.17	2.19	25.54	2.28	2.26	2.64	2.99	4.70	2.10	8.54
CaO	%	10.98	0.57	21.59	0.87	19.65	0.97	15.20	0.56	2.44	0.46	1.55	9.41	0.61	17.40
MgO	%	7.66	1.49	16.82	1.62	16.55	1.87	15.16	1.55	2.79	1.48	2.01	6.61	1.35	12.79
Na_2O	%	1.64	0.95	3.94	0.41	5.42	0.58	7.49	0.42	1.19	0.42	0.78	3.56	0.43	5.62
K_2O	%	0.66	2.29	0.74	1.95	1.12	2.51	1.23	2.09	1.88	1.86	1.78	0.77	1.59	0.94
P_2O_5	%	0.33	0.19	1.02	0.08	0.12	0.06	0.07	0.07	0.33	0.18	0.58	1.46	0.04	0.11
TiO_2	%	1.26	1.05	0.39	1.22	0.28	0.98	0.33	1.30	1.11	1.38	1.68	1.67	1.84	0.39

Table 20-10 Desliming Test Data

Hour	1 H	3 H	6 H	12 H	24 H	48 H	72 H	Residue %
Ply No. 1	0.3	0.4	0.4	0.4	0.4	0.4	0.4	99.6
2	60.6	70.0	75.2	76.3	76.9	77.2	77.3	22.7
3	0.3	0.6	0.7	0.8	0.8	0.8	0.8	99.2
4	43.1	49.2	52.9	55.1	56.1	56.8	57.4	42.6
5	0.2	0.3	0.4	0.4	0.4	0.4	0.4	99.6
6	22.2	36.6	48.2	50.2	51.2	52.1	53.0	47.0
7	0.2	0.4	0.5	0.6	0.6	0.6	0.6	99.4
8	47.3	59.4	64.1	66.0	66.6	66.8	67.0	33.0
9	0.2	0.3	0.4	0.4	0.4	0.4	0.4	99.6
10	54.6	64.1	74.2	75.6	76.4	79.6	80.0	20.0
11	4.9	9.0	10.4	11.6	12.7	13.4	13.5	86.5
12	0.1	0.1	0.1	0.1	0.1	0.1	0.1	99.9
13	18.5	26.9	31.2	34.5	37.3	41.3	43.1	56.9
14	0.1	0.2	0.3	0.3	0.3	0.3	0.3	99.7
Pilot Prep. Plant								
FEED	26.8	29.3	31.1	32.0	32.6	33.2	33.5	66.5
PRODUCT	16.4	17.3	17.9	18.2	18.4	18.6	18.8	81.2
SSC Shiploading	2.2	3.0	3.4	3.6	3.8	4.0	4.1	95.9

Fig. 20-5 Results of Desliming Test



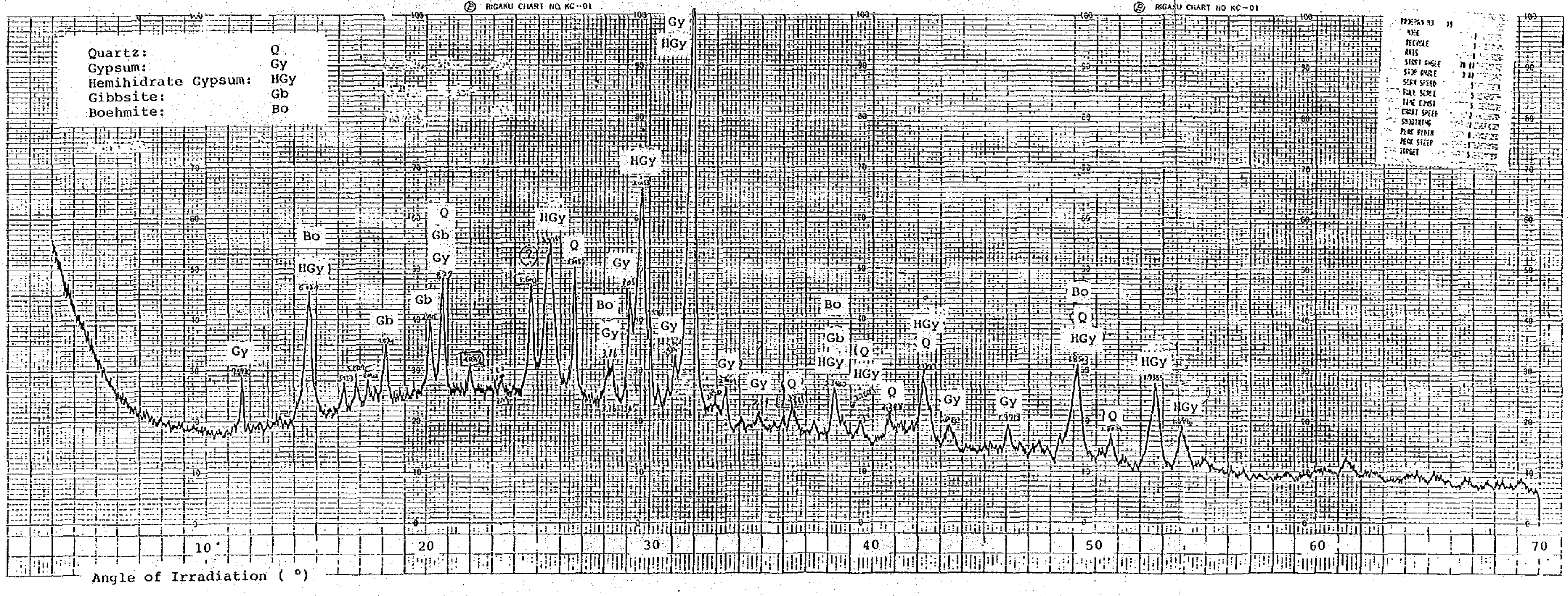


Fig. 20-6 X-Ray Diffraction Test Chart (#7 Ply Coal Sample)

3) Desalination

Seeking for possibilities of desalination, several analyses were conducted on the samples taken at the Calaca power plant as well as at the Unong pit.

a. Na_2O and K_2O contents by specific gravity fraction

Na_2O and K_2O contents in ash were analysed by specific gravity fraction on the SSC sample prepared in the size range of 11.2 to 4 mm.

The results are summarized in Tables 20-11 and 20-12 for Na_2O and K_2O contents, respectively.

As read from the Table 20-11, Na_2O contents in ash are higher in the lower specific gravity fractions, on the other hand, the net contents in the moisture free coal are higher in the higher specific gravity fractions.

The K_2O contents in ash becomes higher in the higher specific gravity fractions.

Accordingly, the net contents of Na_2O and K_2O in the coal with no moisture can be reduced by recovering the lower specific gravity fractions segregating from the higher specific gravity fractions, as well as K_2O contents, however, the Na_2O contents in ash, which are the major affecting factor for a boiler fouling, are obviously increase at lower specific gravity fractions, thus it must be concluded that Na_2O contents in ash cannot be reduced by a coal preparation.

b. X-ray micro analyser analysis

In order to identify the distribution of metal components in coal, particularly Na distribution, X-ray micro analyser analysis was done on the sample taken from #7 ply of the Main seam at the Unong pit. The detected elements and the distributions are as follow:

a) Detected elements

Table 20-13 shows a summary of the detected elements and density.

Table 20-11 SSC Na_2O Content in Ash by Specific Gravity

Na_2O Unit: %

Specific Gravity	Ash Na_2O	Coal (AD)		Moisture Free Coal Na_2O
		Moisture	Ash	
– 1.25	5.23	10.29	3.86	0.22
1.25 – 1.30	5.28	11.26	4.34	0.26
1.30 – 1.35	3.03	10.62	8.32	0.28
1.35 – 1.40	2.12	9.80	16.10	0.38
1.40 – 1.50	1.08	7.86	23.84	0.28
1.50 – 1.60	0.81	6.73	34.46	0.30
+ 1.60	0.48	4.50	61.82	0.31

Table 20-12 SSC K_2O Content in Ash by Specific Gravity

K_2O Unit: %

Specific Gravity	Ash K_2O	Coal (AD)		Moisture Free Coal K_2O
		Moisture	Ash	
- 1.25	1.20	10.29	3.86	0.05
1.25 – 1.30	1.22	11.26	4.34	0.06
1.30 – 1.35	1.24	10.62	8.32	0.12
1.35 – 1.40	1.54	9.80	16.10	0.27
1.40 – 1.50	1.86	7.86	23.84	0.48
1.50 – 1.60	2.01	6.73	34.46	0.74
+ 1.60	1.95	4.50	61.82	1.26

Table 20-13 Detected Metal Component

Element	Coal Part/Metal Part	Density (%)
Al	160 cps/8.4 kcps	Approx. 2
Mg	1,000 cps/40 kcps	Approx. 0.3
Na	70 cps	0.1–1.0*
Fe	80 cps/22 kcps	Approx. 0.4
Ca	60 cps	0.1–1.0*

Note: * - marks are inferred values, since no standard samples are available for Na and Ca.

b) Element distribution

The element distributions are observed in the image photos of electronic beam reflections. The heavier element has higher reflection ratio due to its higher electron density, resulting in brighter image. The area with lighter element gives darker image.

Photos 1–8 show the image of each element.

Photo 1:
The white bar at the bottom indicates the scale of 1,000 μm. There are many cracks developed due to an oxidization. A stripe pattern, which indicates the different component. In the darker area, lighter elements are predominantly observed.

Photo 2:
Secondary electron beam image. The white bar indicates 100 μm. The square marked area is used for the element analysis.

Photo 3:
Component image of the square marked area. The slanting stripe pattern is a trace of polishing the specimen. From the vertical stripes, the component difference is observed.

Photo 4:
Image of AlKα-Ray. Al content is high in the white part.

Photo 5:

Image of MgKα-Ray. Mg shows even distribution.

Photo 6:

Image of FeKα-Ray. Fe shows uneven distribution.

Photo 7:

Image of CaKα-Ray. Ca shows even distribution.

Photo 8:

Image of NaKα-Ray. Stripes are observed a little.

There are Al, Mg, Fe, Ca and Na contained in the coal. The Al, Fe and Na show stripe patterns indicating density variations, however, their existence is all-over the specimen. The Mg and Ca are evenly distributed. This tendency is almost same as the rest of sample speciments.

X-Ray Micro Analyzer Analysis Component Image Photos (1)

Photo 1 Component Image

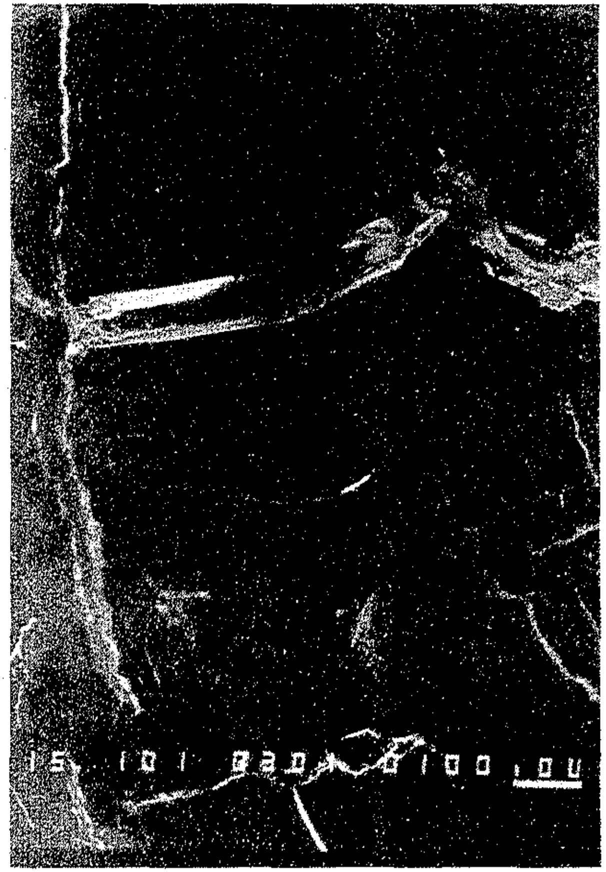


Photo 2 Secondary Electron Beam Image

X-Ray Micro Analyzer Analysis Component Image Photos (2)

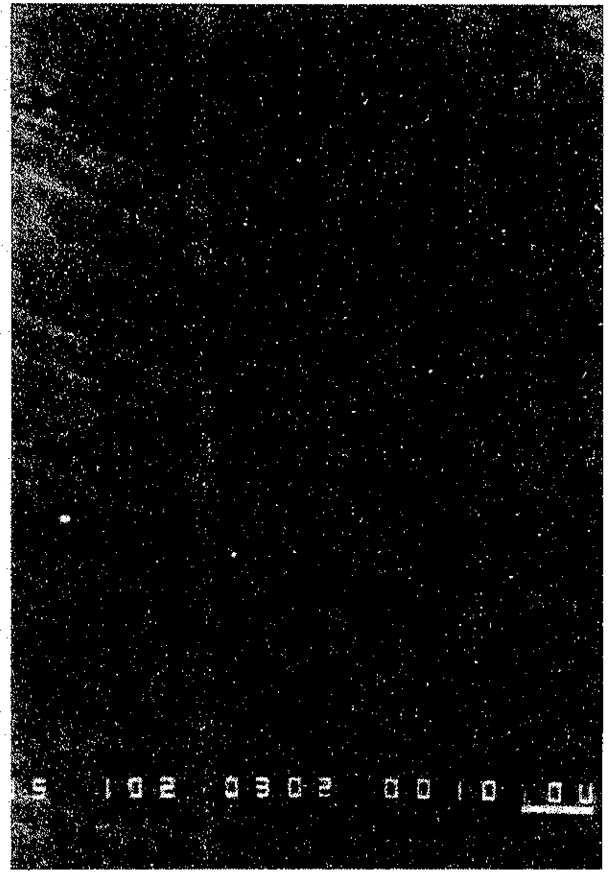


Photo 3 Component Image of Square Marked Area

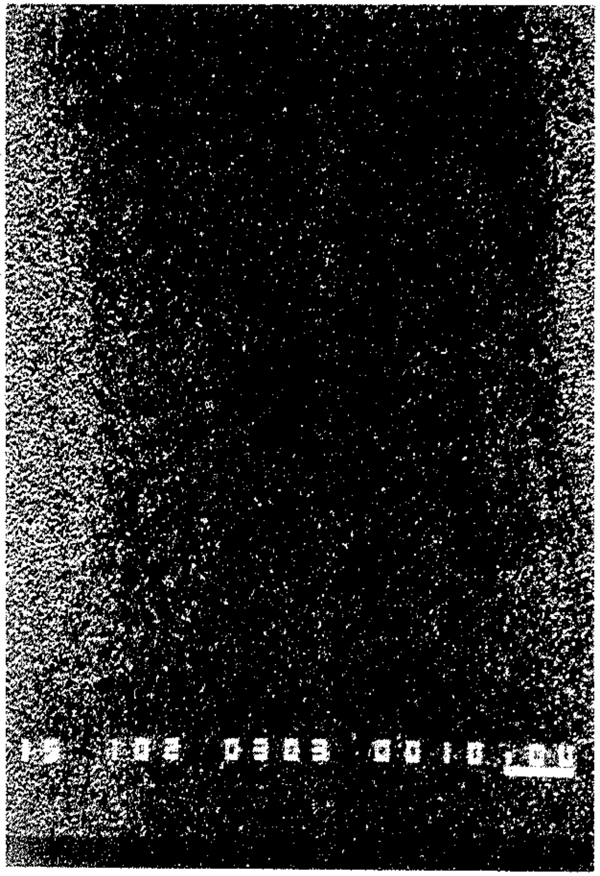


Photo 4 Image of AlKα-Ray

X-Ray Micro Analyzer Analysis Component Image Photos (3)

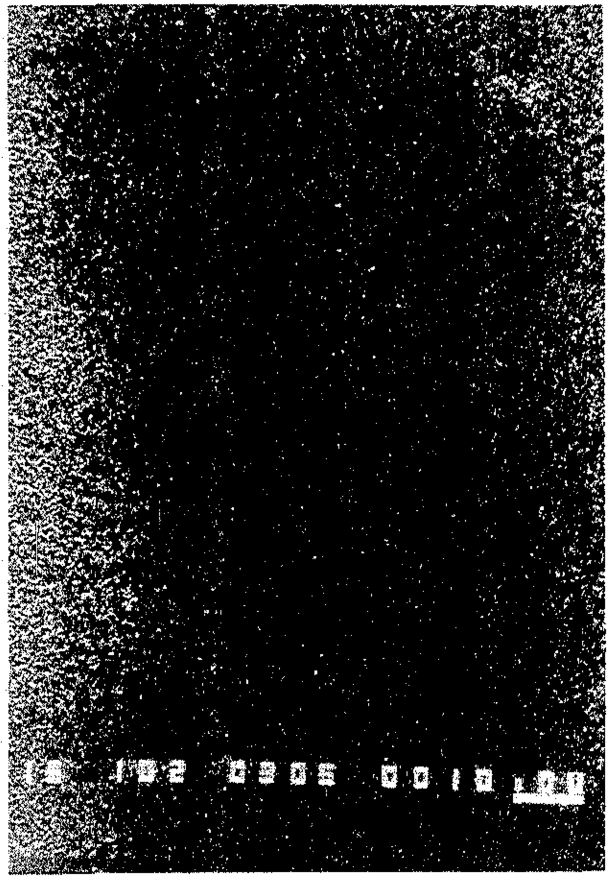


Photo 5 Image of MgKα-Ray

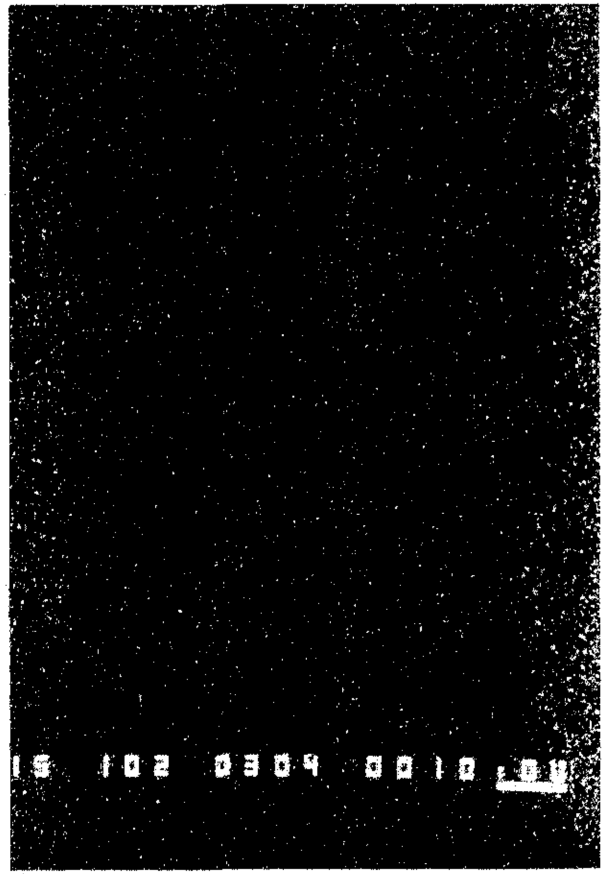


Photo 6 Image of FeKα-Ray

X-Ray Micro Analyzer Analysis Component Image Photos (4)

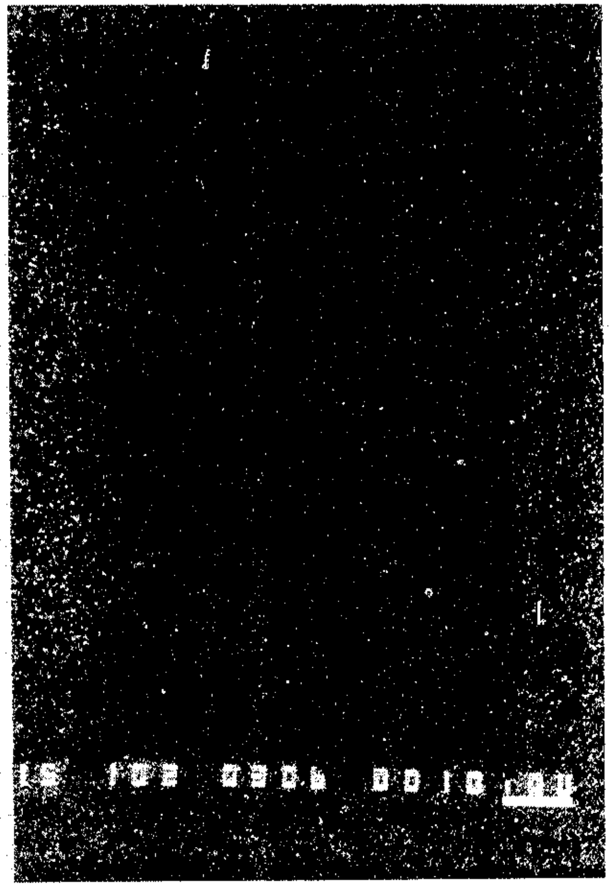


Photo 7 Image of CaKα-Ray

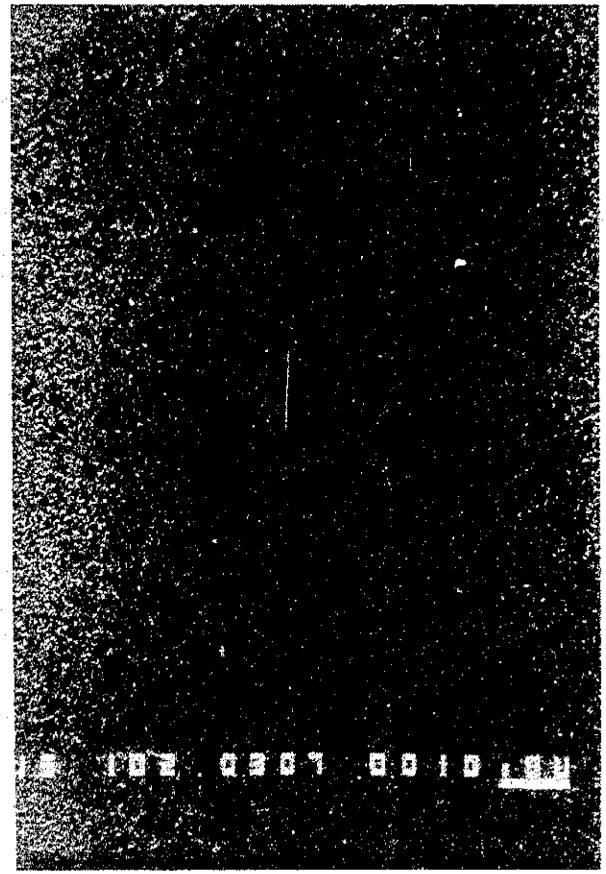


Photo 8 Image of NaKα-Ray

21. Coal Processing

21. Coal Processing

21-1 Washability Studies

To determine the preparation methods and equipment suitable for cleaning the Semirara "run-of-mine" coal, various tests have been conducted to obtain necessary data. Among those test data, washability is the major item required to estimate the product coal quantity and quality. Float and sink tests have been extensively conducted on each ply sample. The washability of the "run-of-mine" coal is obtained by composing the float and sink test data of each ply.

Besides the above mentioned washability tests, additional float and sink tests have been conducted on the samples taken at the Calaca power plant, which is "selective mining" coal. The samples were sized at nine fractions and the float and sink tests have been conducted on each size fraction except -0.045 mm fraction, as well as on the original sample with no sizing.

Table 21-1 (1–15) are the float and sink test data of each ply, accompanied with the washability curves derived from the test data. Table 21-2 is the composed float and sink test data of all plies and the washability curve, which represent the whole coal seam.

Table 21-3 (1–8) are the float and sink test data and the washability curves of every size fractions on the "selective mining" coal sample taken at the Calaca power plant.

Table 21-4 is the float and sink test data and the washability curve of the bulk sample of the "selective mining" coal taken at the Calaca power plant.

Based on the all data obtained by the above mentioned tests, the plant performance is designed aiming at yielding product coal with about 8,500 Btu/lb of heating value at 19% total moisture content to meet the design criteria of the boiler at the power plant.

The coal specifications are summarized in Table 21-5. It has been observed from the sales invoice that the currently agreed coal specifications are a little different from that of specified in the original supply agreement.

Table 21-1 Washability Test Data by Play Face Sample at Unong Pit

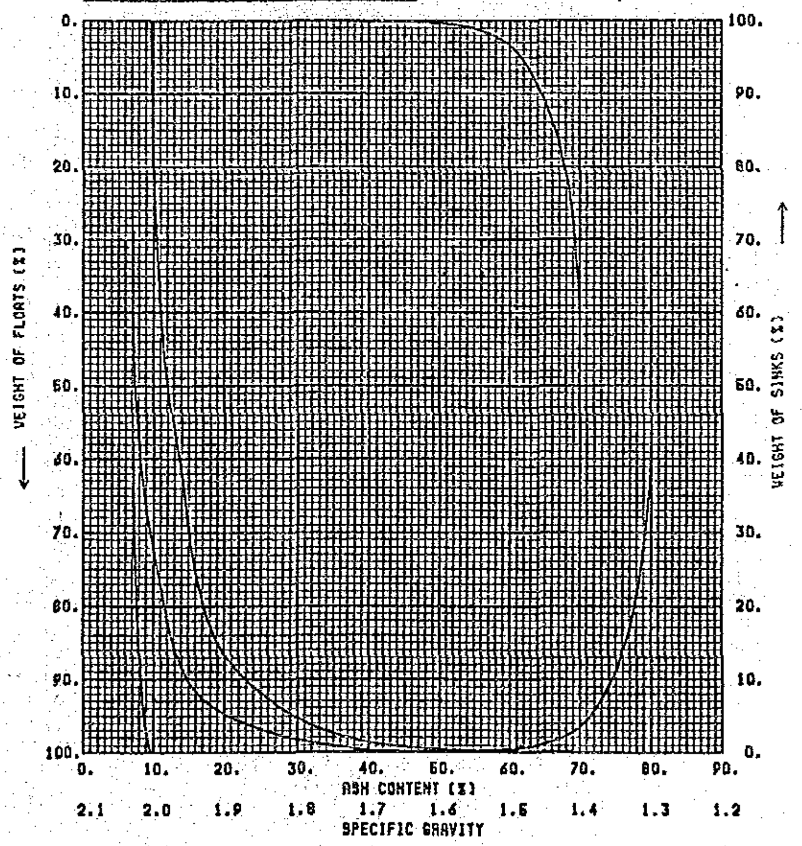
SAMPLE: A:　　　　　　　　　　DATE:

(1)

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\frac{\Sigma WN-1 + WN}{2}$	W·A	ΣW·A	ΣW	$\frac{\Sigma W \cdot A}{\Sigma W}$	TOTAL W·A - ΣW·A	100 - ΣW	$\frac{G}{H}$	±0.1 S.G.
- 1.30	57.71	7.05	28.86	406.86	406.86	57.71	7.05	560.65	42.29	13.26	
1.30 ~ 1.35	31.10	10.20	73.26	317.22	724.08	88.81	8.15	243.43	11.19	21.75	
1.35 ~ 1.40	7.70	16.90	92.66	130.13	854.21	96.51	8.85	113.30	3.49	32.47	41.80
1.40 ~ 1.45	2.28	27.90	97.65	63.61	917.82	98.79	9.29	49.69	1.21	41.07	10.93
1.45 ~ 1.50	0.72	35.41	99.15	25.50	943.31	99.51	9.48	24.19	0.49	49.38	3.30
1.50 ~ 1.55	0.23	39.08	99.63	8.99	952.30	99.74	9.55	15.21	0.26	58.49	1.06
1.55 ~ 1.60	0.07	42.95	99.78	3.01	955.31	99.81	9.57	12.20	0.19	64.22	0.37
1.60 ~ 1.65	0.04	51.18	99.83	2.05	957.35	99.85	9.59	10.15	0.15	67.69	0.17
1.65 ~ 1.70	0.03	56.76	99.87	1.70	959.06	99.88	9.60	8.45	0.12	70.42	0.12
1.70 ~ 1.80	0.05	65.49	99.91	3.27	962.33	99.93	9.63	5.18	0.07	73.94	0.09
1.80 ~ 1.90	0.04	71.64	99.95	2.87	965.20	99.97	9.65	2.31	0.03	76.98	0.06
1.90 ~ 2.00	0.02	75.75	99.98	1.51	966.71	99.99	9.67	0.80	0.01	79.37	0.02
2.00 ~ 2.20	0.01	79.58	99.99	0.80	967.51	100.00	9.68				
2.20 - +		82.30	100.00		967.51	100.00	9.68	.00	.00	.00	

SAMPLE: A:　　　　　　　　　　DATE:

SIZE :



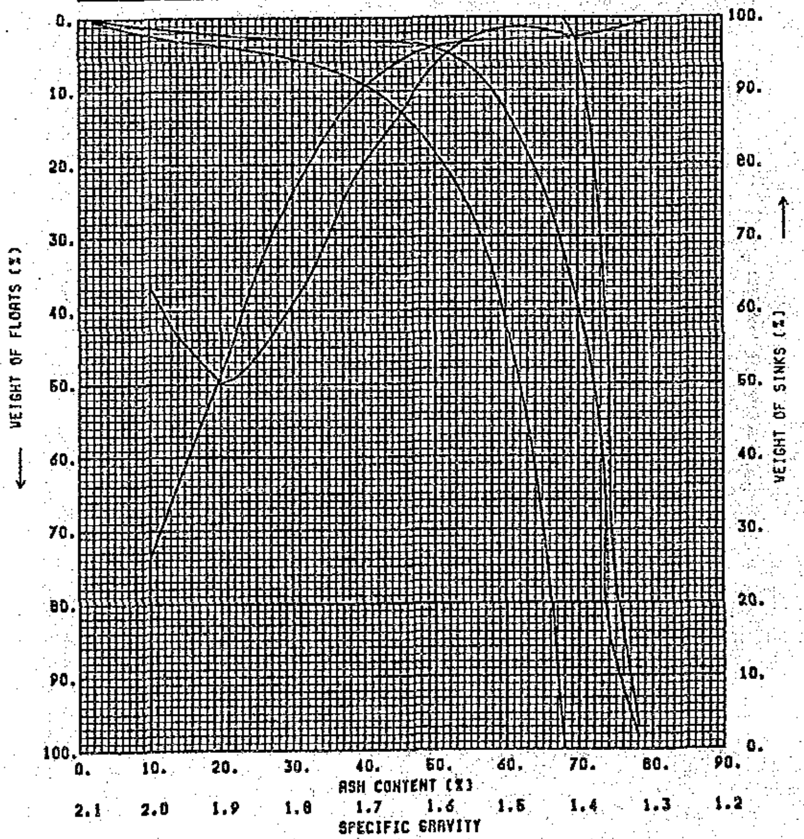
SAMPLE: A2 (VASTE)　　　　DATE:

(2)

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\Sigma W_{N-1} + \frac{W_N}{2}$	W·A	$\Sigma W \cdot A$	ΣW	$\frac{\Sigma W \cdot A}{\Sigma W}$	TOTAL W·A $- \Sigma W \cdot A$	100 $- \Sigma W$	$\frac{G}{H}$	±01 S.G.
- 1.30	0.29	2.07	0.14	0.60	0.60	0.29	2.07	6805.47	99.71	68.25	
1.30 ~ 1.35	1.35	8.27	0.97	11.16	11.76	1.64	7.17	6794.31	98.36	69.08	
1.35 ~ 1.40	0.97	18.28	2.13	17.73	29.50	2.61	11.30	6776.57	97.39	69.58	2.77
1.40 ~ 1.45	0.38	27.14	2.80	10.31	39.81	2.99	13.31	6766.26	97.01	69.75	1.58
1.45 ~ 1.50	0.07	34.87	3.02	2.44	42.25	3.06	13.81	6763.82	96.94	69.77	1.38
1.50 ~ 1.55	0.16	43.26	3.14	6.92	49.17	3.22	15.27	6756.90	96.78	69.82	2.92
1.55 ~ 1.60	0.77	48.01	3.60	36.97	86.14	3.99	21.59	6719.93	96.01	69.99	6.45
1.60 ~ 1.65	1.92	52.28	4.95	100.38	186.52	5.91	31.56	6619.55	94.09	70.35	13.49
1.65 ~ 1.70	3.60	56.17	7.71	202.21	388.73	9.51	40.88	6417.34	90.49	70.92	19.92
1.70 ~ 1.80	14.40	62.16	16.71	895.39	1284.12	23.91	53.71	5521.95	76.09	72.57	39.14
1.80 ~ 1.90	24.74	69.27	36.28	1713.74	2997.86	48.65	61.62	3808.21	51.35	74.16	49.89
1.90 ~ 2.00	25.15	73.50	61.22	1848.52	4846.38	73.80	65.67	1959.69	26.20	74.80	36.63
2.00 ~ 2.20	22.96	74.32	85.28	1706.39	6552.77	96.76	67.72	253.30	3.24	78.18	
2.20 - +	3.24	78.18	98.38	253.30	6806.07	100.00	68.06	.00	.00	.00	

SAMPLE: A2 (VASTE)　　　　DATE:

SIZE :



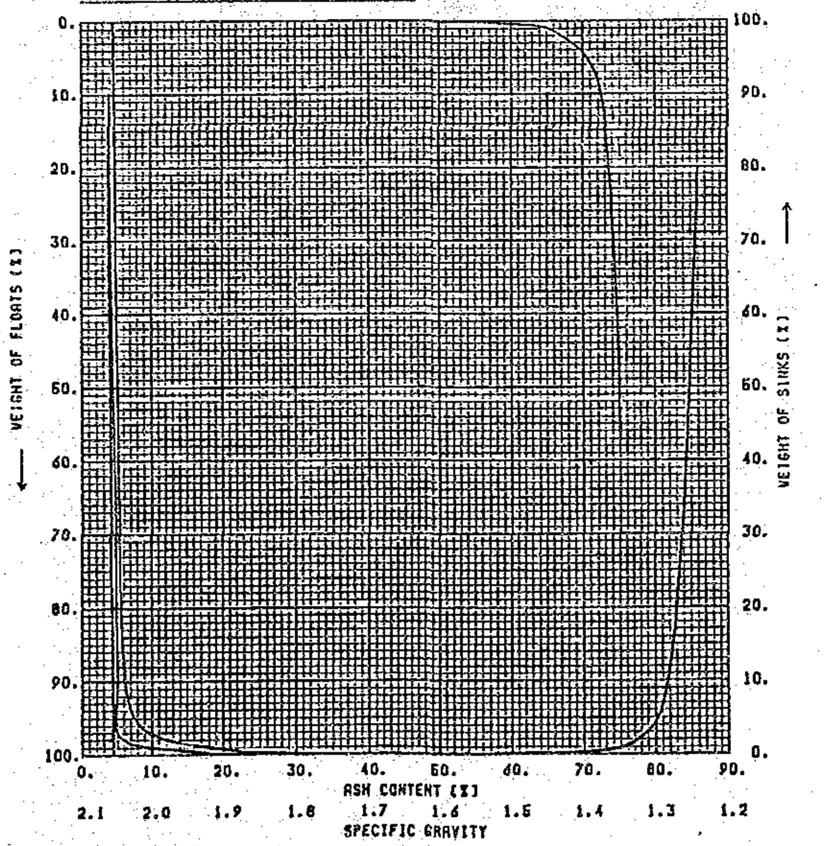
SAMPLE: A3 DATE:

(3)

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\Sigma VN-1 + \frac{VN}{2}$	V·A	$\Sigma V \cdot A$	ΣV	$\frac{\Sigma V \cdot A}{\Sigma V}$	TOTAL V·A $- \Sigma V \cdot A$	100 $- \Sigma V$	$\frac{G}{H}$	±0.1 S.G.
- 1.30	95.50	4.37	47.75	417.34	417.34	95.50	4.37	43.18	4.50	9.60	
1.30 ~ 1.35	3.40	5.10	97.20	17.34	434.67	98.90	4.40	25.84	1.10	23.49	
1.35 ~ 1.40	0.50	12.90	99.15	6.45	441.12	99.40	4.44	19.39	0.60	32.32	4.20
1.40 ~ 1.45	0.25	16.30	99.53	4.08	445.20	99.65	4.47	15.32	0.35	43.77	0.87
1.45 ~ 1.50	0.05	21.64	99.68	1.08	446.28	99.70	4.48	14.24	0.30	47.45	0.40
1.50 ~ 1.55	0.07	26.20	99.74	1.83	448.12	99.77	4.49	12.40	0.23	53.92	0.18
1.55 ~ 1.60	0.03	36.58	99.79	1.10	449.21	99.80	4.50	11.30	0.20	56.52	0.15
1.60 ~ 1.65	0.03	43.57	99.82	1.31	450.52	99.83	4.51	10.00	0.17	58.81	0.10
1.65 ~ 1.70	0.02	48.25	99.84	0.96	451.48	99.85	4.52	9.03	0.15	60.22	0.09
1.70 ~ 1.80	0.04	52.24	99.87	2.09	453.57	99.89	4.54	6.94	0.11	63.11	0.07
1.80 ~ 1.90	0.03	55.52	99.91	1.67	455.24	99.92	4.56	5.28	0.08	65.96	0.06
1.90 ~ 2.00	0.03	59.77	99.94	1.79	457.03	99.95	4.57	3.48	0.05	69.68	0.05
2.00 ~ 2.20	0.04	67.61	99.97	2.70	459.74	99.99	4.60	0.78	0.01	77.90	
2.20 - ·	0.01	78.00	99.99	0.78	460.52	100.00	4.61	.00	.00	.00	

SAMPLE: A3 DATE:

SIZE :



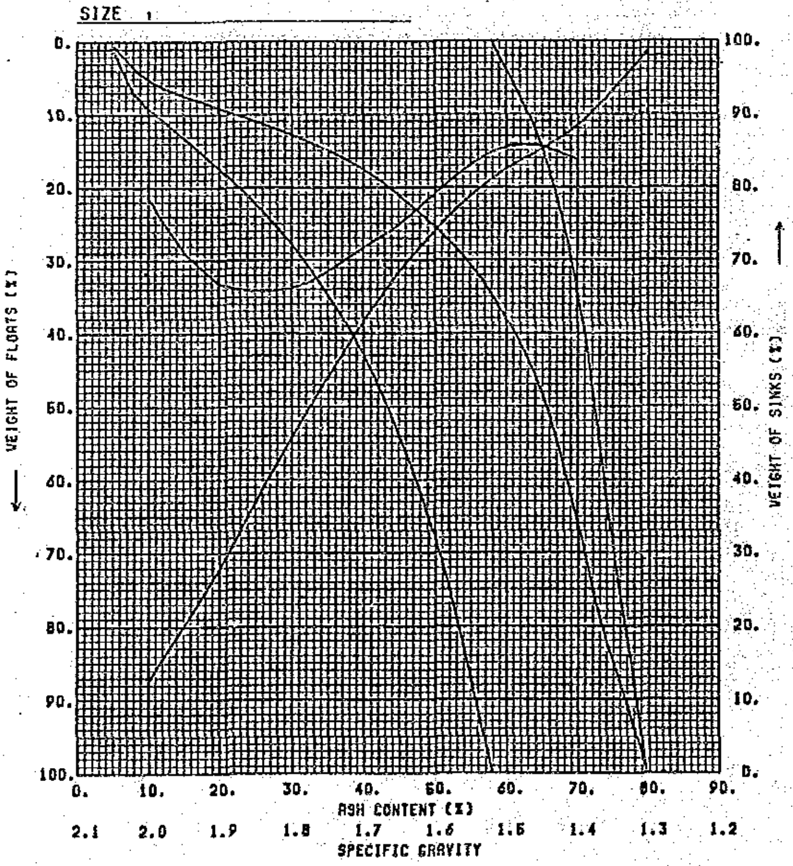
SAMPLE: A4 DATE:

(4)

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\sum WN-1 + \frac{WN}{2}$	W·A	$\sum W \cdot A$	$\sum W$	$\frac{\sum W \cdot A}{\sum W}$	TOTAL W·A $-\sum W \cdot A$	100 $-\sum W$	$\frac{G}{H}$	±0.1 S.G.
~ 1.30	1.30	5.40	0.65	7.02	7.02	1.30	5.40	5785.50	98.70	58.62	
1.30 ~ 1.35	5.50	8.50	4.05	46.75	53.77	6.80	7.91	5738.75	93.20	61.57	
1.35 ~ 1.40	4.70	20.10	9.15	94.47	148.24	11.50	12.89	5644.29	88.50	63.78	16.20
1.40 ~ 1.45	3.23	30.83	13.12	99.58	247.82	14.73	16.82	5544.70	85.27	65.03	14.36
1.45 ~ 1.50	2.77	37.47	16.11	103.79	351.61	17.50	20.09	5440.92	82.50	65.95	14.40
1.50 ~ 1.55	3.66	42.78	19.33	156.57	508.19	21.16	24.02	5284.34	78.84	67.03	16.92
1.55 ~ 1.60	4.74	47.95	23.53	227.28	735.47	25.90	28.40	5057.06	74.10	68.25	20.83
1.60 ~ 1.65	5.75	53.43	28.77	307.22	1042.69	31.65	32.94	4749.83	68.35	69.49	25.10
1.65 ~ 1.70	6.68	58.22	34.99	388.91	1431.60	38.33	37.35	4360.92	61.67	70.71	28.29
1.70 ~ 1.80	15.86	64.20	46.26	1018.21	2449.81	54.19	45.21	3342.71	45.81	72.97	33.76
1.80 ~ 1.90	17.90	69.25	63.14	1239.57	3689.39	72.09	51.18	2103.14	27.91	75.35	33.21
1.90 ~ 2.00	15.31	73.26	79.74	1121.61	4811.00	87.40	55.05	981.53	12.60	77.90	21.29
2.00 ~ 2.20	11.96	77.81	93.38	930.61	5741.61	99.36	57.79	50.92	0.64	79.56	
2.20 ~ +	0.64	79.57	99.68	50.92	5792.53	100.00	57.93	.00	.00	.00	

SAMPLE: A4 DATE:

SIZE :



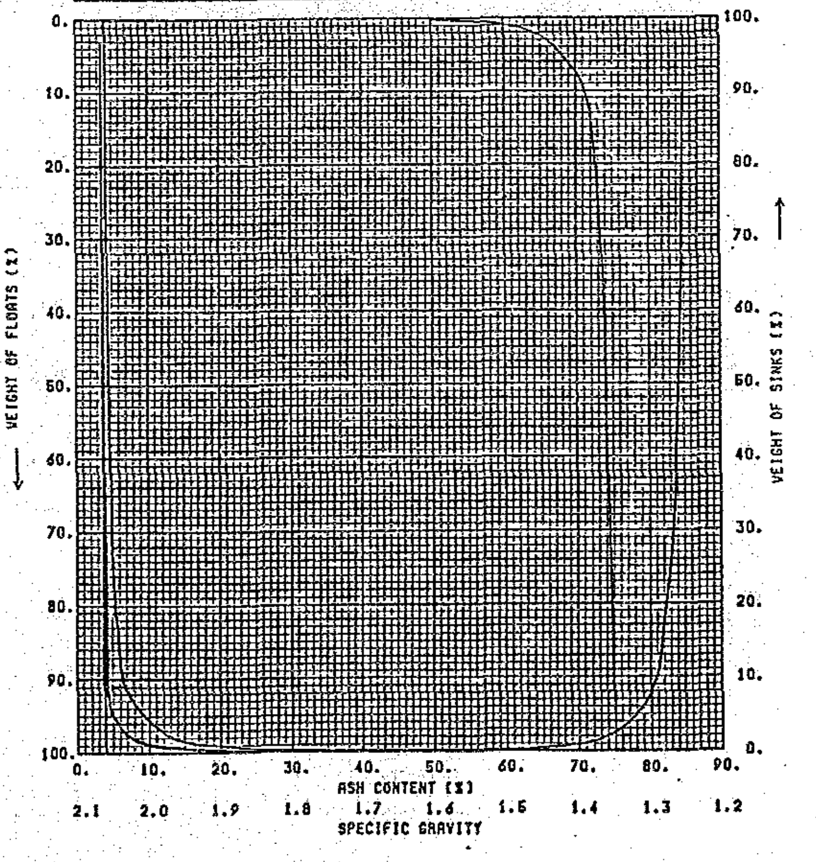
SAMPLE: A5 DATE:

(5)

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\Sigma W_{N-1} + \frac{W_N}{2}$	W·A	ΣW·A	ΣW	$\frac{\Sigma W \cdot A}{\Sigma W}$	TOTAL W·A - ΣW·A	100 - ΣW	$\frac{G}{H}$	±0.1 S.G.
~ 1.30	92.41	3.87	46.21	357.63	357.63	92.41	3.87	56.07	7.59	7.39	
1.30 ~ 1.35	5.10	4.95	94.96	25.24	382.87	97.51	3.93	30.83	2.49	12.38	
1.35 ~ 1.40	1.60	8.02	98.31	12.83	395.70	99.11	3.99	18.00	0.89	20.22	7.40
1.40 ~ 1.45	0.45	14.12	99.34	6.35	402.06	99.56	4.04	11.64	0.44	26.46	2.40
1.45 ~ 1.50	0.25	19.50	99.69	4.88	406.93	99.81	4.08	6.77	0.19	35.62	0.83
1.50 ~ 1.55	0.10	26.95	99.86	2.69	409.63	99.91	4.10	4.07	0.09	45.26	0.40
1.55 ~ 1.60	0.03	33.67	99.93	1.01	410.64	99.94	4.11	3.06	0.06	51.05	0.16
1.60 ~ 1.65	0.02	40.76	99.95	0.82	411.45	99.96	4.12	2.25	0.04	56.19	0.07
1.65 ~ 1.70	0.01	47.90	99.97	0.46	411.93	99.97	4.12	1.77	0.03	58.95	0.05
1.70 ~ 1.80	0.02	55.68	99.98	1.11	413.04	99.99	4.13	0.65	0.01	65.41	0.03
1.80 ~ 1.90	0.01	65.50	99.99	0.66	413.70	100.00	4.14				0.01
1.90 ~ 2.00		70.41	100.00		413.70	100.00	4.14				
2.00 ~ 2.20		76.00	100.00		413.70	100.00	4.14				
2.20 ~ +		79.53	100.00		413.70	100.00	4.14	.00	.00	.00	

SAMPLE: A5 DATE:

SIZE :



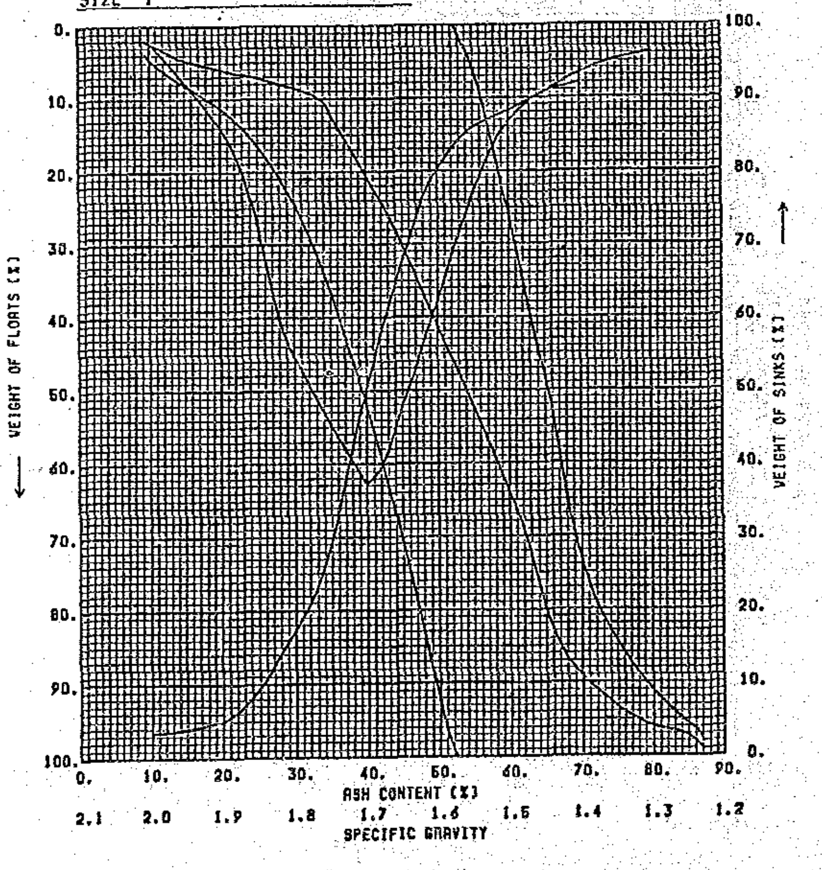
SAMPLE: A6 DATE:

(6)

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	ΣVN-1 + VN/2	V·A	ΣV·A	ΣV	ΣV·A / ΣV	TOTAL V·A - ΣV·A	100 - ΣV	G / H	±0.1 S.G.
- 1.30	3.80	9.40	1.90	35.72	35.72	3.80	9.40	5200.74	96.20	54.06	
1.30 ~ 1.35	1.00	13.90	4.30	13.90	49.62	4.80	10.34	5186.84	95.20	54.48	
1.35 ~ 1.40	1.80	18.90	5.70	34.02	83.64	6.60	12.67	5152.83	93.40	55.17	8.00
1.40 ~ 1.45	2.69	27.83	7.95	74.86	158.50	9.29	17.06	5077.96	90.71	55.98	9.24
1.45 ~ 1.50	2.51	34.20	10.55	85.84	244.34	11.80	20.71	4992.12	88.20	56.60	13.20
1.50 ~ 1.55	2.24	35.47	12.92	79.45	323.80	14.04	23.06	4912.67	85.96	57.15	23.11
1.55 ~ 1.60	5.76	37.87	16.92	218.13	541.93	19.80	27.37	4694.54	80.20	58.54	37.74
1.60 ~ 1.65	12.60	43.06	26.10	542.56	1084.48	32.40	33.47	4151.98	67.60	61.42	52.03
1.65 ~ 1.70	17.14	49.91	40.97	855.46	1939.94	49.54	39.16	3296.52	50.46	65.33	62.80
1.70 ~ 1.80	33.06	60.86	66.07	2012.03	3951.97	82.60	47.84	1284.49	17.40	73.82	45.46
1.80 ~ 1.90	12.40	69.67	88.80	863.91	4815.88	95.00	50.69	420.59	5.00	84.12	13.92
1.90 ~ 2.00	1.52	79.26	95.76	120.48	4936.35	96.52	51.14	300.11	3.48	86.24	2.27
2.00 ~ 2.20	1.50	85.00	97.27	127.50	5063.85	98.02	51.66	172.61	1.98	87.18	
2.20 - +	1.98	87.13	99.01	172.62	5236.47	100.00	52.36	.00	.00	.00	

SAMPLE: A6 DATE:

SIZE :



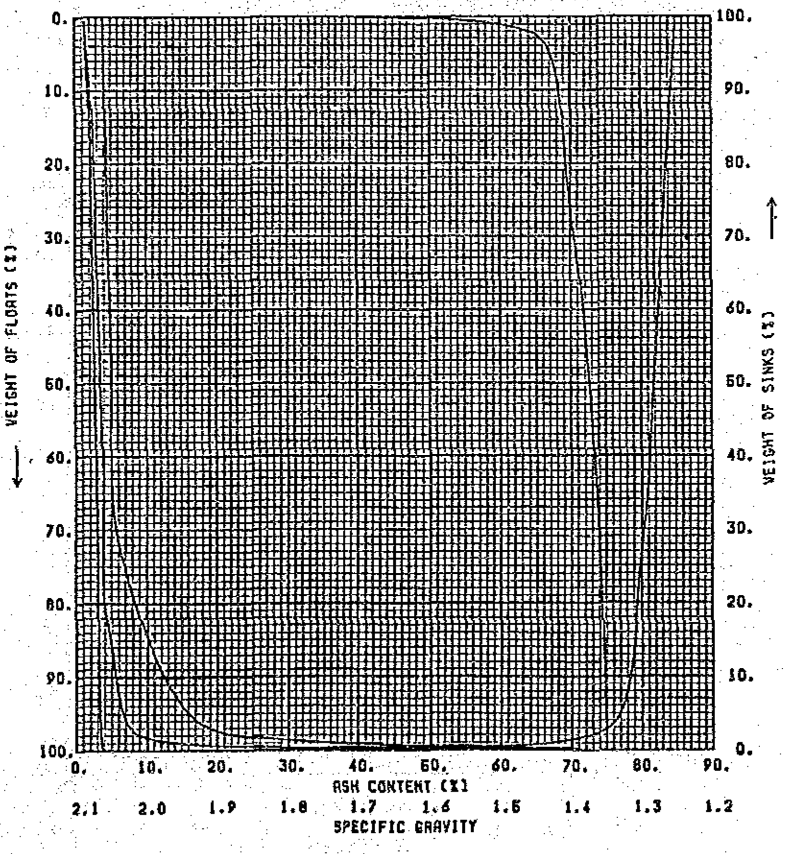
SAMPLE: A7 (UPPER) DATE:

(7)

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\Sigma W_{N-1} + \frac{W_N}{2}$	W·A	ΣW·A	ΣW	$\frac{\Sigma W \cdot A}{\Sigma W}$	TOTAL W·A -ΣW·A	100 -ΣW	$\frac{G}{H}$	±0.1 S.G.
- 1.30	72.90	3.07	36.45	223.80	223.80	72.90	3.07	170.38	27.10	6.29	
1.30 ~ 1.35	24.30	4.80	85.05	116.64	340.44	97.20	3.50	53.74	2.80	19.19	
1.35 ~ 1.40	1.40	8.60	97.90	12.04	352.48	98.60	3.57	41.70	1.40	29.79	26.60
1.40 ~ 1.45	0.61	13.96	98.91	8.52	361.00	99.21	3.64	33.19	0.79	42.01	2.41
1.45 ~ 1.50	0.29	19.95	99.36	5.79	366.78	99.50	3.69	27.40	0.50	54.80	1.06
1.50 ~ 1.55	0.11	26.13	99.56	2.87	369.66	99.61	3.71	24.53	0.39	62.89	0.47
1.55 ~ 1.60	0.05	31.89	99.64	1.59	371.25	99.66	3.73	22.93	0.34	67.45	0.18
1.60 ~ 1.65	0.02	35.52	99.67	0.71	371.96	99.68	3.73	22.22	0.32	69.44	0.08
1.65 ~ 1.70		38.09	99.66		371.96	99.68	3.73	22.22	0.32	69.44	0.04
1.70 ~ 1.80	0.02	51.35	99.69	1.03	372.99	99.70	3.74	21.19	0.30	70.64	0.12
1.80 ~ 1.90	0.10	61.57	99.75	6.16	379.15	99.80	3.80	15.04	0.20	75.18	0.17
1.90 ~ 2.00	0.07	70.57	99.83	4.94	384.09	99.87	3.85	10.10	0.13	77.65	0.10
2.00 ~ 2.20	0.07	75.78	99.90	5.30	389.39	99.94	3.90	4.79	0.06	79.83	
2.20 - +	0.06	79.89	99.97	4.79	394.18	100.00	3.94	.00	.00	.00	

SAMPLE: A7 (UPPER) DATE:

SIZE :



SAMPLE: A7 (LOWER) DATE:

(8)

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\Sigma W_{N-1} + \frac{W_N}{2}$	W·A	ΣW·A	ΣW	$\frac{\Sigma W \cdot A}{\Sigma W}$	TOTAL W·A − ΣW·A	100 − ΣW	$\frac{G}{H}$	±0.1 S.G.
~ 1.30	70.70	4.17	35.35	294.82	294.82	70.70	4.17	148.04	29.30	5.05	
1.30 ~ 1.35	28.50	4.70	84.95	133.95	428.77	99.20	4.32	14.09	0.80	17.61	
1.35 ~ 1.40	0.50	8.70	99.45	4.35	433.12	99.70	4.34	9.74	0.30	32.47	29.10
1.40 ~ 1.45	0.05	12.50	99.73	0.63	433.74	99.75	4.35	9.11	0.25	36.46	0.62
1.45 ~ 1.50	0.05	17.50	99.78	0.88	434.62	99.80	4.35	8.24	0.20	41.20	0.14
1.50 ~ 1.55	0.02	22.51	99.81	0.45	435.07	99.82	4.36	7.79	0.18	43.27	0.13
1.55 ~ 1.60	0.02	27.49	99.83	0.55	435.62	99.84	4.36	7.24	0.16	45.24	0.12
1.60 ~ 1.65	0.04	32.80	99.86	1.31	436.93	99.88	4.37	5.93	0.12	49.39	0.12
1.65 ~ 1.70	0.04	37.20	99.90	1.49	438.42	99.92	4.39	4.44	0.08	55.48	0.11
1.70 ~ 1.80	0.03	44.70	99.93	1.34	439.76	99.95	4.40	3.10	0.05	61.95	0.05
1.80 ~ 1.90	0.02	53.40	99.96	1.07	440.83	99.97	4.41	2.03	0.03	67.62	0.04
1.90 ~ 2.00	0.02	64.80	99.98	1.30	442.12	99.99	4.42	0.74	0.01	73.18	0.02
2.00 ~ 2.20	0.01	73.60	99.99	0.74	442.86	100.00	4.43				
2.20 ~ +		79.83	100.00		442.86	100.00	4.43	.00	.00	.00	

SAMPLE: A7 (LOWER) DATE:

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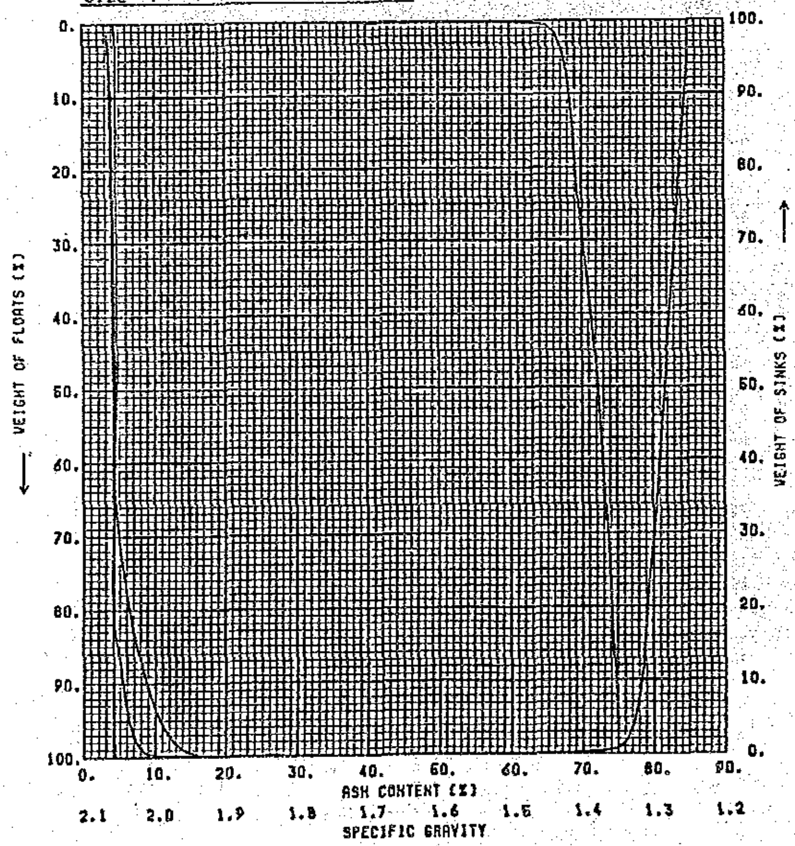


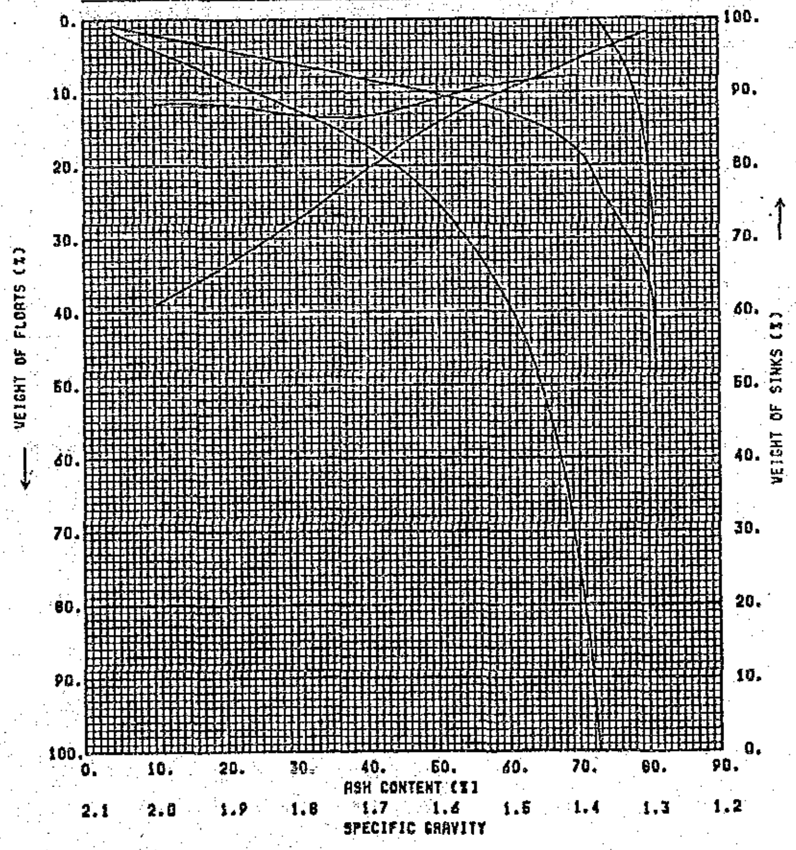
SAMPLE: AB (WASTE) DATE:

(9)

SPECIFIC GRAVITY	A WEIGHT (%)	A ASH (%)	B $\sum W_{N-1} + \frac{W_N}{2}$	C W·A	D ΣW·A	E ΣW	F ΣW·A / ΣW	G TOTAL W·A - ΣW·A	H 100 - ΣW	I G / H	J ±0.1 S.G.
- 1.30	1.78	4.24	0.89	7.55	7.55	1.78	4.24	7270.97	98.22	74.03	
1.30 ~ 1.35	1.82	12.86	2.69	23.41	30.95	3.60	8.60	7247.57	96.40	75.18	
1.35 ~ 1.40	1.90	21.88	4.55	41.57	72.52	5.50	13.19	7205.99	94.50	76.25	7.82
1.40 ~ 1.45	2.02	31.61	6.51	63.85	136.38	7.52	18.14	7142.14	92.48	77.23	8.15
1.45 ~ 1.50	2.08	41.62	8.56	86.57	222.95	9.60	23.22	7055.57	90.40	78.05	8.70
1.50 ~ 1.55	2.15	51.86	10.67	111.50	334.45	11.75	28.46	6944.08	88.25	78.69	9.63
1.55 ~ 1.60	2.45	60.44	12.97	148.08	482.52	14.20	33.98	6796.00	85.80	79.21	10.90
1.60 ~ 1.65	2.95	66.70	15.67	196.76	679.29	17.15	39.61	6599.23	82.85	79.65	12.25
1.65 ~ 1.70	3.35	70.66	18.82	236.71	916.00	20.50	44.68	6362.52	79.50	80.03	13.30
1.70 ~ 1.80	7.00	73.51	24.00	514.57	1430.57	27.50	52.02	5847.95	72.50	80.66	13.10
1.80 ~ 1.90	6.10	77.62	30.55	473.48	1904.05	33.60	56.67	5374.47	66.40	80.94	11.70
1.90 ~ 2.00	5.60	80.29	36.40	449.62	2353.67	39.20	60.04	4924.84	60.80	81.00	11.56
2.00 ~ 2.20	11.92	80.84	45.16	963.61	3317.29	51.12	64.89	3961.23	48.88	81.04	
2.20 - +	48.88	81.04	75.56	3961.24	7278.52	100.00	72.79	.00	.00	.00	

SAMPLE: AB (WASTE) DATE:

SIZE :

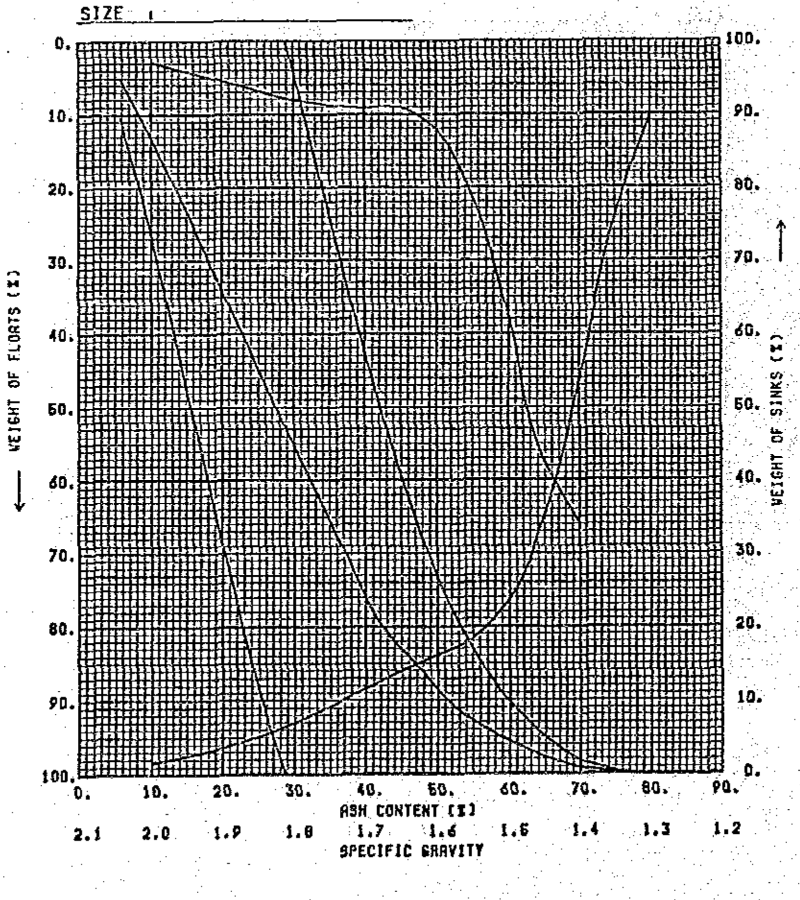


SAMPLE: A9 (10) DATE:

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\Sigma WN-1 + \frac{WN}{2}$	W·A	ΣW·A	ΣW	$\frac{\Sigma W \cdot A}{\Sigma W}$	TOTAL W·A − ΣW·A	100 − ΣW	$\frac{G}{H}$	±0.1 S.G.
− 1.30	10.40	5.81	5.20	60.42	60.42	10.40	5.81	2827.29	89.60	31.55	
1.30 ~ 1.35	13.60	12.10	17.20	164.56	224.98	24.00	9.37	2662.73	76.00	35.04	
1.35 ~ 1.40	22.19	20.50	35.10	454.90	679.88	46.19	14.72	2207.83	53.81	41.03	65.89
1.40 ~ 1.45	18.50	30.05	55.44	555.93	1235.80	64.69	19.10	1651.91	35.31	46.78	57.65
1.45 ~ 1.50	11.59	37.46	70.49	434.16	1669.97	76.28	21.89	1217.74	23.72	51.34	37.69
1.50 ~ 1.55	5.37	41.59	78.97	223.34	1893.30	81.65	23.19	994.41	18.35	54.19	21.28
1.55 ~ 1.60	2.23	44.71	82.76	99.70	1993.01	83.88	23.76	894.70	16.12	55.50	12.06
1.60 ~ 1.65	2.09	46.83	84.92	97.87	2090.88	85.97	24.32	796.83	14.03	56.79	9.02
1.65 ~ 1.70	2.37	48.77	87.15	115.58	2206.47	88.34	24.98	681.24	11.66	58.43	9.11
1.70 ~ 1.80	4.65	52.05	90.66	242.03	2448.50	92.99	26.33	439.21	7.01	62.65	6.02
1.80 ~ 1.90	3.37	58.17	94.67	196.03	2644.53	96.36	27.44	243.18	3.64	66.81	5.43
1.90 ~ 2.00	2.06	64.06	97.39	131.96	2776.49	98.42	28.21	111.22	1.58	70.39	2.80
2.00 ~ 2.20	1.49	69.95	99.16	104.23	2880.72	99.91	28.83	6.99	0.09	77.63	
2.20 − +	0.09	77.67	99.95	6.99	2887.71	100.00	28.88	.00	.00	.00	

SAMPLE: A9 DATE:

SIZE :



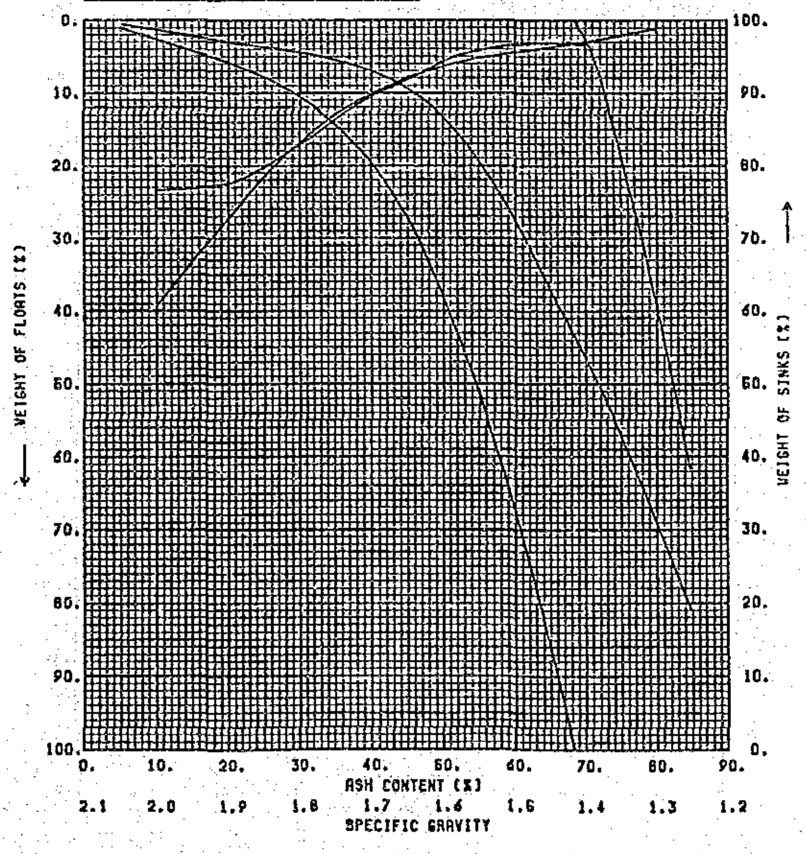
SAMPLE: A10 DATE:

(11)

SPECIFIC GRAVITY	A WEIGHT (%)	A ASH (%)	B $\Sigma WN-1 + \frac{WN}{2}$	C W·A	D $\Sigma W \cdot A$	E ΣW	F $\frac{\Sigma W \cdot A}{\Sigma W}$	G TOTAL W·A $- \Sigma W \cdot A$	H 100 $- \Sigma W$	I $\frac{G}{H}$	J ±0.1 S.G.
– 1.30	1.09	5.31	0.55	5.79	5.79	1.09	5.31	6834.54	98.91	69.10	
1.30 ~ 1.35	1.02	11.67	1.60	11.90	17.69	2.11	8.38	6822.63	97.89	69.70	
1.35 ~ 1.40	0.89	17.50	2.56	15.57	33.27	3.00	11.09	6807.06	97.00	70.18	3.34
1.40 ~ 1.45	0.73	22.68	3.37	16.56	49.82	3.73	13.36	6790.50	96.27	70.54	3.14
1.45 ~ 1.50	0.70	27.64	4.08	19.35	69.17	4.43	15.61	6771.15	95.57	70.85	3.36
1.50 ~ 1.55	0.82	32.21	4.84	26.41	95.58	5.25	18.21	6744.74	94.75	71.18	4.18
1.55 ~ 1.60	1.11	36.45	5.80	40.46	136.04	6.36	21.39	6704.28	93.64	71.60	5.63
1.60 ~ 1.65	1.55	40.45	7.13	62.70	198.74	7.91	25.13	6641.58	92.09	72.12	8.18
1.65 ~ 1.70	2.15	44.31	8.98	95.27	294.01	10.06	29.23	6546.32	89.94	72.79	10.44
1.70 ~ 1.80	6.74	50.18	13.43	338.21	632.22	16.80	37.63	6208.10	83.20	74.62	17.15
1.80 ~ 1.90	10.41	56.77	22.00	590.98	1223.19	27.21	44.95	5617.13	72.79	77.17	22.50
1.90 ~ 2.00	12.09	62.96	33.25	761.19	1984.38	39.30	50.49	4855.94	60.70	80.00	23.28
2.00 ~ 2.20	22.38	71.95	50.49	1610.24	3594.62	61.68	58.28	3245.70	38.32	84.70	
2.20 – +	38.32	84.70	80.84	3245.70	6840.33	100.00	68.40	.00	.00	.00	

SAMPLE: A10 DATE:

SIZE :



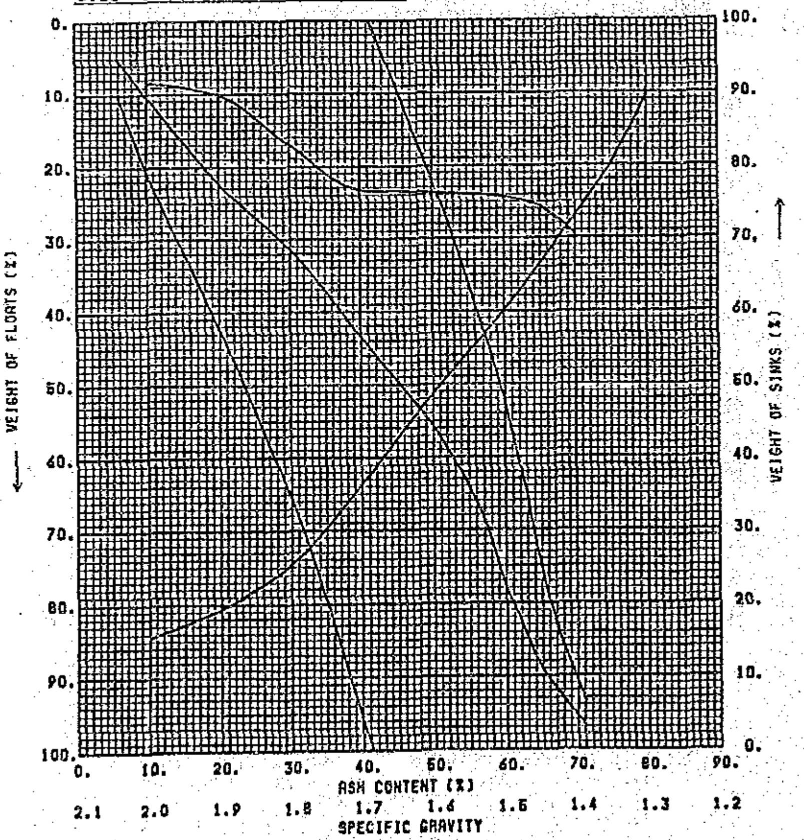
SAMPLE: All (VASHABLE) DATE:

(12)

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\Sigma VN-1 + \frac{VN}{2}$	V·A	$\Sigma V \cdot A$	ΣV	$\frac{\Sigma V \cdot A}{\Sigma V}$	TOTAL V·A $- \Sigma V \cdot A$	100 $- \Sigma V$	$\frac{G}{H}$	±0.1 S.G.
- 1.30	10.40	6.00	5.20	62.40	62.40	10.40	6.00	4072.33	89.60	45.45	
1.30 ~ 1.35	9.70	14.00	15.25	135.80	198.20	20.10	9.86	3936.53	79.90	49.27	
1.35 ~ 1.40	6.80	21.20	23.50	144.16	342.36	26.90	12.73	3792.37	73.10	51.88	29.50
1.40 ~ 1.45	6.56	28.68	30.18	188.14	530.50	33.46	15.85	3604.23	66.54	54.17	25.52
1.45 ~ 1.50	6.44	34.77	36.68	223.92	754.42	39.90	18.91	3380.31	60.10	56.24	24.30
1.50 ~ 1.55	5.72	39.43	42.76	225.54	979.96	45.62	21.48	3154.77	54.38	58.01	23.85
1.55 ~ 1.60	5.58	44.02	48.41	245.63	1225.59	51.20	23.94	2909.14	48.80	59.61	23.71
1.60 ~ 1.65	6.11	48.95	54.26	299.08	1524.68	57.31	26.60	2610.05	42.69	61.14	23.44
1.65 ~ 1.70	6.30	52.96	60.46	333.65	1858.32	63.61	29.21	2276.41	36.39	62.56	23.30
1.70 ~ 1.80	10.89	57.22	69.06	623.13	2481.45	74.50	33.31	1653.28	25.50	64.83	17.05
1.80 ~ 1.90	6.16	59.93	77.58	369.17	2850.62	80.66	35.34	1284.11	19.34	66.40	10.00
1.90 ~ 2.00	3.84	61.94	82.58	237.85	3088.47	84.50	36.55	1046.26	15.50	67.50	8.37
2.00 ~ 2.20	9.05	64.90	89.03	587.35	3675.81	93.55	39.29	458.92	6.45	71.15	
2.20 ~ +	6.45	71.15	96.78	458.92	4134.73	100.00	41.35	.00	.00	.00	

SAMPLE: All (VASHABLE) DATE:

SIZE :



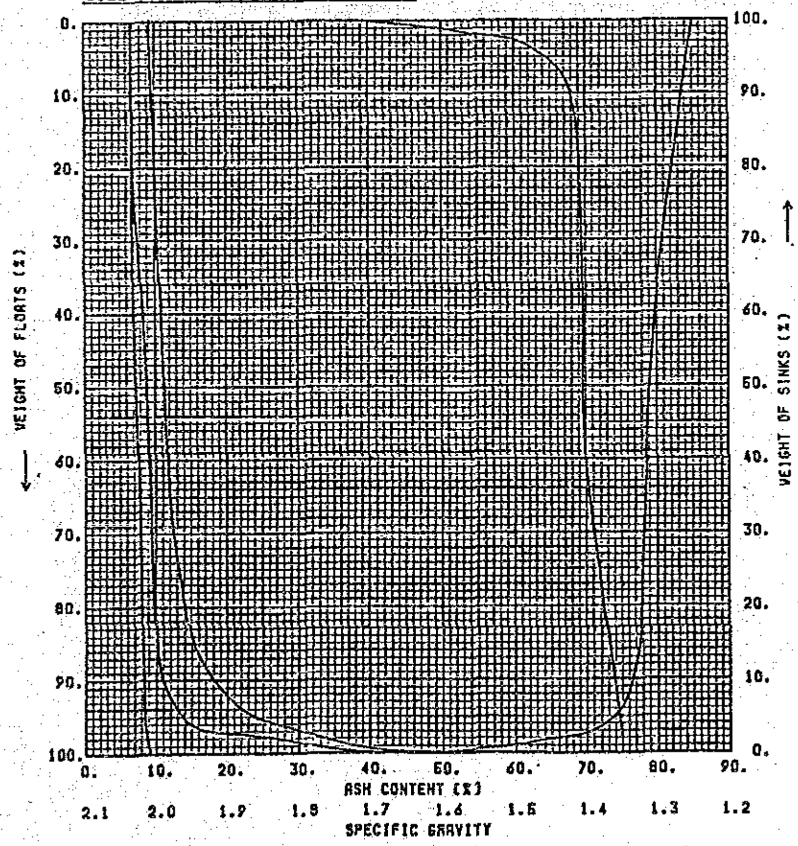
SAMPLE: A12 DATE:

(13)

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\Sigma V_{N-1} + \frac{V_N}{2}$	V·A	ΣV·A	ΣV	$\frac{\Sigma V \cdot A}{\Sigma V}$	TOTAL V·A −ΣV·A	100 −ΣV	$\frac{G}{H}$	±0.1 S.G.
− 1.30	37.70	6.90	18.85	260.13	260.13	37.70	6.90	667.87	62.30	10.72	
1.30 ~ 1.35	56.21	9.50	65.81	534.00	794.13	93.91	8.46	133.87	6.09	21.98	
1.35 ~ 1.40	3.40	14.30	95.61	48.62	842.74	97.31	8.66	85.25	2.69	31.69	61.21
1.40 ~ 1.45	0.70	24.96	97.66	17.47	860.22	98.01	8.78	67.78	1.99	34.06	5.50
1.45 ~ 1.50	0.90	30.01	98.46	27.01	887.23	98.91	8.97	40.77	1.09	37.40	2.60
1.50 ~ 1.55	0.50	33.80	99.16	16.90	904.13	99.41	9.09	23.87	0.59	40.46	1.92
1.55 ~ 1.60	0.50	37.80	99.66	18.90	923.03	99.91	9.24	4.97	0.09	55.24	1.03
1.60 ~ 1.65	0.02	39.80	99.92	0.80	923.82	99.93	9.24	4.17	0.07	59.64	0.54
1.65 ~ 1.70	0.01	45.50	99.94	0.46	924.28	99.94	9.25	3.72	0.06	61.99	0.04
1.70 ~ 1.80	0.01	51.70	99.94	0.52	924.79	99.95	9.25	3.20	0.05	64.05	0.02
1.80 ~ 1.90	0.01	55.10	99.95	0.55	925.34	99.96	9.26	2.65	0.04	66.28	0.02
1.90 ~ 2.00	0.01	60.50	99.96	0.61	925.95	99.97	9.26	2.05	0.03	68.20	0.02
2.00 ~ 2.20	0.02	65.80	99.98	1.32	927.26	99.99	9.27	0.73	0.01	72.91	
2.20 − •	0.01	73.10	99.99	0.73	928.00	100.00	9.28	.00	.00	.00	

SAMPLE: A12 DATE:

SIZE :

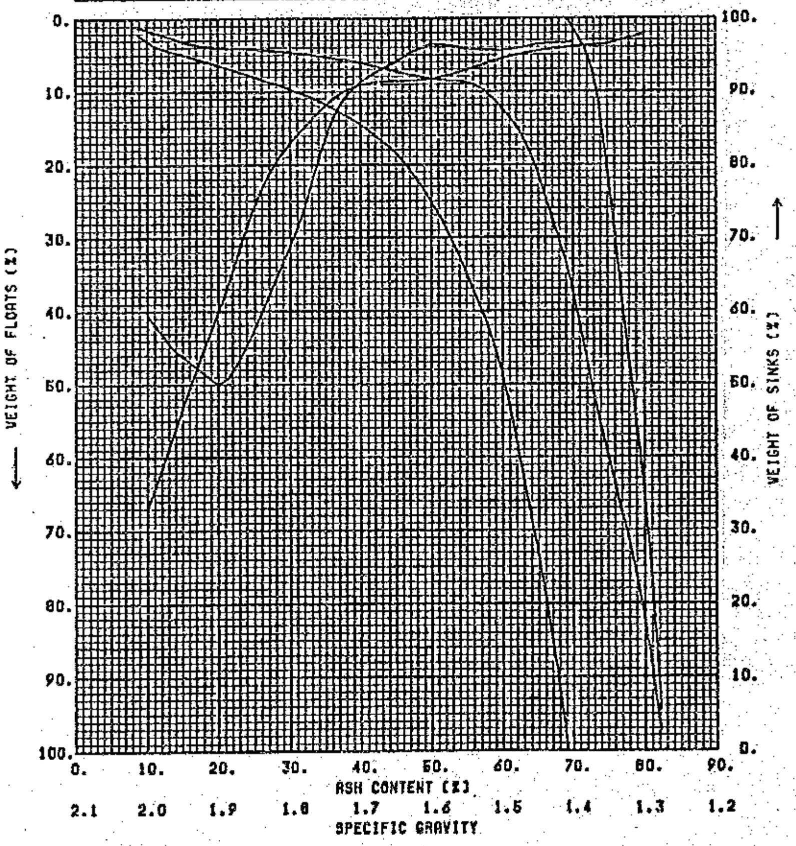


SAMPLE: A13 (LOW GRADE) (14) DATE:

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	$\Sigma VN-1 + \frac{VN}{2}$	V·A	ΣV·A	ΣV	$\frac{\Sigma V \cdot A}{\Sigma V}$	TOTAL V·A - ΣV·A	100 - ΣV	$\frac{G}{H}$	±01 S.G.
- 1.30	2.20	8.80	1.10	19.36	19.36	2.20	8.80	6898.85	97.80	70.54	
1.30 ~ 1.35	1.30	14.00	2.85	18.20	37.56	3.50	10.73	6880.65	96.50	71.30	
1.35 ~ 1.40	0.40	17.50	3.70	7.00	44.56	3.90	11.43	6873.65	96.10	71.53	3.30
1.40 ~ 1.45	0.53	24.87	4.16	13.18	57.74	4.43	13.03	6860.47	95.57	71.78	3.57
1.45 ~ 1.50	1.07	32.86	4.96	35.16	92.90	5.50	16.89	6825.31	94.50	72.23	4.40
1.50 ~ 1.55	1.57	40.82	6.28	64.09	156.99	7.07	22.20	6761.22	92.93	72.76	4.14
1.55 ~ 1.60	1.23	46.92	7.68	57.71	214.70	8.30	25.87	6703.51	91.70	73.10	3.55
1.60 ~ 1.65	0.27	50.89	8.43	13.74	228.44	8.57	26.66	6689.77	91.43	73.17	5.95
1.65 ~ 1.70	0.48	55.64	8.81	26.71	255.15	9.05	28.19	6663.06	90.95	73.26	8.70
1.70 ~ 1.80	7.95	60.58	13.02	481.61	736.76	17.00	43.34	6181.45	83.00	74.48	31.05
1.80 ~ 1.90	23.10	67.39	28.55	1556.71	2293.47	40.10	57.19	4624.74	59.90	77.21	50.00
1.90 ~ 2.00	26.90	73.54	53.55	1978.23	4271.69	67.00	63.76	2646.52	33.00	80.20	40.65
2.00 ~ 2.20	27.51	79.80	80.75	2195.30	6466.99	94.51	68.43	451.22	5.49	82.19	
2.20 - +	5.49	82.19	97.25	451.22	6918.21	100.00	69.18	.00	.00	.00	

SAMPLE: A13 (LOW GRADE) DATE:

SIZE :



SAMPLE: A14 (15) DATE:

SPECIFIC GRAVITY	A		B	C	D	E	F	G	H	I	J
	WEIGHT (%)	ASH (%)	ΣWN-1 + WN/2	W·A	ΣW·A	ΣW	ΣW·A / ΣW	TOTAL W·A - ΣW·A	100 - ΣW	G / H	±0.1 S.G.
- 1.30	91.60	4.20	45.80	384.72	384.72	91.60	4.20	90.62	8.40	10.79	
1.30 ~ 1.35	4.90	5.90	94.05	28.91	413.63	96.50	4.29	61.71	3.50	17.63	
1.35 ~ 1.40	1.50	12.50	97.25	18.75	432.38	98.00	4.41	42.96	2.00	21.48	8.20
1.40 ~ 1.45	1.10	17.40	98.55	19.14	451.52	99.10	4.56	23.82	0.90	26.47	3.35
1.45 ~ 1.50	0.70	21.51	99.45	15.06	466.58	99.80	4.68	8.77	0.20	43.85	1.89
1.50 ~ 1.55	0.05	26.30	99.83	1.32	467.89	99.85	4.69	7.45	0.15	49.69	0.82
1.55 ~ 1.60	0.04	34.01	99.87	1.36	469.25	99.89	4.70	6.09	0.11	55.40	0.14
1.60 ~ 1.65	0.03	40.66	99.91	1.22	470.47	99.92	4.71	4.87	0.08	60.93	0.10
1.65 ~ 1.70	0.02	46.90	99.93	0.94	471.41	99.94	4.72	3.93	0.06	65.59	0.07
1.70 ~ 1.80	0.02	55.08	99.95	1.10	472.51	99.96	4.73	2.83	0.04	70.83	0.03
1.80 ~ 1.90	0.01	63.20	99.97	0.63	473.14	99.97	4.73	2.20	0.03	73.37	0.02
1.90 ~ 2.00	0.01	69.84	99.97	0.70	473.84	99.98	4.74	1.50	0.02	75.12	0.01
2.00 ~ 2.20	0.01	73.76	99.98	0.74	474.58	99.99	4.75	0.77	0.01	76.44	
2.20 - +	0.01	76.53	99.99	0.77	475.34	100.00	4.75	.00	.00	.00	

SAMPLE: A14 DATE:

SIZE :

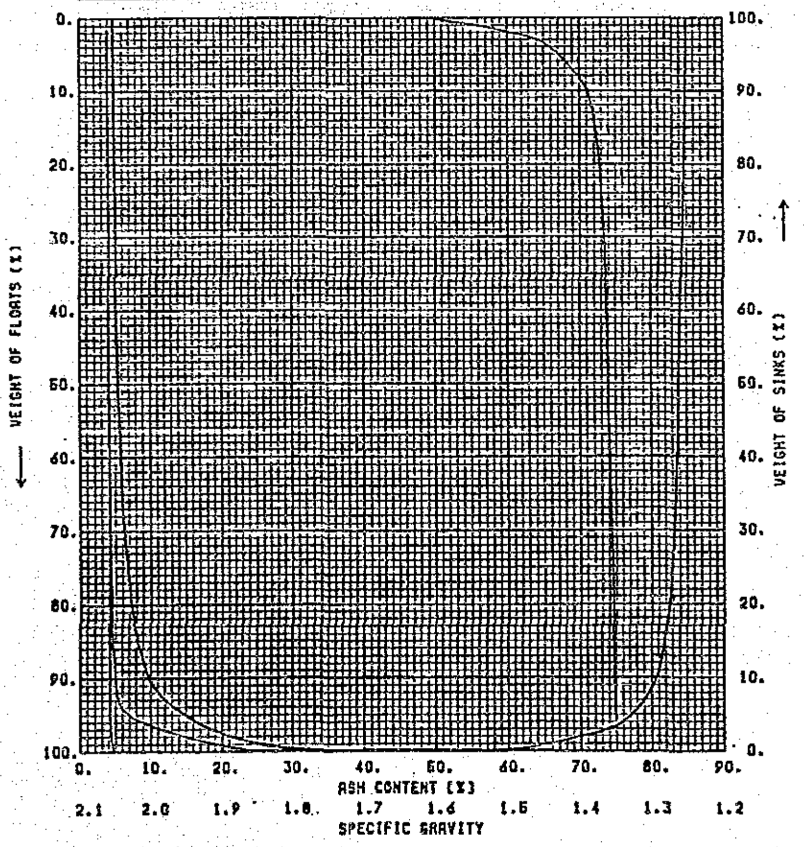


Table 21-2 Composed Washability Data
Face Sample at Unong Pit

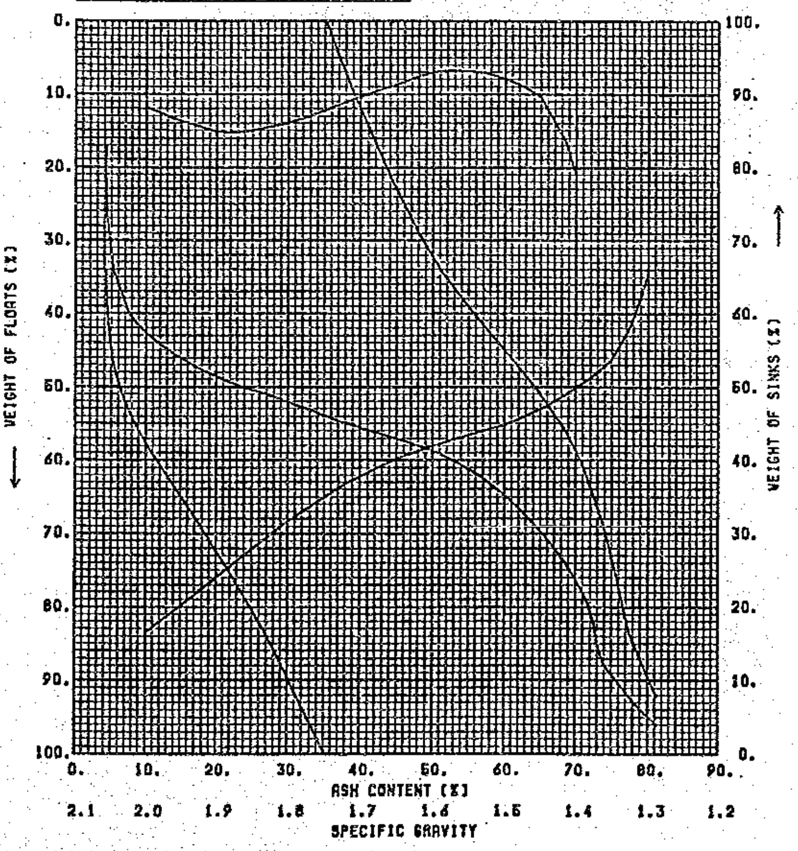
SAMPLE: COMPOSITE WASHABILITY DATE:

(1)

SPECIFIC GRAVITY	A WEIGHT (%)	A ASH (%)	B $\Sigma W_{N-1} + \frac{W_N}{2}$	C W·A	D ΣW·A	E ΣW	F ΣW·A / ΣW	G TOTAL W·A − ΣW·A	H 100 − ΣW	I G / H	J ±0.1 S.G.
− 1.30	34.13	4.28	17.07	146.08	146.08	34.13	4.28	3372.81	65.87	51.20	
1.30 ~ 1.35	12.13	7.63	40.20	92.55	238.63	46.26	5.16	3280.26	53.74	61.04	
1.35 ~ 1.40	3.86	19.00	48.19	73.34	311.97	50.12	6.22	3206.92	49.88	64.29	21.02
1.40 ~ 1.45	2.91	28.59	51.58	83.20	395.17	53.03	7.45	3123.72	46.97	66.50	10.36
1.45 ~ 1.50	2.12	35.65	54.09	75.58	470.74	55.15	8.54	3048.14	44.85	67.96	7.90
1.50 ~ 1.55	1.47	41.03	55.89	60.31	531.06	56.62	9.38	2987.83	43.38	68.88	6.80
1.55 ~ 1.60	1.40	45.91	57.32	64.27	595.33	58.02	10.26	2923.55	41.98	69.64	7.01
1.60 ~ 1.65	1.81	50.52	58.93	91.44	686.77	59.83	11.48	2832.11	40.17	70.50	8.63
1.65 ~ 1.70	2.33	54.69	61.00	127.43	814.20	62.16	13.10	2704.68	37.84	71.48	10.32
1.70 ~ 1.80	6.18	60.53	65.25	374.08	1188.28	68.34	17.39	2330.61	31.66	73.61	13.92
1.80 ~ 1.90	7.74	67.22	72.21	520.28	1708.56	76.08	22.46	1810.33	23.92	75.68	15.15
1.90 ~ 2.00	7.41	71.78	79.79	531.89	2240.45	83.49	26.83	1278.44	16.51	77.43	11.74
2.00 ~ 2.20	8.67	73.92	87.83	640.89	2881.34	92.16	31.26	637.55	7.84	81.32	
2.20 − +	7.84	81.32	96.08	637.55	3518.88	100.00	35.19	.00	.00	.00	

SAMPLE: COMPOSITE WASHABILITY DATE:

SIZE :



COMPOSITION RATIO

Ply No.	Ratio
1	1.0878
2	5.2425
3	0.7614
4	0.4968
5	0.7614
6	0.4441
7	6.5266
8	2.0688
9	2.3762
10	2.0688
11	2.9211
12	0.7380
13	0.5826
14	2.1086