F1304 C-MJV for B.C. Hydro - Hat Creek

# WASHABILITY TESTWORK

# OF

# 1977 BULK SAMPLES

F1304 C-MJV for B.C. Hydro - Hat Creek
Washability Testwork of 1977 Bulk Samples

February 1978

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## SECTION 1

## SUMMARY

This Report brings together the Washability Data obtained from Samples collected from the 1977 Test Trenches A and B. Interpretation of this Data is the subject of a separate report "The Potential Application of Alternative Processes for the Beneficiation of Hat Creek Coals".

The Sampling Procedure and Laboratory Flowsheet was drawn up by Simon-Carves in consultation with B.C. Hydro to ensure that problems encountered in the 1976 Washability Tests were avoided.

The procedure used included, for the first time on Canadian coals, the Wet Attrition Procedure recently published as an Australian Standard.

# SECTION 2

# INTRODUCTION

At least 3 samples over the width of the coal deposit for each identifiable coal seam and/or zone are required to properly develop beneficiation proposals. The impractibility of achieving this during 1977 (and thus to form part of the Phase I Study) was obvious. Since, however, the need for beneficiation would not be established until towards the end of this Study, it was agreed that samples from the 1977 Test Mines programme would provide the best data even though limited in scope.

## 2.1 1976 Test Procedure

At the commencement of the C-MJV Study, SCAN reviewed the Washability and Test Wash Data obtained from the 1976 Sampling Programme: -

> "A Report to B.C. Hydro and Power Authority on the Analysis and Beneficiation of Bulk Samples "A", "B" and "C" from the Hat Creek Deposit" submited by Birtley Engineering (Canada) Ltd., Dr. D.F. Symonds, P.Eng., General Manager and Coal Science and Minerals Testing Division, Frank J. Horvat, Manager, August 13, 1976.

It was evident from this report that: -

2.1.1 Conventional Float and Sink analysis had not be practicable due to the rate of breakdown of the material through the handling and wetting/drying stages. The cumulative method ultimately used by CSMT had given consistent results.

2.1.2 Despite the care taken, the Washability Data did not correlate satisfactorily with the Test Wash results.

Mr. Frank Horvat was most helpful in our review of this report.

## 2.2 Correlation with Mining Results

The 1976 Samples had been taken by a 3 ft. diameter auger and thus were thought to contain a higher percentage of fines that would be incurred by actual mining. A direct comparison was possible by this stage since test mining had commenced in Trench A, the coal being mined by front bucket/shovel, handled twice by truck and front end loader, and fed through a small hopper to an 11 ft. diameter Bradford Breaker. This breaker was intended to reject wet clays whilst reducing the coal to 40mm x 0 for the Burn Tests.

## SECTION 2

## INTRODUCTION

2.2 Correlation with Mining Results - cont.

In practice the Run of Mine Coal was, by visual observation, 300mm x 0. The clays did not ball-up, but reported as breaker underflow, the reject being largely 150 x 40mm good quality coal: approximately 15 to 20% by weight.

We considered that this operation was resulting in a similar degree of size breakdown to that which would occur prior to any coal beneficiation plant. We did not consider that the full scale mining would give a substantially coarser product since the natural partings in the A Trench coal gave essentially a 200mm x 0 product.

Later mining in Trench B gave a coal which broke, if anything more readily, to -40mm, but in this case there were significant quantities of +300mm fossilized material, which would give a high ash breaker reject.

2.3 Consideration of Possible Beneficiation Schemes

2.3.1 The small proportion of +100mm preclude float and sink testing of this material to acceptable accuracies unless excessively large bulk samples were taken. Since the previous testwork and present observations also showed a comparatively easy coal/refuse separation for the +100mm material, it was decided to design the test programme for 100mm x 0 coal.

2.3.2 "Extremely Difficult" washability characteristics were revealed by the 1976 Tests and the practical use of dry cleaning techniques was ruled out.

2.3.3 The ability of the plastic clay materials to swell to less than 1.7 sp. gr. revealed in the 1976 Wash Test, suggested that washing at high gravity cut points would not be practicable. Thus the tests could be restricted to the 1.40 to 1.80 sp. gr. range.

## SECTION 2

## INTRODUCTION

2.3 Consideration of Possible Beneficiation Schemes - cont.

2.3.4 It was envisaged that computer interpolation would be used for intermediate gravities; thus it would be best practice to concentrate on achieving high accuracy of 5 sp. gr. separations in the range using the cumulative method. Thus 1.40, 1.45, 1.50, 1.60 and 1.80 were selected.

2.3.5 The size ranges which could be treated simultaneously by appropriate beneficiation processes was reviewed with a view to minimizing the number of separate size fractions for float and sink analysis.

The following fractions were thus selected: -

4" x ½", ½" x ¼", ¼" x 28 mesh, 28 mesh x 100 mesh

(Note that Imperial Units were used due to equipment availability.)

2.4 Wet Attrition Procedure

The most serious problem revealed in the 1976 Test Procedure was that the size consist data from the Test Washes showed considerably more (and higher ash) fines than were predicted from the conventional analysis procedures. Thus the washability data itself could not represent the coal as processed.

This problem had been defined in a series of some 17 test programmes conducted by the Australian Coal Industries Research Laboratories Ltd., and set out in their paper by A. LePage and F. Pollard to the 1976 International Coal Preparation Congress. Subsequently their Wet Attrition Test Method has been incorporated in the 1977 Australian Standard for Washability Testing.

The Australian research had been specifically correlated with plants (both pilot and full scale) treating + 0.5mm raw coal in Dense Medium Cyclones, and the -0.5mm by Froth Flotation. Preliminary evaluations suggested that some -½" or -¼" material at Hat Creek would probably require washing in Autogenous Medium Cyclones. The "wet attrition" in such a system would probably be, if anything, more severe than using Dense Medium Cyclones plus Froth Floation. It was therefore, recommended that the -½" material be subjected to the Australian Test.

SECTION 2

INTRODUCTION

2.4 Wet Attrition Procedure - cont.

The work flowsheet thus shows the following: -

4" x ½" and ½" x ¼" - Conventional Methods
½" x ¼", ¼" x 28 mesh, 28 x 100 mesh - Wet Attrition prior to float and sink analysis.

2.5 Sulphur Beneficiation

Due to the particular importance of sulphur beneficiation, sulphur contents should be determined on all fractions so that "sulphur washability" would be established.

2.6 1977 Test Procedures

The above points were therefore, incoporated into the 1977 Washability Test Programme Flowsheet, to form a basis for arranging a sub-contract with a Testing Laboratory. This is set out in Section 4.

The problems encountered in previous work suggested, however, that B.C. Hydro and SCAN personnel should be present at various stages in the testwork to agree modifications to procedures if necessary.

2.7 1977 Test Samples

The trenches "A" and "B" were believed to be in "A" and "D" Coal Zones and thus would supplement the data to hand from the 1976 Tests.

From the larger "A" Trench it was decided to take separate samples from two different strata sections. From the smaller "B" trench, in the more homogenous "D" Zone coal, only one sample was proposed.

These samples would be specifically mined and not taken from the general run of mine operation for several reasons:

2.7.1 To identify the samples relative to geological strata.

2.7.2 To facilitate careful and immediate sealing of sample drums to avoid size breakdown by drying out.

## SECTION 2

## INTRODUCTION

2.7 1977 Test Samples - cont.

2.7.3 To allow the correct reconstitution of the Breaker oversize and undersize products without interference to the main mining programme.

2.7.4 To take the "A" trench samples immediately adjacent to the samples for the E.M.R. Test Wash, thus enabling a reasonable estimate of the effects of crushing and attrition.

2.7.5 To ensure that the "A" trench samples were not contaminated by unrepresentative material from the burn zone.

It was observed that the product size analyses and ash distribution from these mine products were not so different as to discount the 1976 Data, despite the reservations detailed in paragraph 2.1.

2.8 Future Requirements

It was noted that the Wet Attrition Test was part of a much larger total procedure being developed in Australia for obtaining washability data from large diameter bore-cores. This method thus merited the study outlined in paragraph 2.4 as a pre-requisite to designing any programme to meet the criteria set out in the first paragraph of this section.

# SECTION 3

## RECOMMENDATIONS AND CONCLUSIONS

3.1 A much larger number of Washability Samples will be required from the Hat Creek deposit prior to finalization of any Beneficiation Scheme.

3.2 Particular problems related to the clays were not found with the 1977 Samples.

3.3 The 1976 Tests form a usefuly part of the present knowledge. Correlation between 1976 Tests, 1977 Tests and Test Washes is not good.

3.4 The Cumulative Float and Sink procedure is proven.

3.5 Wet Screening for all Hat Creek samples is essential. This must in future be done with mechanical test equipment.

3.6 The Wet Attrition Procedure is not proven by the three tests to-date. For use with the high fines content Canadian Coals, an effective arrangement of the drum with the wet screening equipment is necessary. Development of the technique to give reliable results from a bore-core programme will be necessary if a washing scheme is required at Hat Creek.

# SECTION 4

# TEST PROCEDURE

1. Introduction

2. Method of Obtaining Sample

3. Dry Screening

4. Wet Screening and Attrition

5. Float and Sink Analysis

6. Analysis Requirements

Appendix A: Flowsheet

Appendix B: Observations and Procedural Modifications

Appendix C: Correspondance with A.C.I.R.L. Ltd.

# 1977 HAT CREEK COAL WASHABILITY TEST PROCEDURE

## 1. INTRODUCTION

1.1 During previous washability testwork it has been observed that the rate of breakdown of coal during the necessary handling, screening, drying and float and sink operations has given anomalous results. This is, of course, a universally observed characteristic of Sub-Bituminous C (or Black Lignite) Coals, for which breakdown is reported as most severe on alternate wetting and drying.

1.2 The matter is further complicated by the breakdown characteristics of the various clay materials. Some have identified three types:

1.2.1 Sticky, plastic, bentonitic clay

1.2.2 Dry, powdery clay

1.2.3 Nodules of clay (which behave as discrete dirt particles if the period of wetting is a minimum.

Visual observation of the behaviour of these or other possible classifications should be made throughout the test. This is important since clay materials rather than conventional shales will form the bulk of the high ash material which we intend to remove by beneficiation.

1.3 The object of the Washability Test Procedure is therefore to determine the washability characteristics in a manner which will relate to the proposed mining, raw coal handling and preparation methods. Thus,

1.3.1 Sticky, plastic clay if found in hand size pieces will be removed from the samples (and recorded) to simulate removal in the Raw Coal Breaker.

1.3.2 A degree of handling and breaking of raw dry coal is an essential part of the sample collection programme.

1.3.3 All tests should be done on material at the "as mined" moisture content. (See 1.1 above - this must be maintained by the handling method not by synthetic re-wetting). The samples will be loaded into Drums with polythene liners (or equivalent agreed method) and BETWEEN EVERY TEST STAGE THE LABORATORY MUST RETURN ALL MATERIAL FRACTIONS TO EQUIVALENT SEALED STORAGE unless the next stage is proceeded with immediately. On no account must any material lie in open dry air conditions.

1.3.4 Wet Attrition Testing is specified for the 1/2" x 0 Raw Coal prior to Float and Sink Analysis.

1.4 Further, the Float and Sink Analysis must be done according to the method determined by CSMT in the 1976 Testwork, i.e. each size fraction to be sub-divided into five representative "splits." Each "split" to be subjected to Float and Sink at ONE S.G. only. Thus a set of five Cummulative Washability Data Points is obtained from which the Conventional Data may be calculated. This method demands a somewhat larger weight of raw coal of each size fraction to be put to Float and Sink Analysis than is normally practiced. The full weights proposed in the 1963 ISO Draft (Para. 5.1 below) should not therefore be compromised.

1.5 In practice the above weights would present problems above 1/2", and thus the procedure set out below for a realistic total sample weight of 10,000 lb. for each channel means that

1.5.1 For the +4" results are only a reasonable indication

1.5.2 For the 4" x 1/2" fractions the results for two or more channels should be ultimately cummulated to form one set considered statistically reliable.

1.6 Close liaison between BCH/CMJV - SCAN personnel and the Laboratory Supervisor and staff is necessary throughout.

1.7 The Description of Work below to be read in conjunction with the Flowsheet, Appendix "A".

## 2. METHOD OF OBTAINING SAMPLE

2.1 Position of Channels to be agreed on site between Dr. Dutt and Messrs. Taplin and Butcher as representative. A pillar section log to be made to permit correlation and interpretation.

2.2 Each channel sample to be obtained from a bench of approximate height 20 ft. Thus a full height face channel 3 ft. wide by 2 ft. deep will give an estimated sample weight of 10,000 lbs. The whole as mined sample for a uniform cross section must be taken whether above or below this weight.

2.3 To be mined by Bucket Shovel, transported to Breaker Area (put down if necessary on a CLEAN surface), fed to Breaker via hopper and broken with the outlet plate set as in mid June to give discharge after two or three tumbles.

2.4 Collection areas for breaker products to be lined with steel (or timber boards) to permit collection of ALL material.

2.5 Breaker Products (oversize and undersize) to be collected in total to reconstitute sample. Pack in polythene lined drums (or other agreed moisture retaining containers) and seal to retain moisture.

2.6 Each drum to be clearly identified internally and externally and a log kept. If possible weigh drums prior to dispatch from site.

## 3. DRY SCREENING

3.1 All screening to be done using Standard Square Aperture Sieves to ASTM method.

3.2 Dry Screen at 4"..
Weigh total sample - undersize and oversize to determine wt% +4" material.

3.3 Homogenize 4" x 0 Sample on clean sample preparation floor.
Extract 1000 lb. Head Sample.
Extract 5000 lb. Main Sample.
Return excess material to lined drums to form emergency Reserve Sample.

3.4 Dry Screen Main Sample at 2", 1" and 1/2". Weigh and take head samples of each size fractions.
Determine wt% 4" - 2", 2" - 1", 1" - 1/2" and 1/2" - 0.
Recombine 4" x 1/2" material for Float and Sink analysis (N.B. return to lined drums if not processed immediately).

3.5 It is anticipated that this will leave about 3000 lb. 1/2" x 0. Homogenize. Divide Sample:

3.5.1 1000 lb. for Dry Screening
3.5.2. for Wet Screening
3.5.3 As required (see 4.2 below) for Wet Attrition
3.5.4 1/2" x 0 Reserve Sample (remainder)

3.6 Sample 3.5.1. Dry Screen to ASTM method at 1/4", 1/8", 1/16" and 28M to determine wt% and obtain size fraction head samples for analysis.

## 4. WET SCREENING AND ATTRITION

4.1 Wet Screen Sample 3.5.2 to ASTM method at 1/4", 1/8", 1/16", 28M, 45M, 65M, 100M and 200M using appropriate laboratory screening equipment.

4.2 Take increments - Sample 3.5.3 - of 1/2" x 0 Raw Coal and subject to Wet Attrition Procedure as set out in paper D2 by A Le Page and F. Pollard of ACIRL Ltd. (Australian Method), attached, to give an estimated 200 lb. of 1/2" x 1/4" material.

4.2.1 Take sample of this Attrited Material and Wet Screen as in 4.1 above.

4.2.2 Bulk of this Attrited Material to be Wet Screened at 1/4", 28M and 100M for Float and Sink Analysis.

## 5. FLOAT AND SINK ANALYSIS

5.1 The ISO Recommended Weights for each size fraction are given below, Column I. The anticipated available weights from the 5000 lb. 4" x 0 Main Sample are given in Column II.

| | SAMPLE WEIGHTS lb. | |
|---|---|---|
| | I<br>ISO<br>Recommended | II<br>Anticipated<br>Available |
| 8" - 4" | 15,000 | |
| 4" - 2" | 4,000 | 400 |
| 2" - 1" | 1,500 | 800 |
| 1" - 1/2" | 500 | 800 |
| 1/2" - 1/4" | 200 | 800 |
| 1/4" - 1/8" | 150 | 600 |
| 1/8" - 1/16" | 100 | 600 |
| 1/16" - 28M | 50 | 400 |
| 28M - 100M | 50 | 400 |

5.2 Thus only an indication of the characteristics of the +4" material will be obtained. Hand Select to give Bright Coal, Dull Coal, Clay and Rock fractions. Determine S.G. of individual pieces using standard gravity baths prepared for -4" testwork. (Anticipated weight of +4" material from 10,000 lb. sample = 400 lb.)

5.3 Anticipated 2000 lb. of 4" x 1/2" recombined sample (3.4). Make five representative "splits", i.e. each approximately 400 lb. (It may be found easier to make this five way split representative to do this when separated into +2", 2" - 1" and 1" - 1/2" fractions and then recombine).

| | |
|---|---|
| One "Split" to be Float/Sink at | 1.40 |
| Second " " " | 1.45 |
| Third " " " | 1.50 |
| Fourth " " " | 1.60 |
| Fifth " " " | 1.80 |

5.4 "Split" Float and Sink Procedure to be similarly used for all other size fractions, i.e.:

5.4.1 1/2" x 1/4" 200 lb. Dry Sample from 3.6

5.4.2 1/2" x 1/4" 200 lb. Wet Attrition Sample from 4.2.2

5.4.3 1/4" x 28M 200 lb. Wet Attrition Sample sub-divided from 4.2.2

5.4.4 28M x 100M 50 lb. Wet Attrition Sample sub-divided from 4.2.2.

## 6. ANALYSES REQUIREMENTS (ASTM METHODS)

All analyses (except moisture) to be reported on Dry Basis.

6.1 1000 lb. Head Sample, 4" x 0 (3.3)
- Total Moisture (As Received)
- Residual Moisture (Air Dried)
- Ash
- BTU
- S

6.2 +4" "Quality" Fractions (5.2)
- Total Moisture
- Air Dried Moisture
- Ash
- BTU
- S

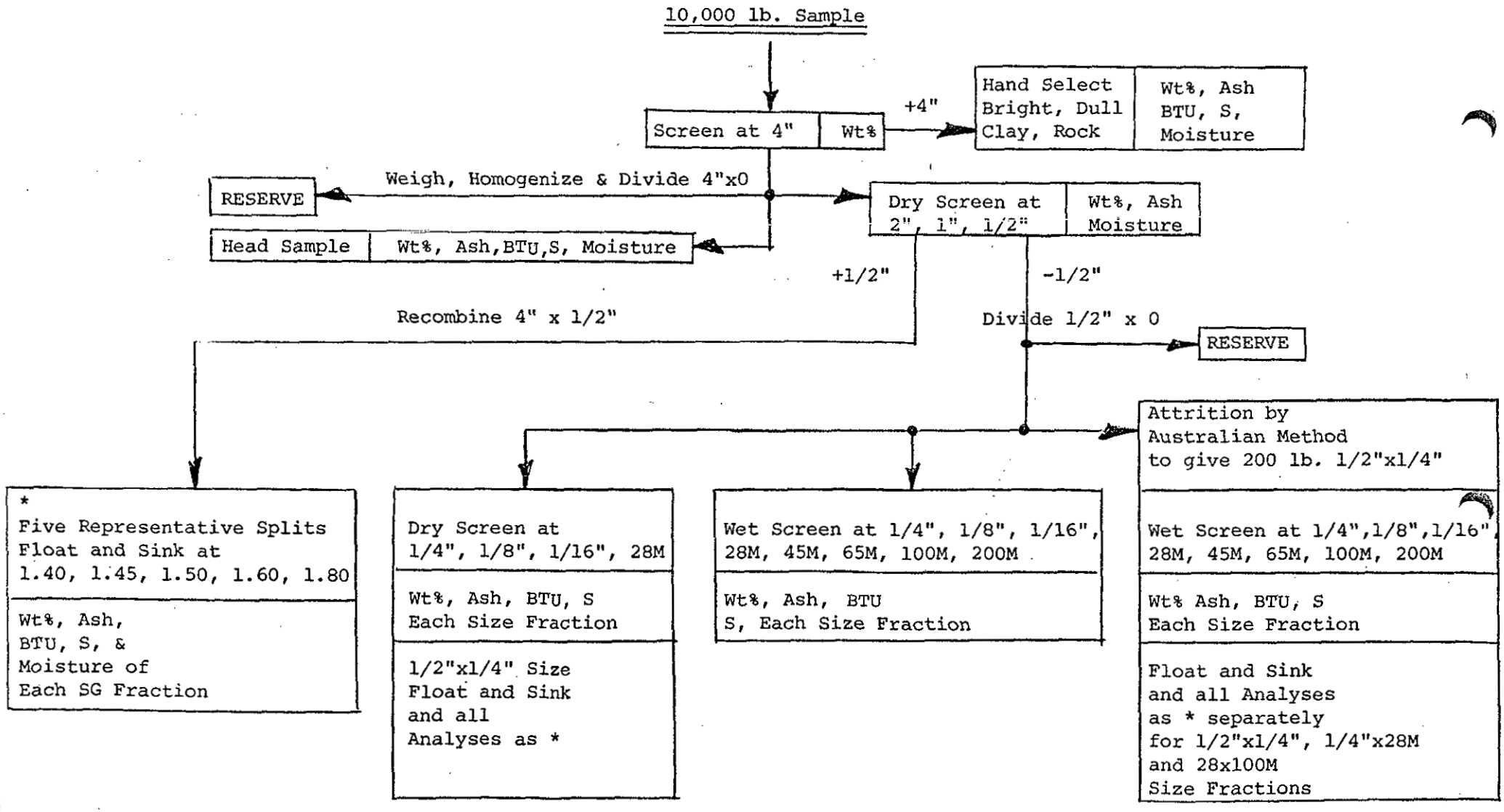
6.3 All Size Fraction Head Samples, i.e. 4" x 2", 2" x 1", 1" x 1/2" from (3.4)
1/2" x 1/4", 1/4" x 1/8", 1/8" x 1/16", 1/16" x 28M, 28M x 0 "Dry
samples from (3.6)
Size fractions from (4.1)
Wet Attrition Size fractions from (4.2)
- Total Moisture (3.4 and 3.6 only)
- Air Dried Moisture
- Ash
- BTU
- S

6.4 All S.G. Fractions from Float and Sink Analyses:
- Air Dried Moisture
- Ash
- BTU
- S

6.5 Note that all material, S.G. Fractions etc., to be retained pending instructions to dispatch samples to others for special analyses, e.g. ash composition analyses.

# B.C. HYDRO - HAT CREEK PROJECT

## SIZING AND WASHABILITY STUDIES FLOWSHEET



# SECTION 4

# TEST PROCEDURE

## APPENDIX "B"

## OBSERVATIONS AND PROCEDURAL MODIFICATIONS

See also the detail comments by Warnock-Hersey in Sections 5 - 7.

### B.1 Site Sampling

1.1 Originally three samples were scheduled for Trench A and two for Trench B. The sample size of 10,000 lbs. was acknowledged to be too small for the +2 inch material to meet ISO Sample Size recommendations. Thus for the coarser coal the composite of two samples should be used.

It was decided to take only two samples, X & Y from A, and one Z, from B. The sample size was thus increased to 20,000 lbs. for B.

1.2 The bench formation did not allow taking face channel samples as proposed. Floor channel samples some 30 ft. long were obtained from A, approximately 2 ft. wide x 2 ft. deep. Excavating from the floor using a "Backhoe" accross the partings gave a somewhat poorer size consist than had been obtained from previous spot samples and observed in general mining operations.

Trench B sample was obtained using a 6 ft. wide bucket excavator.

1.3 Plastic liners were not available for the drums, although the bids were well fitting and properly tightened. The time taken to mine, handle and pass through the breaker was such that moisture contents from this programme should not be regarded as absolute.

1.4 Trench B was pumped out during mining and an excessively wet Sample Z was obtained.

# APPENDIX "B"

## OBSERVATIONS AND PROCEDURAL MODIFICATIONS

### B.2 Dry Screening and Coarse Coal Examination

2.1 The samples, particularly Z, were too damp to permit dry screening as received: limited air drying was thus undertaken.

2.2 Quantities of +4" material were inadequate for any realistic evaluation of its quality.

2.3 Lump clay was not found.

### B.3 Wet Screening

3.1 Warnock-Hersey found difficulty in obtaining repeatability of results, and found a 10 minutes conditioning time necessary (See their report). This may have given rise to soft shale/clay breakdown to greater degree than would occur in a single wet screening process.

We would recommend that any future work be done using mechanical wet screening apparatus, and not hand sieving.

3.2 The size analysis results show a most marked difference in dry and wet screening results. Wet screening is obviously essential for any work on Hat Creek Coals pertaining to wet processing: probably in future the 4" x ½" material should also be wet screened.

### B.4 Float and Sink Testing: +¼" Coal

4.1 The cumulative procedure appeared to be very satisfactory. The large proportion of middlings present suggest that ISO sample size recommendations were more than adequate.

# APPENDIX "B"

## OBSERVATIONS AND PROCEDURAL MODIFICATIONS

### B.5 Wet Attrition Testing

5.1 The 30 seconds wet attrition period is higher than that calculated using the formula given in the paper by LePage and Pollard, or the graph in the Australian Standard. It was obtained as a recommendation direct from Mr. Pollard. (See attached correspondance, which indicated the exact time is not critical).

5.2 The method of calculating the wet attrition period from the HGI does not indicate whether this should be for raw sample or the coal itself. Both were determined at the request of BCH: raw sample values are reported here.

5.3 An initial attempt revealed difficulties in handling the quantity of water with its high ultrafines content after attrition. The test was repeated with representatives of B.C. Hydro and ourselves present at Warnock-Hersey's Laboratories. It was agreed that it would be impracticable to obtain the 200 lb. of ½" x ¼" material after attrition. (Thus from this point forward the ISO Sample Weight recommendation was abandoned - note that the Australian Standard gives substantially smaller weights.) It was therefore, agreed that one 50 kg test of X,Y and Z coals be completed at this stage.

5.4 The settled solids mass from the Wet Attrition of ½" x 0 coal was a somewhat difficult "pudding" to handle, and the total breakdown noticeable. It was decided, therefore, to test 4" x 0 raw coal from the Reserve Sample, with the float and sink analysis confined to the ½" x ¼", ¼" x 28 mesh and 28 x 100 mesh fractions as per flowsheet.

5.5 Visual observation immediately after the tumbling period showed substantial breakdown of the coal - one might almost say the coal had been attacked by the water. The subsequent time taken to complete wet screening was several hours per sample. The coal size breakdown is however, judged to have occurred during the initial tumbling period.

5.6 The Australian Standard calls for a simple screening over ½mm wedgewire and then drying prior to subsequent testing. We advised that this should not be done for sub-bituminous coals as the most severe breakdown characteristic of these coals is by alternate wetting and drying. Also our use is related to separate size fractions and needs wet screening.

Mechanical wet screening equipment is necessary to properly conduct this test with the high fines content Canadian Coals.

APPENDIX "C"

CORRESPONDANCE WITH A.C.I.R.L. LTD.

November 30, 1977
F1304.C3/SGB/kc

Mr. Frank Pollard,
Deputy General Manager

Australia Coal Industry Research
Laboratories Ltd.
22-30 Delhi Road
North Ryde
N.S.W.

Dear Frank,

WET ATTRITION TEST METHOD

Thank you for your letter November 8, 1977, together with enclosures. I have passed your Invoice for action.

You may recall that David Webster asked your advice in June regarding the application of this test to a particular set of coals we are currently investigating. We anticipated the HGI to be 40, and recieved a telex message from David recommending 30 seconds. Our client has read some of your papers and wonders: -

1. Why you recommend 30 seconds, which is greater than calculated from your formula?

2. Whether in our case there would be any significant difference between the very short tumble time and simple soaking in water?

Last week I observed the initial runs using the Drum, tumbling with steel cubes. We obtained an HGI of 53 on a sample of Drum Feed.

I should explain that the coal is, by ASTM Classification, Sub-bituminous B/C. (I would prefer the Seyler/British description as Black Lignite.) Pieces of low ash coal give HGI values of 40 or even less at times. The associated "dirt" is clay rather than shale, and exists from fissure layers to thick bands. This gives very difficult washability curves, with increasing head ash contents in the finer sizes.

....2

Att: Mr. F. Pollard
Re: Wet Attrition Test Method

November 30, 1977


Our sampling and testing programme was drawn up with the possibility of washing 1/2" x 100 mesh size fraction in Water Only Cyclones. We therefore, first tried wet tumbling 1/2" x 0, but didn't like the look of the resultant sticky material.

On reviewing your papers we decided we may not be getting a realistic interaction between coarser coal particles. We thus used a 4" x 0" sample. This had been "dry tumbled" to simulate Prep. Plant Feed using a Bradford Breaker. This gave a handleable product after wet tumbling. We are however, very concerned at the time taken to screen out this material from the water and into appropriate size fractions, and that more degradation may have occurred whilst standing in water. Obviously we have, as yet, to develop an efficient means of handling the product.

We are thus restricting our present test to one 50 kg batch of each of 3 coals, even though this may not give the quantities we would like for Float-Sink of the + 1/4" size fractions.

Thus there are further questions: -

3. How do you handle drum product?

4. What total sample weight do you prepare for Float-Sink? (We note AS1661 gives much lower sample weights than other standards.)

We will let you have the results for information and any comment you may care to make.

With reference to the proposed note in your Annual Report, we are not, as yet, using the ACIRL Borecore Testing System - just trying out the Wet Attrition Drum Test.

Regards,

SIMON-CARVES OF CANADA LTD.

S.G. Butcher, P.Eng.,
Senior Process Engineer

bcc: WHL/DSW

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# Australian Coal Industry Research Laboratories Ltd.

(Incorporated in New South Wales)

Ipswich Laboratory,
Foote Lane,
Ipswich, Qld.
Telephone 281 3344

ALP:DN

13th December, 1977.

Mr. S. G. Butcher,
Senior Process Engineer,
Simon Carves of Canada Ltd.,
2025 Sheppard Avenue East,
Willowdale (Toronto),
ONTARIO. M2J 1W2

Dear Stan,

WET ATTRITION TEST METHOD

This refers to your letter, 30th November, 1977 F1304.C3/SGB/kc, addressed to Frank Pollard regarding the wet tumbling of coal samples. Frank will be writing to you independently but he has asked me to offer some comments on the points which you have raised.

Possibly the best approach would be to describe in some detail the way in which the test is carried out.

The required amount of water is placed in the drum (200 litre or 44 gallon capacity) and then the coal sample is added. The drum is sealed and then rotated for the required duration. After this time the contents are removed by means of a small plastic bucket and placed onto a 0·50 mm wedgewire (ww) screen which forms the lid of a second 200 litre drum. The residue on the screen is sprayed using a hand-held hose. The screen oversize is then air-dried and rescreened at 0·50 mm (ww), the undersize is added to the minus 0·50 mm (ww) which reported as slurry after the tumbling operation.

The total operation takes about 15 minutes so the coal sample is under the influence of water for about that period of time.

For hard coal, Hardgrove grindability index less than 50, the duration of tumbling is not critical because the degradation of the coal is not great when compared with softer coals. If I had to be more specific I would say 30 $\pm$ 10 seconds would be adequate tolerance.

Also, we have found that shales and clays that are troublesome in plant, breakdown rapidly in water provided that there is sufficient interaction between the clays or shales and the water. The end-over-end rotation of the drum was used in our tumbling work to ensure that the interaction was adequate. We have found that soaking the sample in water might not provide adequate interaction.

We use AS 1661 as a guide for sample mass but increase the quantity when we consider that this is necessary.

I hope that these comments will be of some assistance and please do not hesitate to correspond if additional information is required.

Yours faithfully,

A. J. Le Page,
Chief Research Scientist.

c.c. F. Pollard

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel. 276 - 9138

SECTION 5

ANALYSIS OF SAMPLE W77Z

Report of Analysis of

Hat Creek Bulk Sample W 77 Z

Includes Wet Attrition

PART I. "Z" only

Submitted, December 20, 1977

John Kay

John Kay, C. Eng., M. Inst. F.
Manager of Laboratory

## Introduction

The Hat Creek Project took the form of a work program to the instructions of Simon Carves of Canada.

This was to examine, using the Warnock Hersey Professional Services Laboratory at Calgary, Canada, the physical properties of the three samples.

This analysis took the form of grading, float & sink characteristics, proximate analysis.

Also included was a scheme whereby the breakdown of the coal / clay could be measured using a Wet Attrition drum constructed to, and complying with, the standards of the Australian Method AS 1161 1977 p. 42/3.

Description of Samples and Methods Used

One sample marked "Z" which was derived from trench "Z" weighing 11115 kgms. packed into 73 steel drums was delivered to Calgary on August 11, 1977. On opening these drums, it was immediately noticeable that polythene liners had not been used. A separate moisture sample was not delivered.

The methods used to obtain these samples were outside the terms of reference to Warnock Hersey Professional Services Ltd.

After air drying the coals very few lumps of clay were to be seen and even after separting the + 4 " material the amounts of pure clay was very small. Discrete inorganic material could be seen occluded in the clay, and when samples were placed in water, the coal could be seen to separate according to the clay content. High coal content pieces would stay in their original shape, but low coal content pieces, i.e. due to larger amounts of clay occlusions, broke up rapidly and became a slurry. After filtering, it was possible to settle the dispersion easily and a clear supernatent could be decanted.

Grading, using a Gilson mechanical sieving apparatus to separate the fractions, and Float & Sink analysis, in organic solutions at prescribed gravities were used to separate the coals further. Drying on down draught benches was followed by preparation of samples for analysis. Riffling was accomplished by means of a manual riffle.

The Flow sheet was supplied by Simon Carves and this was generally adhered to except some shale analysis had to be added, and moisture contents prior to analysis had also to be added to the flow sheets. All three samples were treated in the same way. The weights and % weights are also reported. In some cases a very small fractional weight resulted, but the test was completed noting this. A Float & Sink test on the + 4 " was carried out on "X" and "Z" samples only - "Y" did not produce a fraction at + 4 ". Since separate moisture samples were not received, air drying followed by loss in weight at 107 $^{o}$ techniques were used to determine total moisture.

During the processing of sample "Z" a Simon Carves representative was present in the lab and again during some of the later stages only.

No Ash Examination was requested.

A mechanical type of wet screening apparatus was not available, so careful control over water supplies and hand manipulation had to be used to separate the fines into respective size fractions. It was found that "conditioning" i.e. soaking in water prior to screening ensured the best separation and each sample was subjected to 10 minutes in water before screening.

Reference to the flow sheet will show a reserve sample was requested after the initial grading at + 4 " - this amounted to:

3,360 kgms. for "X"

13,000 kgms. for "Y"

800 kgms. for "Z"

Further requests from the flow sheet asked for hand selecting to be used for "bright, dull clay and rock". In practice this was less than feasible since we found agglomerates of these materials with coal and a reduction in particle size would have accompanied any mechanical breakage. The Simon Carves representative was present during this operation and was in agreement with what was done.

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Z D - Coal

LAB. NO. - 77 - 8073

## RAW COAL SIZE / ASH DISTRIBUTION

| | WT. % | DRY ASH % | CUM. WT. % | CUM. ASH % | WEIGHT (kg.) |
|---|---|---|---|---|---|
| + 4 " | 3.1 | 25.6 | 3.1 | 25.6 | 344 |
| 4 " x 2 " | 6.4 | 27.1 | 9.5 | 26.6 | 723 |
| 2" x 1 " | 24.8 | 27.9 | 34.3 | 27.5 | 2,352(SUB) |
| 1 " x ½ " | 32.8 | 26.1 | 67.1 | 26.8 | 3,107 |
| ½ " x ¼ " | 12.7 | 28.5 | 79.8 | 27.1 | 302.4 (SUB) |
| ¼" x 1/8" | 10.1 | 28.5 | 89.9 | 27.3 | 55.3 |
| 1/8" x 1/16" | 4.8 | 30.6 | 94.7 | 27.4 | 10.1 (SUB) |
| 1/16" x 28 M | 2.6 | 32.4 | 97.3 | 27.6 | 3.3 (SUB) |
| 28 M x 0 | 2.7 | 33.9 | 100.0 | 27.7 | 3.4 |
| TOTAL | 100.0 | 27.7 | | | |

15.38 MJ/kg AS RECEIVED BASIS.

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. HYDRO

SAMPLE - HAT CREEK - Bulk Sample W 77 Z

LAB. NO. - 77 - 8073

RAW COAL FRACTIONS - ANALYSIS % - Dry Screened

| Size | + 4" | 4" x 2" | 2" x 1" | 1" x ½" | 4" x 0 | ½" x 0 |
|---|---|---|---|---|---|---|
| Wt. % Head | 3.1 | 6.4 | 24.8 | 32.8 | 96.9 | 32.9 |
| Air Dried Loss | 4.6 | 6.8 | 6.4 | 4.0 | 7.1 | 7.5 |
| Inherent Moisture | 21.0 | 19.3 | 20.4 | 21.0 | 21.5 | 22.8 |
| Total Moisture | 24.6 | 24.8 | 25.5 | 24.2 | 27.1 | 28.6 |
| Ash (Air Dried) | 22.3 | 21.8 | 22.2 | 20.6 | 21.1 | 22.0 |
| Sulphur (Air Dried) | 0.16 | - | - | - | 0.24 | 0.33 |
| Btu / lb. (Air Dried) | 6,856 | - | - | - | 6,966 | 6,805 |
| DRY BASIS | | | | | | |
| Ash | 25.6 | 27.1 | 27.9 | 26.1 | 26.9 | 29.1 |
| Sulphur | 0.20 | - | - | - | 0.31 | 0.42 |
| Btu / lb. | 8,681 | - | - | - | 8,873 | 8,695 |
| DRY, ASH FREE BASIS | | | | | | |
| Btu / lb. | 12,087 | - | - | - | 12,142 | 12,259 |

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. HYDRO

SAMPLE - HAT CREEK - - Bulk Sample W 77 Z

LAB. NO. - 77 - 8073

RAW COAL FRACTIONS - ANALYSIS % - Dry Screen

| Size | ½" x ¼" | ¼" x 1/8" | 1/8" x1/16" | 1/16" x 28M | 28 M x 0 |
|---|---|---|---|---|---|
| Wt. % Head | 12.7 | 10.1 | 4.8 | 2.6 | 2.7 |
| Air Dried Loss | 5.4 | 3.8 | 4.6 | 6.7 | 1.8 |
| Inherent Moisture | 21.1 | 22.0 | 19.0 | 17.5 | 18.0 |
| Total Moisture | 25.4 | 25.0 | 22.7 | 23.0 | 19.5 |
| Ash (Air Dried Basis) | 22.5 | 22.2 | 24.8 | 26.7 | 27.8 |
| Sulphur (Air Dried Basis) | 0.22 | 0.24 | 0.32 | 0.48 | 0.86 |
| Btu / lb.(Air Dried Basis) | 6,696 | 6,638 | 6,648 | 6,600 | 6,479 |
| DRY BASIS | | | | | |
| Ash | 28.5 | 28.5 | 30.6 | 32.4 | 33.9 |
| Sulphur | 0.28 | 0.30 | 0.39 | 0.58 | 1.05 |
| Btu / lb. | 8,484 | 8,510 | 8,207 | 8,001 | 7,901 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 11,872 | 11,896 | 11,829 | 11,829 | 11, 954 |

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. HYDRO

Sample Identification - Hat Creek - Bulk Sample W 77 Z

LAB. NO. - 77 - 8073

## RAW COAL SIZE / ASH DISTRIBUTION

Wet Screen Analysis of ½" x 0

| Size | Wt. % | Dry Ash % | Cum. Wt. % | Cum. Ash % | Wt. % Head |
|---|---|---|---|---|---|
| ½ x ¼ " | 46.9 | 27.2 | 46.9 | 27.2 | 15.4 |
| ¼ x 1/8" | 5.3 | 28.0 | 52.2 | 27.3 | 1.7 |
| 1/8 x 1/16" | 5.1 | 28.2 | 57.3 | 27.4 | 1.7 |
| 1/16 x 28M | 3.8 | 29.6 | 61.1 | 27.5 | 1.3 |
| 28 x 45 M | 3.5 | 28.9 | 64.6 | 27.6 | 1.2 |
| 45 x 65 M | 7.1 | 27.2 | 71.7 | 27.5 | 2.3 |
| 65 x 100 M | 7.1 | 39.8 | 78.8 | 28.6 | 2.3 |
| 100 x 200 M | 10.6 | 38.9 | 89.4 | 29.9 | 3.5 |
| 200 x 0 | 10.6 | 45.3 | 100.0 | 31.5 | 3.5 |
| Total | 100.0 | 31.5 | | | 32.9 |

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Z

LAB. NO. - 77 - 8073

RAW COAL FRACTIONS - ANALYSIS % - Wet Screened

| Size | ½" X ¼" | ¼" X 1/8" | 1/8" x 1/16" | 1/16" x 28M | 28 x 45 M |
|---|---|---|---|---|---|
| Weight (kg.) | 4.35 | 0.49 | 0.47 | 0.35 | 0.010 (SUB) |
| Wt. % Head | 15.4 | 1.7 | 1.7 | 1.3 | 1.2 |
| Moisture (As Run) | 15.7 | 18.5 | 9.4 | 14.2 | 4.7 |
| Ash | 23.0 | 22.8 | 25.6 | 25.4 | 27.6 |
| Sulphur | 0.22 | 0.27 | 0.40 | 0.64 | 0.95 |
| Btu / lb. | 7,319 | 6,972 | 7,702 | 7,228 | 8,032 |
| DRY BASIS | | | | | |
| Ash | 27.2 | 28.0 | 28.2 | 29.6 | 28.9 |
| Sulphur | 0.26 | 0.33 | 0.44 | 0.75 | 1.00 |
| Btu / lb. | 8,679 | 8,552 | 8,500 | 8,420 | 8,431 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 11,924 | 11,878 | 11,838 | 11,961 | 11,862 |

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Z

LAB. NO. - 77 - 8073

RAW COAL FRACTIONS - ANALYSIS % - Wet Screened

| Size | 45 x 65 M | 65 x 100 M | 100 x 200 M | 200 x 0 |
|---|---|---|---|---|
| Weight (kg.) | 0.021 | 0.020 | 0.031 | 0.029 |
| Wt. % Head | 2.3 | 2.3 | 3.5 | 3.5 |
| Moisture (As Run) | 5.2 | 6.7 | 5.5 | 4.9 |
| Ash | 25.8 | 37.1 | 36.8 | 43.1 |
| Sulphur | 1.23 | 0.81 | 0.57 | 0.34 |
| Btu / lb. | 8,110 | 6,556 | 6,680 | 5,529 |
| DRY BASIS | | | | |
| Ash | 27.2 | 39.8 | 38.9 | 45.3 |
| Sulphur | 1.30 | 0.87 | 0.60 | 0.36 |
| Btu / lb. | 8,556 | 7,026 | 7,071 | 5,813 |
| DRY, ASH FREE BASIS | | | | |
| Btu / lb. | 11,764 | 11,672 | 11,573 | 11,098 |

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W - 77 - Z

LAB. NO. - 77 - 8073

ANALYSIS OF CLEAN COAL - 4" x 1 " Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 | 1.80 Sink |
|---|---|---|---|---|---|---|
| Wt. % (Cum.) | 64.5 | 76.8 | 87.9 | 95.9 | 99.1 | 100.0 |
| Wt. (kg.) | 257.4 | 280.2 | 324.6 | 346.3 | 309.5 | |
| As Run | | | | | | |
| Moisture | 21.1 | 21.1 | 20.5 | 18.3 | 18.1 | 5.0 |
| Ash | 13.3 | 15.4 | 18.4 | 20.8 | 21.9 | 68.0 |
| Sulphur | 0.19 | 0.20 | 0.21 | 0.20 | 0.18 | - |
| Btu / lb. | 7,641 | 7,437 | 7,248 | 7,087 | 6,970 | - |
| Dry Basis | | | | | | |
| Ash | 16.8 | 19.5 | 23.2 | 25.5 | 26.7 | 71.6 |
| Sulphur | 0.24 | 0.25 | 0.26 | 0.24 | 0.22 | - |
| Btu / lb. | 9,686 | 9,425 | 9,117 | 8,676 | 8,510 | - |
| Dry, Ash Free Basis | | | | | | |
| Btu / lb. | 11,648 | 11,710 | 11,863 | 11,647 | 11,611 | - |
| Cum. Sink | | | | | | |
| As Run | | | | | | |
| Wt. (kg.) | 141.8 | 84.4 | 44.7 | 14.8 | 2.8 | |
| Wt. % | 35.5 | 23.2 | 12.1 | 4.1 | 0.9 | |
| Moisture | 19.6 | 18.6 | 16.6 | 10.5 | 5.0 | |
| Ash | 37.6 | 42.7 | 45.2 | 56.0 | 68.0 | |
| Dry Basis | | | | | | |
| Ash | 46.8 | 52.4 | 54.3 | 62.5 | 71.6 | |

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W - 77 - Z

LAB. NO. - 77 - 8073

ANALYSIS OF CLEAN COAL - 1" x ½" Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 | 1.80 Sink |
|---|---|---|---|---|---|---|
| Wt. % (Cum.) | 60.8 | 74.1 | 85.8 | 94.5 | 97.8 | 100.0 |
| Wt. (kg.) | 69.6 | 79.3 | 105.5 | 109.2 | 109.3 | - |
| As Run | | | | | | |
| Moisture | 19.8 | 19.5 | 19.2 | 20.1 | 16.8 | 9.6 |
| Ash | 14.6 | 16.0 | 18.6 | 19.9 | 21.8 | 68.5 |
| Sulphur | 0.23 | 0.22 | 0.20 | 0.23 | 0.21 | - |
| Btu / lb. | 7,698 | 7,551 | 7,478 | 7,185 | 7,273 | - |
| Dry Basis | | | | | | |
| Ash | 18.1 | 19.9 | 23.0 | 24.9 | 26.2 | 75.8 |
| Sulphur | 0.29 | 0.27 | 0.25 | 0.29 | 0.25 | - |
| Btu / lb. | 9,592 | 9,375 | 9,260 | 8,997 | 8,737 | - |
| Dry, Ash Free Basis | | | | | | |
| Btu / lb. | 11,717 | 11,705 | 12,025 | 11,980 | 11,838 | - |
| Cum. Sink | | | | | | |
| As Run | | | | | | |
| Wt. (kg.) | 44.9 | 27.8 | 17.5 | 6.4 | 2.5 | |
| Wt. % | 39.2 | 25.9 | 14.2 | 5.5 | 2.2 | |
| Moisture | 9.8 | 8.9 | 10.5 | 8.2 | 9.6 | |
| Ash | 37.4 | 43.8 | 47.0 | 61.2 | 68.5 | |
| Dry Basis | | | | | | |
| Ash | 41.5 | 48.1 | 52.5 | 66.6 | 75.8 | |

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W - 77 - Z

LAB. NO. - 77 - 8073

ANALYSIS OF CLEAN COAL ½" x ¼" Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 | 1.80 Sink |
|---|---|---|---|---|---|---|
| Wt. % (Cum.) | 61.9 | 65.9 | 83.9 | 93.6 | 99.6 | 100.0 |
| Wt. (kg.) | 13.8 | 16.6 | 19.3 | 21.8 | 23.1 | |
| As Run | | | | | | |
| Moisture | 19.3 | 20.9 | 19.7 | 19.8 | 19.9 | 5.1 |
| Ash | 14.2 | 14.2 | 19.1 | 21.3 | 22.9 | 68.9 |
| Sulphur | 0.24 | 0.23 | 0.26 | 0.26 | 0.22 | - |
| Btu / lb. | 7,921 | 7,755 | 7,331 | 7,020 | 6,823 | - |
| Dry Basis | | | | | | |
| Ash | 17.6 | 17.9 | 23.8 | 26.5 | 28.6 | 72.6 |
| Sulphur | 0.30 | 0.29 | 0.32 | 0.32 | 0.27 | - |
| Btu / lb. | 9,816 | 9,800 | 9,134 | 8,750 | 8,518 | - |
| Dry, Ash Free Basis | | | | | | |
| Btu / lb. | 11,915 | 11,937 | 11,981 | 11,904 | 11,930 | - |
| Cum. Sink | | | | | | |
| As Run | | | | | | |
| Wt. (kg.) | 8.5 | 8.6 | 3.7 | 1.5 | 0.1 | |
| Wt. % | 38.1 | 34.1 | 16.1 | 6.4 | 0.4 | |
| Moisture | 16.0 | 14.4 | 14.7 | 9.4 | 5.1 | |
| Ash | 39.5 | 42.7 | 47.5 | 56.3 | 68.9 | |
| Dry Basis | | | | | | |
| Ash | 47.0 | 49.9 | 55.6 | 62.2 | 72.6 | |

Warnock Hersey Professional Services Ltd
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel 276 - 9138

Sample Identification: Hat Creek Bulk Sample Z
Size fraction: + 4"
Lab. No. (s): 77 - 8073
Wt % of head sample: 3.1

FLOAT AND SINK ANALYSIS % FROTH FLOTATION

| Specific Gravity Sink | Specific Gravity Float | WEIGHT (kg.) | Elementary Weight | Elementary Ash | Elementary Sulphur | Cumulative Float Weight | Cumulative Float Ash | Cumulative Float Sulphur | Cumulative Sink Weight | Cumulative Sink Ash | Cumulative Sink Shulphur |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.40 | 130.3 | 67.4 | 17.3 | | 67.4 | 17.3 | | 100.0 | 22.0 | |
| 1.40 | 1.45 | 35.8 | 18.5 | 28.4 | | 85.9 | 19.7 | | 32.6 | 31.8 | |
| 1.45 | 1.50 | 18.7 | 9.7 | 31.8 | | 95.6 | 20.9 | | 14.1 | 36.4 | |
| 1.50 | 1.60 | 8.5 | 4.4 | 46.5 | | 100.0 | 22.0 | | 4.4 | 46.5 | |
| 1.60 | 1.80 | NIL | 0.0 | - | | - | - | | - | - | |
| 1.80 | | NIL | 0.0 | - | | - | - | | - | - | |
| | TOTAL | | 100.0 | 22.0 | | | | | | | |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel. ~~284-9120~~ 276 - 9138

Sample Identification: Hat Creek Bulk Sample Z
Size fraction: 4" x 1"
Lab. No. (s): 77 - 8073
Wt % of head sample: 31.2

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash | Sulphur | Weight | Ash | Sulphur |
| | 1.40 | 64.5 | 16.8 | | 64.5 | 16.8 | | 100.0 | 27.1 | |
| 1.40 | 1.45 | 12.3 | 33.6 | | 76.8 | 19.5 | | 35.5 | 45.7 | |
| 1.45 | 1.50 | 11.1 | 48.8 | | 87.9 | 23.2 | | 23.2 | 52.1 | |
| 1.50 | 1.60 | 8.0 | 51.3 | | 95.9 | 25.5 | | 12.1 | 55.1 | |
| 1.60 | 1.80 | 3.2 | 60.1 | | 99.1 | 26.7 | | 4.1 | 62.6 | |
| 1.80 | | 0.9 | 71.6 | | 100.0 | 27.1 | | 0.9 | 71.6 | |
| | TOTAL | 100.0 | 27.1 | | | | | | | |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel. 276 - 9138

Sample Identification: Hat Creek Sample Z
Size fraction: 1' x ½"
Lab. No. (s): 77 - 8073
Wt % of head sample: 32.8

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash | Sulphur | Weight | Ash | Shulphur |
| | 1.40 | 60.8 | 18.1 | | 60.8 | 18.1 | | 100.0 | 27.3 | |
| 1.40 | 1.45 | 13.3 | 28.1 | | 74.1 | 19.9 | | 39.2 | 41.7 | |
| 1.45 | 1.50 | 11.7 | 42.8 | | 85.8 | 23.0 | | 25.9 | 48.6 | |
| 1.50 | 1.60 | 8.7 | 43.9 | | 94.5 | 24.9 | | 14.2 | 53.4 | |
| 1.60 | 1.80 | 3.3 | 63.7 | | 97.8 | 26.2 | | 5.5 | 68.5 | |
| 1.80 | | 2.2 | 75.8 | | 100.0 | 27.3 | | 2.2 | 75.8 | |
| | TOTAL | 100.0 | 27.3 | | | | | | | |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel ~~264-9120~~ 276 - 9138

Sample Identification: Hat Creek Bulk Sample Z
Size fraction: ½" x ¼"
Lab. No. (s): 77 -8073
Wt % of head sample: 12.7

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash | Sulphur | Weight | Ash | Shulphur |
| | 1.40 | 61.9 | 17.6 | | 61.9 | 17.6 | | 100.0 | 28.8 | |
| 1.40 | 1.45 | 4.0 | 22.5 | | 65.9 | 17.9 | | 38.1 | 46.9 | |
| 1.45 | 1.50 | 18.0 | 45.4 | | 83.9 | 23.8 | | 34.1 | 49.8 | |
| 1.50 | 1.60 | 9.7 | 49.8 | | 93.6 | 26.5 | | 16.1 | 54.7 | |
| 1.60 | 1.80 | 6.0 | 61.4 | | 99.6 | 28.6 | | 6.4 | 62.1 | |
| 1.80 | | 0.4 | 72.6 | | 100.0 | 28.8 | | 0.4 | 72.6 | |
| | TOTAL | 100.0 | 28.8 | | | | | | | |

# Hat Creek Bulk Sample W 77 Z

## Wet Attrition Test and Analysis

## Wet Attrition Test

The test apparatus consisted of a cylindrical drum, fabricated to the Australian Standards AS 1661 1977, with a measured volume of water and known amount of coal, together with steel cubes, the whole being subjected to rotation at a prescribed speed for a measured length of time. On completion of the test, the water was filtered through a specially designed cover made up from ½ mm wedge wire and the attrited coal then subjected to the anlysis as laid down per instructions.

The tumbling time was decided by the Hardgrove Index which was determined prior to the test being carried out. A calibration graph (also in the Australian Standards) was provided.

## Details

Drum – volume capacity – 200 litres
Steel Cubes – 18 each edge 50 mm
Speed – 20 R.P. M.
Amount coal used – 50 kgm.
Water volume – 150 litres

In practice, during early commissioning of the drum, the wedge wire screen was not used as a filter, the drum was allowed to stand for a short while until settlement had taken place and the water decanted off – this shortened the time slightly and this water was collected and used for the subsequent wet screening.

We have in hand a slight alteration to the driving mechanism in so far as an additional crank, which will enable the drum to be slowly turned by hand in order to facilitate emptying.

Determined Hardgrove Indexes

| "X" | "Y" | "Z" |
|---|---|---|
| 53.9 | 49.7 | 56.7 |

The tumbling times from the calibration graph fall under the lowest point of the curve. However, in order to comply with the instructions issued by Simon Carves the tumbling times used were 30 seconds in all three cases.

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Z

LAB. NO. - 77 - 8073

## RAW COAL SIZE / ASH DISTRIBUTION

Wet Screen Analysis After Wet Attrition

| Size | Wt.% | Dry Ash % | Cum. Wt. % | Cum. Ash % | Weight (kg.) |
|---|---|---|---|---|---|
| 4" x ½" | 26.5 | 21.0 | 26.5 | 21.0 | 11.45 |
| ½" x ¼" | 22.4 | 27.6 | 48.9 | 24.0 | 9.65 |
| ¼" x 1/8" | 27.2 | 31.2 | 76.1 | 26.6 | 11.70 |
| 1/8" x 1/16" | 9.5 | 30.9 | 85.6 | 27.1 | 4.10 |
| 1/16" x 28 M | 4.5 | 31.7 | 90.1 | 27.3 | 1.95 |
| 28 x 45 M | 1.2 | 29.1 | 91.3 | 27.3 | 0.047 |
| 45 x 65 M | 0.6 | 32.7 | 91.9 | 27.4 | 0.024 |
| 65 x 100 M | 0.1 | 35.5 | 92.0 | 27.4 | 0.002 |
| 100 x 200 M | 3.7 | 34.4 | 95.7 | 27.6 | 1.59 |
| 200 M x 0 | 4.3 | 52.4 | 100.0 | 28.7 | 1.85 |
| Total | 100.0 | 28.7 | | | 42.363 |

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Z

LAB. NO. - 77 - 8073

RAW COAL FRACTIONS - ANALYSIS % - After Wet Attrition

| Size | 4 " x 0 | 4 " x ½ " | ½" x ¼ " | ¼ " x 28 M | ¼ " x 0 |
|---|---|---|---|---|---|
| Weight (kg.) | - | 11.45 | 9.65 | - | - |
| Wt. % Head | 96.9 | 26.5 | 22.4 | 41.2 | 51.1 |
| Moisture (As Run) | 7.2 | 5.6 | 2.0 | 9.0 | 7.9 |
| Ash | 26.6 | 19.9 | 27.0 | 28.4 | 30.6 |
| Sulphur | 0.31 | 0.25 | 0.23 | 0.25 | 0.32 |
| Btu / lb. | 7,863 | 9,011 | 8,452 | 7,508 | 7,434 |
| DRY BASIS | | | | | |
| Ash | 28.7 | 21.0 | 27.6 | 31.2 | 33.2 |
| Sulphur | 0.33 | 0.26 | 0.24 | 0.27 | 0.35 |
| Btu / lb. | 8,473 | 9,551 | 8,624 | 8,254 | 8,072 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 11,878 | 12,097 | 11,904 | 11,997 | 12,088 |

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Z

LAB. NO. - 77 - 8073

RAW COAL FRACTIONS - ANALYSIS % - After Wet Attrition

| Size | ¼" x 1/8" | 1/8" x 1/16" | 1/16" x 28M | 28 M x 45 M | 45 x 65 M |
|---|---|---|---|---|---|
| Weight (kg.) | 11.70 | 4.10 | 1.95 | 0.047 | 0.024 |
| Wt. % Head | 27.2 | 9.5 | 4.5 | 1.2 | 0.6 |
| Moisture (As Run) | 11.9 | 5.0 | 3.3 | 2.8 | 11.5 |
| Ash | 27.5 | 29.3 | 30.6 | 28.4 | 29.0 |
| Sulphur | 0.24 | 0.23 | 0.39 | 0.54 | 0.70 |
| Btu / lb. | 7,276 | 7,737 | 7,734 | 8,203 | 7,605 |
| DRY BASIS | | | | | |
| Ash | 31.2 | 30.9 | 31.7 | 29.1 | 32.7 |
| Sulphur | 0.27 | 0.24 | 0.40 | 0.56 | 0.79 |
| Btu / lb. | 8,255 | 8,142 | 8,000 | 8,443 | 8,596 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 12,000 | 11,778 | 11,711 | 11,902 | 12,779 |

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Z

LAB. NO. - 77 - 8073

RAW COAL FRACTIONS - ANALYSIS % - After Wet Attrition

| Size | 65 x 100 M | 100 x 200 M | 200 M x 0 | 28 x 100 M |
|---|---|---|---|---|
| Weight (kg.) | 0.002 | 1.59 | 1.85 | - |
| Wt. % Head | 0.1 | 3.7 | 4.3 | 1.9 |
| Moisture (As Run) | I.S. | 3.1 | 1.6 | 5.7 |
| Ash | - | 33.3 | 51.6 | 30.0 |
| Sulphur | I.S. | 1.12 | 0.42 | 0.58 |
| Btu / lb. | I.S. | 7,478 | 4,799 | 7,836 |
| DRY BASIS | | | | |
| Ash | 35.5 | 34.4 | 52.4 | 31.8 |
| Sulphur | - | 1.16 | 0.43 | 0.61 |
| Btu / lb. | - | 7,720 | 4,876 | 8,313 |
| DRY, ASH FREE BASIS | | | | |
| Btu / lb. | - | 11,773 | 10,254 | 12,188 |

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Z

LAB. NO. - 77 - 8073 After Wet Attrition

ANALYSIS OF CLEAN COAL ½" x ¼" Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 |
|---|---|---|---|---|---|
| Wt. % (Cum.) | 43.9 | 58.3 | 65.5 | 75.0 | 91.2 |
| Wt. (kg.) | 0.82 | 1.05 | 1.33 | 1.35 | 1.55 |
| As Run | | | | | |
| Moisture | 3.8 | 2.8 | 5.2 | 3.3 | 4.0 |
| Ash | 10.9 | 13.6 | 14.7 | 17.1 | 21.4 |
| Sulphur | 0.22 | 0.26 | 0.31 | 0.22 | 0.21 |
| Btu / lb. | 10,361 | 10,114 | 9,563 | 9,263 | 8,678 |
| Dry Basis | | | | | |
| Ash | 11.3 | 14.0 | 15.5 | 17.7 | 22.3 |
| Sulphur | 0.23 | 0.27 | 0.33 | 0.23 | 0.22 |
| Btu / lb. | 10,769 | 10,403 | 10,083 | 9,582 | 9,038 |
| Dry, Ash Free Basis | | | | | |
| Btu / lb. | 12,139 | 12,102 | 11,936 | 11,782 | 11,636 |
| Cum. Sink | | | | | |
| As Run | | | | | |
| Wt. (kg.) | 1.05 | 0.75 | 0.70 | 0.45 | 0.15 |
| Wt. % | 56.1 | 41.7 | 34.5 | 25.0 | 8.8 |
| Moisture | 2.6 | 2.7 | 2.7 | 2.8 | 2.1 |
| Ash | 35.5 | 40.4 | 41.8 | 48.1 | 57.1 |
| Sulphur | 0.16 | 0.22 | 0.20 | 0.15 | 0.16 |
| Btu / lb. | 7,054 | 6,355 | 6,136 | 5,185 | 3,855 |
| Dry Basis | | | | | |
| Ash | 36.5 | 41.6 | 43.0 | 49.5 | 58.3 |
| Sulphur | 0.16 | 0.23 | 0.21 | 0.15 | 0.16 |
| Btu / lb. | 7,242 | 6,531 | 6,309 | 5,332 | 3,937 |

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Z

LAB. NO. - 77 - 8073 After Wet Attrition

ANALYSIS OF CLEAN COAL ¼ " x 28 M Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 |
|---|---|---|---|---|---|
| Wt. % (Cum.) | 19.8 | 28.2 | 37.8 | 56.5 | 81.5 |
| Wt. (kg.) | 0.542 | 0.875 | 1.275 | 1.700 | 2.910 |
| As Run | | | | | |
| Moisture | 2.8 | 3.2 | 3.3 | 3.4 | 6.0 |
| Ash | 5.9 | 8.2 | 10.9 | 15.4 | 20.0 |
| Sulphur | 0.31 | 0.35 | 0.38 | 0.28 | 0.31 |
| Btu / lb. | 11,074 | 10,629 | 10,176 | 9,403 | 8,269 |
| Dry Basis | | | | | |
| Ash | 6.1 | 8.5 | 11.2 | 16.0 | 21.3 |
| Sulphur | 0.32 | 0.36 | 0.39 | 0.29 | 0.33 |
| Btu / lb. | 11,393 | 10,978 | 10,520 | 9,734 | 8,792 |
| Dry, Ash Free Basis | | | | | |
| Btu / lb. | 12,133 | 11,997 | 11,850 | 11,584 | 11,174 |
| Cum. Sink | | | | | |
| As Run | | | | | |
| Wt. (kg.) | 2.200 | 2.225 | 2.095 | 1.310 | 0.660 |
| Wt. % | 80.2 | 71.8 | 62.2 | 43.5 | 18.5 |
| Moisture | 3.0 | 4.3 | 4.6 | 3.3 | 1.7 |
| Ash | 33.9 | 35.7 | 37.9 | 44.1 | 61.0 |
| Sulphur | 0.21 | 0.20 | 0.19 | 0.23 | 0.18 |
| Btu / lb. | 7,096 | 6,781 | 6,368 | 5,409 | 4,287 |
| Dry Basis | | | | | |
| Ash | 35.0 | 37.3 | 39.2 | 45.6 | 62.1 |
| Sulphur | 0.22 | 0.21 | 0.20 | 0.24 | 0.18 |
| Btu / lb. | 7,317 | 7,088 | 6,677 | 5,592 | 4,363 |

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Z

LAB. NO. - 77 - 8073 After Wet Attrition

ANALYSIS OF CLEAN COAL 28 x 100 M. Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 |
|---|---|---|---|---|---|
| Wt. % (Cum.) | 21.5 | 27.8 | 31.5 | 44.6 | 61.5 |
| Wt. (gm.) | 29 | 39 | 51 | 83 | 96 |
| As Run | | | | | |
| Moisture | 2.4 | 2.5 | 1.3 | 1.4 | 2.1 |
| Ash | 6.2 | 7.3 | 8.8 | 12.3 | 17.7 |
| Sulphur | 0.30 | 0.30 | 0.27 | 0.27 | 0.34 |
| Btu / lb. | 11,969 | 11,609 | 11,350 | 10,601 | 9,492 |
| Dry Basis | | | | | |
| Ash | 6.4 | 7.5 | 9.0 | 12.5 | 18.1 |
| Sulphur | 0.31 | 0.31 | 0.27 | 0.27 | 0.35 |
| Btu / lb. | 12,266 | 11,909 | 11,504 | 10,753 | 9,695 |
| Dry, Ash Free Basis | | | | | |
| Btu / lb. | 13,099 | 12,875 | 12,636 | 12,288 | 11,838 |
| Cum. Sink | | | | | |
| As Run | | | | | |
| Wt. (gm.) | 106 | 101 | 111 | 103 | 60 |
| Wt. % | 78.5 | 72.2 | 68.5 | 55.4 | 38.5 |
| Moisture | 2.0 | 1.3 | 1.2 | 1.4 | 1.6 |
| Ash | 33.7 | 36.2 | 37.6 | 42.5 | 46.1 |
| Sulphur | 0.35 | 0.38 | 0.48 | 0.77 | 0.90 |
| Btu / lb. | 7,927 | 7,569 | 7,102 | 6,259 | 5,714 |
| Dry Basis | | | | | |
| Ash | 34.4 | 36.7 | 38.1 | 43.1 | 46.9 |
| Sulphur | 0.36 | 0.38 | 0.49 | 0.78 | 0.92 |
| Btu / lb. | 8,093 | 7,669 | 7,189 | 6,350 | 5,808 |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel 276 - 9138

Sample Identification: Hat Creek Bulk Sample W 77 Z
Size fraction: ½" × ¼"
Lab. No. (s): 77 - 8073 After Wet Attrition
Wt % of head sample: 22.4

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash | Sulphur | Weight | Ash | Sulphur |
| | | | | | | Dry | | | | |
| | 1.40 | 43.9 | 11.3 | | 43.9 | 11.3 | | 100.0 | 25.5 | |
| 1.40 | 1.45 | 14.4 | 22.2 | | 58.3 | 14.0 | | 56.1 | 36.5 | |
| 1.45 | 1.50 | 7.2 | 27.6 | | 65.5 | 15.5 | | 41.7 | 41.5 | |
| 1.50 | 1.60 | 9.5 | 32.9 | | 75.0 | 17.7 | | 34.5 | 44.4 | |
| 1.60 | 1.80 | 16.2 | 43.6 | | 91.2 | 22.3 | | 25.0 | 48.8 | |
| 1.80 | | 8.8 | 58.3 | | 100.0 | 25.5 | | 8.8 | 58.3 | |
| TOTAL | | 100.0 | 25.5 | | | | | | | |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel. ~~264-9120~~ 276 - 9138

Sample Identification: Hat Creek Bulk Sample W 77 Z
Size fraction: ¼ " x 28 M
Lab. No. (s): 77 - 8073 After Wet Attrition
Wt % of head sample: 41.2

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash | Sulphur | Weight | Ash | ~~Sulphur~~ |
| | | | | | | Dry | | | | |
| | 1.40 | 19.8 | 6.1 | | 19.8 | 6.1 | | 100.0 | 28.8 | |
| 1.40 | 1.45 | 8.4 | 14.2 | | 28.2 | 8.5 | | 80.2 | 34.5 | |
| 1.45 | 1.50 | 9.6 | 19.1 | | 37.8 | 11.2 | | 71.8 | 36.3 | |
| 1.50 | 1.60 | 18.7 | 25.7 | | 56.5 | 16.0 | | 62.2 | 39.6 | |
| 1.60 | 1.80 | 25.0 | 33.3 | | 81.5 | 21.3 | | 43.5 | 45.5 | |
| 1.80 | | 18.5 | 62.1 | | 100.0 | 28.8 | | 18.5 | 62.1 | |
| TOTAL | | 100.0 | 28.8 | | | | | | | |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel ~~264-9120~~ 276 - 9138

Sample Identification: Hat Creek Bulk Sample W 77 Z
Size fraction: 28 M x 100
Lab. No. (s): 77 - 8073 After Wet Attrition
Wt % of head sample: 1.9

| Specific Gravity Sink | Specific Gravity Float | FLOAT AND SINK ANALYSIS % Elementary Weight | Elementary Ash | Elementary Sulphur | Cumulative Float Weight | Cumulative Float Ash (Dry) | Cumulative Float Sulphur | Cumulative Sink Weight | Cumulative Sink Ash | Cumulative Sink ~~Sulphur~~ |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.40 | 21.5 | 6.4 | | 21.5 | 6.4 | | 100.0 | 29.2 | |
| 1.40 | 1.45 | 6.3 | 11.2 | | 27.8 | 7.5 | | 78.5 | 35.4 | |
| 1.45 | 1.50 | 3.7 | 20.3 | | 31.5 | 9.0 | | 72.2 | 37.5 | |
| 1.50 | 1.60 | 13.1 | 20.9 | | 44.6 | 12.5 | | 68.5 | 38.5 | |
| 1.60 | 1.80 | 16.9 | 32.9 | | 61.5 | 18.1 | | 55.4 | 42.6 | |
| 1.80 | | 38.5 | 46.9 | | 100.0 | 29.2 | | 38.5 | 46.9 | |
| TOTAL | | 100.0 | 29.2 | | | | | | | |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel 276 - 9138

SECTION 6

ANALYSIS OF SAMPLE W77Y

Report of Analysis of

Hat Creek Bulk Sample W 77 Y

Includes Wet Attrition

PART II. "Y" only

Submitted,

John Kay, C. Eng., M. Inst. F.
Manager of Laboratory

## Introduction

The Hat Creek Project took the form of a work program to the instructions of Simon Carves of Canada.

This was to examine, using the Warnock Hersey Professional Services Laboratory at Calgary, Canada, the physical properties of the three samples.

This analysis took the form of grading, float & sink characteristics, proximate analysis.

Also included was a scheme whereby the breakdown of the coal / clay could be measured using a Wet Attrition drum constructed to, and complying with, the standards of the Australian Method AS 1161 1977 p. 42/3.

Description of Samples and Methods Used

One sample marked "Z" which was derived from trench "Z" weighing 11115 kgms. packed into 73 steel drums was delivered to Calgary on August 11, 1977. On opening these drums, it was immediately noticeable that polythene liners had not been used. A separate moisture sample was not delivered.

The methods used to obtain these samples were outside the terms of reference to Warnock Hersey Professional Services Ltd.

After air drying the coals very few lumps of clay were to be seen and even after separting the + 4 " material the amounts of pure clay was very small. Discrete inorganic material could be seen occluded in the clay, and when samples were placed in water, the coal could be seen to separate according to the clay content. High coal content pieces would stay in their original shape, but low coal content pieces, i.e. due to larger amounts of clay occlusions, broke up rapidly and became a slurry. After filtering, it was possible to settle the dispersion easily and a clear supernatent could be decanted.

Grading, using a Gilson mechanical sieving apparatus to separate the fractions, and Float & Sink analysis, in organic solutions at prescribed gravities were used to separate the coals further. Drying on down draught benches was followed by preparation of samples for analysis. Riffling was accomplished by means of a manual riffle.

The Flow sheet was supplied by Simon Carves and this was generally adhered to except some shale analysis had to be added, and moisture contents prior to analysis had also to be added to the flow sheets. All three samples were treated in the same way. The weights and % weights are also reported. In some cases a very small fractional weight resulted, but the test was completed noting this. A Float & Sink test on the + 4 " was carried out on "X" and "Z" samples only - "Y" did not produce a fraction at + 4 ". Since separate moisture samples were not received, air drying followed by loss in weight at 107 $^{o}$ techniques were used to determine total moisture.

During the processing of sample "Z" a Simon Carves representative was present in the lab and again during some of the later stages only.

No Ash Examination was requested.

A mechanical type of wet screening apparatus was not available, so careful control over water supplies and hand manipulation had to be used to separate the fines into respective size fractions. It was found that "conditioning" i.e. soaking in water prior to screening ensured the best separation and each sample was subjected to 10 minutes in water before screening.

Reference to the flow sheet will show a reserve sample was requested after the initial grading at + 4 " – this amounted to:

3,360 kgms. for "X"

13,000 kgms. for "Y"

800 kgms. for "Z"

Further requests from the flow sheet asked for hand selecting to be used for "bright, dull clay and rock". In practice this was less than feasible since we found agglomerates of these materials with coal and a reduction in particle size would have accompanied any mechanical breakage. The Simon Carves representative was present during this operation and was in agreement with what was done.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

## RAW COAL SIZE / ASH DISTRIBUTION

| | WT. % | | DRY ASH % | | CUM. WT. % | CUM. ASH % | WEIGHT (kg.) | |
|---|---|---|---|---|---|---|---|---|
| + 4 " | 0.4 | | 14.4 | | 0.4 | 14.4 | 26.1 | |
| 4 " x 2 " | 1.4 | | 17.8 | | 1.8 | 17.0 | 88.6 | |
| 2" x 1 " | 19.4 | | 32.7 | | 21.2 | 31.4 | 1216.0 | |
| 1 " x ½ " | 27.3 | | 38.5 | | 48.5 | 35.4 | 1706.8 | |
| ½ " x ¼ " | 19.2 | | 44.4 | | 67.7 | 37.9 | 214.5 | (SUB) |
| ¼" x 1/8" | 15.1 | .47 | 45.5 | 21.39 | 82.8 | 39.3 | 34.0 | (SUB) |
| 1/8" x 1/16" | 6.3 | .20 | 51.1 | 10.22 | 89.1 | 40.2 | 13.8 | (SUB) |
| 1/16" x 28 M | 5.0 | .15 | 55.5 | 8.33 | 94.1 | 41.0 | 10.7 | (SUB) |
| 28 M x 0 | 5.9 | .18 | 60.0 | 10.8 | 100.0 | 42.1 | 12.7 | |
| | | | | 50.74 | | | | |
| Total | 100.0 | | 42.1 | | | | | |

* No Clay + 4 "

* Insufficient + 4 " Coal for F/S

CLIENT - B.C. HYDRO

SAMPLE - HAT CREEK - Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

RAW COAL FRACTIONS - ANALYSIS % - Dry Screened

| Size | + 4" | 4" x 2" | 2" x 1" | 1" x ½" | 4" x 0 | ½" x 0 |
|---|---|---|---|---|---|---|
| Wt. % Head | 0.4 | 1.4 | 19.4 | 27.3 | 99.6 | 51.5 |
| Air Dried Loss | 8.1 | 5.0 | 4.4 | 3.0 | 2.6 | 10.0 |
| Inherent Moisture | 20.1 | 16.1 | 15.5 | 16.0 | 14.2 | 9.9 |
| Total Moisture | 26.6 | 20.3 | 19.2 | 18.5 | 16.4 | 18.9 |
| Ash (Air Dried) | 11.5 | 15.0 | 27.6 | 32.3 | 36.3 | 44.8 |
| Sulphur (Air Dried) | 0.59 | 0.87 | 0.87 | 0.75 | 0.75 | 0.93 |
| Btu / lb. (Air Dried) | 8,336 | 8,391 | 6,735 | 6,099 | 5,687 | 4,940 |
| DRY BASIS | | | | | | |
| Ash | 14.4 | 17.8 | 32.7 | 38.5 | 42.3 | 49.3 |
| Sulphur | 0.74 | 1.04 | 1.03 | 0.89 | 0.87 | 1.03 |
| Btu / lb. | 10,432 | 9,996 | 7,974 | 7,263 | 6,629 | 5,485 |
| DRY, ASH FREE BASIS | | | | | | |
| Btu / lb. | 12,185 | 12,163 | 11,849 | 11,811 | 11,494 | 10,926 |

CLIENT - B.C. HYDRO

SAMPLE - HAT CREEK - Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

RAW COAL FRACTIONS - ANALYSIS % - Dry Screened

| Size | ½" x ¼" | ¼" x 1/8" | 1/8" x 1/16" | 1/16" x 28M | 28 M x 0 |
|---|---|---|---|---|---|
| Wt. % Head | 19.2 | 15.1 | 6.3 | 5.0 | 5.9 |
| Air Dried Loss | 5.0 | 4.1 | 5.8 | 6.6 | 5.5 |
| Inherent Moisture | 15.5 | 16.1 | 13.9 | 13.4 | 13.2 |
| Total Moisture | 19.7 | 19.5 | 18.9 | 19.2 | 18.0 |
| Ash (Air Dried) | 37.5 | 38.2 | 44.0 | 48.0 | 52.1 |
| Sulphur (Air Dried) | 0.79 | 0.73 | 0.81 | 0.95 | 1.05 |
| Btu / lb. (Air Dried) | 5,345 | 5,190 | 4,570 | 3,962 | 3,259 |
| DRY BASIS | | | | | |
| Ash | 44.4 | 45.5 | 51.1 | 55.5 | 60.0 |
| Sulphur | 0.93 | 0.87 | 0.94 | 1.10 | 1.21 |
| Btu / lb. | 6,322 | 6,187 | 5,308 | 4,573 | 3,753 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 11,363 | 11,347 | 10,863 | 10,270 | 9,389 |

CLIENT - B. C. Hydro

Sample Identification - Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

## RAW COAL SIZE / ASH DISTRIBUTION

Wet Screen Analysis of ½ " x 0

| Size | Wt. % | Dry Ash % | Cum. Wt. % | Cum. Ash % | Wt. % Head |
|---|---|---|---|---|---|
| ½ " x ¼ " | 21.0 | 29.1 | 21.0 | 29.1 | 10.8 |
| ¼ " x 1/8 " | 22.5 | 42.0 | 43.5 | 35.8 | 11.6 |
| 1/8 " x 1/16" | 9.2 | 51.8 | 52.7 | 38.6 | 4.7 |
| 1/16 " x 28 M | 7.0 | 54.4 | 59.7 | 40.4 | 3.6 |
| 28 x 45 M | 1.3 | 56.2 | 61.0 | 40.8 | 0.7 |
| 45 x 65 M | 3.9 | 56.5 | 64.9 | 41.7 | 2.0 |
| 65 x 100 M | 2.6 | 60.9 | 67.5 | 42.4 | 1.3 |
| 100 x 200 M | 14.3 | 62.6 | 81.8 | 46.0 | 7.4 |
| 200 x 0 | 18.2 | 68.2 | 100.0 | 50.0 | 9.4 |
| Total | 100.0 | 50.0 | | | 51.5 |

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

RAW COAL FRACTIONS - ANALYSIS % - Wet Screened

| Size | ½" x ¼" | ¼" x 1/8" | 1/8" x 1/16" | 1/16" x 28 M | 28 x 45 M |
|---|---|---|---|---|---|
| Weight (kg.) | 2.05 | 2.20 | 0.90 | 0.69 | 0.010 (SUB) |
| Wt. % Head | 10.8 | 11.6 | 4.7 | 3.6 | 0.7 |
| Moisture (As Run) | 12.4 | 13.8 | 6.6 | 6.9 | 5.8 |
| Ash | 25.5 | 36.2 | 48.4 | 50.6 | 53.0 |
| Sulphur | 0.74 | 0.77 | 0.92 | 1.05 | 1.12 |
| Btu / lb. | 7,294 | 5,734 | 4,751 | 4,322 | 3,988 |
| DRY BASIS | | | | | |
| Ash | 29.1 | 42.0 | 51.8 | 54.4 | 56.2 |
| Sulphur | 0.84 | 0.89 | 0.98 | 1.16 | 1.19 |
| Btu / lb. | 8,331 | 6,656 | 5,085 | 4,644 | 4,232 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 11,750 | 11,475 | 10,551 | 10,184 | 9,663 |

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

RAW COAL FRACTIONS - ANALYSIS % - Wet Screened

| Size | 45 x 65 M | 65 x 100 M | 100 x 200 M | 200 M x 0 |
|---|---|---|---|---|
| Weight (kg.) | 0.030 | 0.020 | 0.110 | 0.140 |
| Wt. % Head | 2.0 | 1.3 | 7.4 | 9.4 |
| Moisture (As Run) | 6.0 | 6.2 | 5.4 | 5.1 |
| Ash | 53.1 | 57.1 | 59.2 | 64.7 |
| Sulphur | 1.15 | 0.87 | 0.82 | 0.71 |
| Btu / lb. | 3,737 | 3,247 | 2,868 | n.d. |
| DRY BASIS | | | | |
| Ash | 56.5 | 60.9 | 62.6 | 68.2 |
| Sulphur | 1.22 | 0.93 | 0.87 | 0.75 |
| Btu / lb. | 3,975 | 3,461 | 3,031 | - |
| DRY, ASH FREE BASIS | | | | |
| Btu / lb. | 9,137 | 8,853 | 8,111 | - |

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

ANALYSIS OF CLEAN COAL 4" x ½" Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 | 1.80 Sink |
|---|---|---|---|---|---|---|
| Wt. % (Cum.) | 41.5 | 54.3 | 62.5 | 72.2 | 81.1 | 100.0 |
| Wt. (kg.) | 66.7 | 88.4 | 113.3 | 110.0 | 121.7 | |
| As Run | | | | | | |
| Moisture | 18.9 | 18.0 | 18.2 | 15.7 | 14.9 | 8.2 |
| Ash | 9.8 | 11.7 | 13.1 | 16.9 | 21.3 | 73.2 |
| Sulphur | 0.65 | 0.76 | 0.86 | 0.97 | 0.94 | 0.28 |
| Btu / lb. | 8,708 | 8,521 | 8,333 | 8,131 | 7,699 | - |
| Dry Basis | | | | | | |
| Ash | 12.1 | 14.2 | 16.0 | 20.0 | 25.0 | 79.7 |
| Sulphur | 0.80 | 0.93 | 1.05 | 1.15 | 1.10 | 0.30 |
| Btu / lb. | 10,732 | 10,396 | 10,190 | 9,646 | 9,043 | - |
| Dry, Ash Free Basis | | | | | | |
| Btu / lb. | 12,215 | 12,123 | 12,130 | 12,058 | 12,054 | - |
| Cum. Sink | | | | | | |
| As Run | | | | | | |
| Wt. (kg.) | 94.2 | 74.3 | 68.0 | 42.3 | 28.3 | - |
| Wt. % | 58.5 | 45.7 | 37.5 | 27.8 | 18.9 | - |
| Moisture | 12.5 | 12.2 | 11.6 | 11.0 | 8.2 | - |
| Ash | 45.6 | 52.8 | 60.3 | 67.2 | 73.2 | - |
| Sulphur | 0.83 | 0.63 | 0.52 | 0.35 | 0.28 | - |
| Dry Basis | | | | | | |
| Ash | 52.1 | 60.2 | 68.3 | 75.4 | 79.7 | - |
| Sulphur | 0.95 | 0.72 | 0.59 | 0.39 | 0.30 | - |

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

ANALYSIS OF CLEAN COAL ½" X ¼" Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 | 1.80 Sink |
|---|---|---|---|---|---|---|
| Wt. % (Cum.) | 30.1 | 40.4 | 46.2 | 55.6 | 71.9 | - |
| Wt. (kg.) | 8.7 | 13.8 | 15.9 | 21.3 | 22.8 | - |
| As Run | | | | | | |
| Moisture | 16.3 | 16.3 | 17.0 | 17.2 | 15.8 | 12.2 |
| Ash | 9.1 | 11.5 | 12.9 | 16.5 | 23.8 | 74.9 |
| Sulphur | 0.71 | 0.83 | 0.91 | 0.95 | 0.89 | 0.37 |
| Btu / lb. | 9,129 | 8,913 | 8,560 | 8,115 | 7,235 | - |
| Dry Basis | | | | | | |
| Ash | 10.9 | 13.7 | 15.6 | 19.9 | 28.3 | 85.3 |
| Sulphur | 0.85 | 0.99 | 1.10 | 1.15 | 1.06 | 0.42 |
| Btu / lb. | 10,902 | 10,651 | 10,307 | 9,807 | 8,598 | - |
| Dry, Ash Free Basis | | | | | | |
| Btu / lb. | 12,231 | 12,195 | 12,206 | 12,141 | 11,986 | - |
| Cum. Sink | | | | | | |
| As Run | | | | | | |
| Wt. (kg.) | 20.2 | 20.4 | 18.5 | 17.0 | 8.9 | - |
| Wt. % | 69.9 | 59.6 | 53.8 | 44.4 | 28.1 | - |
| Moisture | 15.7 | 15.2 | 15.6 | 14.4 | 12.2 | - |
| Ash | 49.2 | 54.9 | 58.6 | 64.1 | 74.9 | - |
| Sulphur | 0.71 | 0.55 | 0.50 | 0.38 | 0.37 | - |
| Dry Basis | | | | | | |
| Ash | 58.4 | 64.8 | 69.4 | 74.9 | 85.3 | - |
| Sulphur | 0.84 | 0.65 | 0.59 | 0.44 | 0.42 | - |

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Sample Identification Hat Creek Bulk Sample W 77 Y  Size fraction 4" x ½"

Lab. No. (s) 77 – 9015  Wt % of head sample 48.1

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | ~~Sulphur~~ | Weight | Ash | ~~Sulphur~~ | Weight | Ash | ~~Sulphur~~ |
| | 1.40 | 41.5 | 12.1 | | 41.5 | 12.1 | | 100.0 | 35.3 | |
| 1.40 | 1.45 | 12.8 | 21.0 | | 54.3 | 14.2 | | 58.5 | 51.8 | |
| 1.45 | 1.50 | 8.2 | 27.9 | | 62.5 | 16.0 | | 45.7 | 60.5 | |
| 1.50 | 1.60 | 9.7 | 45.8 | | 72.2 | 20.0 | | 37.5 | 67.6 | |
| 1.60 | 1.80 | 8.9 | 65.6 | | 81.1 | 25.0 | | 27.8 | 75.2 | |
| 1.80 | | 18.9 | 79.7 | | 100.0 | 35.3 | | 18.9 | 79.7 | |
| | TOTAL | 100.0 | 35.3 | | | | | | | |

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Sample Identification: Hat Creek Bulk Sample W 77 Y
Size fraction: ½" x ¼"
Lab. No. (s): 77 - 9015
Wt % of head sample: 19.2

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash | Sulphur | Weight | Ash | Shulphur |
| | 1.40 | 30.1 | 10.9 | | 30.1 | 10.9 | | 100.0 | 44.3 | |
| 1.40 | 1.45 | 10.3 | 21.9 | | 40.4 | 13.7 | | 69.9 | 58.7 | |
| 1.45 | 1.50 | 5.8 | 28.8 | | 46.2 | 15.6 | | 59.6 | 65.1 | |
| 1.50 | 1.60 | 9.4 | 41.0 | | 55.6 | 19.9 | | 53.8 | 69.0 | |
| 1.60 | 1.80 | 16.3 | 57.0 | | 71.9 | 28.3 | | 44.4 | 74.9 | |
| 1.80 | | 28.1 | 85.3 | | 100.0 | 44.3 | | 28.1 | 85.3 | |
| | TOTAL - | 100.0 | 44.3 | | | | | | | |

# Hat Creek Bulk Sample W 77 Y

## Wet Attrition Test and Analysis

## Wet Attrition Test

The test apparatus consisted of a cylindrical drum, fabricated to the Australian Standards AS 1661 1977, with a measured volume of water and known amount of coal, together with steel cubes, the whole being subjected to rotation at a prescribed speed for a measured length of time. On completion of the test, the water was filtered through a specially designed cover made up from ½ mm wedge wire and the attrited coal then subjected to the anlysis as laid down per instructions.

The tumbling time was decided by the Hardgrove Index which was determined prior to the test being carried out. A calibration graph (also in the Australian Standards) was provided.

## Details

Drum - volume capacity - 200 litres
Steel Cubes - 18 each edge 50 mm
Speed - 20 R.P. M.
Amount coal used - 50 kgm.
Water volume - 150 litres

In practice, during early commissioning of the drum, the wedge wire screen was not used as a filter, the drum was allowed to stand for a short while until settlement had taken place and the water decanted off - this shortened the time slightly and this water was collected and used for the subsequent wet screening.

We have in hand a slight alteration to the driving mechanism in so far as an additional crank, which will enable the drum to be slowly turned by hand in order to facilitate emptying.

Determined Hardgrove Indexes

| "X" | "Y" | "Z" |
|---|---|---|
| 53.9 | 49.7 | 56.7 |

The tumbling times from the calibration graph fall under the lowest point of the curve. However, in order to comply with the instructions issued by Simon Carves the tumbling times used were 30 seconds in all three cases.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

## RAW COAL SIZE / ASH DISTRIBUTION

Wet Screen Analysis After Wet Attrition

| Size | Wt.% | Dry Ash % | Cum. Wt. % | Cum. Ash % | Weight (kg.) |
|---|---|---|---|---|---|
| 4" x ½" | 9.1 | 18.7 | 9.1 | 18.7 | 4.03 |
| ½" x ¼" | 8.8 | 17.3 | 17.9 | 18.0 | 3.89 |
| ¼" x 1/8" | 15.8 | 20.7 | 33.7 | 19.3 | 7.00 |
| 1/8" x 1/16" | 12.0 | 30.1 | 45.7 | 22.1 | 5.30 |
| 1/16" x 28 M | 11.1 | 44.6 | 56.8 | 26.5 | 4.93 |
| 28 x 45 M | 5.8 | 54.2 | 62.6 | 29.1 | 0.164 (Sub) |
| 45 x 65 M | 5.3 | 62.8 | 67.9 | 31.7 | 0.152 (Sub) |
| 65 x 100 M | 2.0 | 64.0 | 69.9 | 32.6 | 0.058 (Sub) |
| 100 x 200 M | 3.7 | 61.2 | 73.6 | 34.1 | 0.77 |
| 200 M x 0 | 26.4 | 76.2 | 100.0 | 45.2 | 5.43 |
| Total | 100.0 | 45.2 | | | |

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W77 Y

LAB. NO. - 77 - 9015

## RAW COAL FRACTIONS - ANALYSIS % - After Wet Attrition

| Size | 4" x 0 | 4" x ½" | ½" x ¼" | ¼" x 28M | ¼" x 0 |
|---|---|---|---|---|---|
| Weight (kg.) | - | 4.0 | 3.9 | - | - |
| Wt. % Head | 99.6 | 9.1 | 8.8 | 38.9 | 82.1 |
| Moisture (As Run) | 4.2 | 3.1 | 1.8 | 5.3 | 6.2 |
| Ash | 43.1 | 18.1 | 17.0 | 28.8 | 47.7 |
| Sulphur | 0.76 | 0.96 | 0.91 | 0.88 | 0.70 |
| Btu / lb. | 5,850 | 9,374 | 9,524 | 7,701 | 5,044 |
| DRY BASIS | | | | | |
| Ash | 45.0 | 18.7 | 17.3 | 30.4 | 50.9 |
| Sulphur | 0.79 | 0.99 | 0.93 | 0.93 | 0.75 |
| Btu / lb. | 6,106 | 9,680 | 9,699 | 8,132 | 5,377 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 11,100 | 11,910 | 11,728 | 11,686 | 10,952 |

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

RAW COAL FRACTIONS - ANALYSIS % - After Wet Attrition

| Size | ¼" x 1/8" | 1/8" x 1/16" | 1/16" x 28M | 28M x 45M | 45 x 65M |
|---|---|---|---|---|---|
| Weight (kg.) | 7.0 | 5.3 | 4.9 | 0.16 | 0.15 |
| Wt. % Head | 15.8 | 12.0 | 11.1 | 5.8 | 5.3 |
| Moisture (As Run) | 6.3 | 7.3 | 2.4 | 3.5 | 1.4 |
| Ash | 19.4 | 27.9 | 43.5 | 52.3 | 61.9 |
| Sulphur | 0.90 | 0.90 | 0.82 | 0.63 | 0.70 |
| Btu / lb. | 8,844 | 7,722 | 6,026 | 4,665* | 3,518* |
| DRY BASIS | | | | | |
| Ash | 20.7 | 30.1 | 44.6 | 54.2 | 62.8 |
| Sulphur | 0.96 | 0.97 | 0.84 | 0.65 | 0.71 |
| Btu / lb. | 9,442 | 8,325 | 6,174 | 4,834 | 3,567 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 11,906 | 11,903 | 11,139 | 10,553 | 9,589 |

NB - * mean run with Benzoic Acid

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Y

LAB. NO. - 77 - 9015

RAW COAL FRACTIONS - ANALYSIS % - After Wet Attrition

| Size | 65 x 100 M | 100 x 200 M | 200 M x 0 | 28 x 100 M |
|---|---|---|---|---|
| Weight (kg.) | 0.06 | 0.8 | 5.4 | - |
| Wt. % Head | 2.0 | 3.7 | 26.4 | 13.1 |
| Moisture (As Run) | 1.8 | 2.8 | 1.6 | 2.3 |
| Ash | 62.8 | 59.5 | 75.1 | 57.8 |
| Sulphur | 0.65 | 0.62 | 0.53 | 0.66 |
| Btu / lb. | 3,293* | 3,665* | - | 3,980 |
| DRY BASIS | | | | |
| Ash | 64.0 | 61.2 | 76.3 | 59.2 |
| Sulphur | 0.66 | 0.64 | 0.54 | 0.68 |
| Btu / lb. | 3,354 | 3,770 | - | 4,073 |
| DRY, ASH FREE BASIS | | | | |
| Btu / lb. | 9,315 | 9,714 | - | 9,974 |

NB - * means run with Benzoic Acid

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample -- W 77 Y

LAB. NO. - 77 - 9015 After Wet Attrition

ANALYSIS OF CLEAN COAL - ½" x ¼" Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 |
|---|---|---|---|---|---|
| Wt. % (Cum.) | 54.0 | 72.8 | 82.7 | 92.6 | 97.8 |
| Wt. (kg.) | 0.357 | 0.658 | 0.683 | 0.797 | 0.660 |
| As Run | | | | | |
| Moisture | 1.6 | 1.8 | 2.1 | 2.9 | 3.0 |
| Ash | 9.1 | 11.1 | 12.3 | 13.7 | 15.3 |
| Sulphur | 0.66 | 0.76 | 0.77 | 0.85 | 0.85 |
| Btu / lb. | 10.767 | 10.364 | 10,161 | 9,803 | 9,496 |
| Dry Basis | | | | | |
| Ash | 9.2 | 11.3 | 12.5 | 14.1 | 15.8 |
| Sulphur | 0.67 | 0.77 | 0.79 | 0.88 | 0.88 |
| Btu / lb. | 10,942 | 10,557 | 10,381 | 10,093 | 9,795 |
| Dry, Ash Free Basis | | | | | |
| Btu / lb. | 12,052 | 11,907 | 11,868 | 11,756 | 11,622 |
| Cum. Sink | | | | | |
| As Run | | | | | |
| Wt. (kg.) | 0.304 | 0.246 | 0.143 | 0.064 | 0.015 |
| Wt. % | 46.0 | 27.2 | 17.3 | 7.4 | 2.2 |
| Moisture | 1.6 | 1.6 | 1.6 | 2.1 | 2.2 |
| Ash | 27.0 | 32.0 | 38.7 | 47.6 | 58.9 |
| Sulphur | 1.25 | 1.40 | 1.40 | 1.21 | 1.15 |
| Btu / lb. | 8,088 | 7,554 | 6,400 | 4,946 | 4,497* |
| Dry Basis | | | | | |
| Ash | 27.4 | 32.5 | 39.4 | 48.6 | 60.2 |
| Sulphur | 1.27 | 1.42 | 1.42 | 1.24 | 1.18 |
| Btu / lb. | 8,220 | 7,674 | 6,504 | 5,052 | 4,598 |

JB - * means run with Benzoic Acid

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Y

LAB. NO. - 77 - 9015 After Wet Attrition

ANALYSIS OF CLEAN COAL - ¼" x 28 M Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 |
|---|---|---|---|---|---|
| Wt. % (Cum.) | 33.8 | 41.5 | 58.3 | 70.0 | 80.3 |
| Wt. (kg.) | 1.3 | 1.3 | 1.8 | 2.3 | 2.9 |
| As Run | | | | | |
| Moisture | 3.3 | 4.1 | 3.4 | 5.5 | 3.1 |
| Ash | 7.3 | 9.3 | 12.4 | 14.4 | 17.6 |
| Sulphur | 0.84 | 0.74 | 0.72 | 0.80 | 0.77 |
| Btu / lb. | 10,690 | 10,226 | 9,770 | 9,119 | 9,005 |
| Dry Basis | | | | | |
| Ash | 8.3 | 9.7 | 12.8 | 15.2 | 18.2 |
| Sulphur | 0.87 | 0.77 | 0.74 | 0.85 | 0.79 |
| Btu / lb. | 11,049 | 10,663 | 10,109 | 9,652 | 9,293 |
| Dry, Ash Free Basis | | | | | |
| Btu / lb. | 11,948 | 11,808 | 11,593 | 11,382 | 11,361 |
| Cum. Sink | | | | | |
| As Run | | | | | |
| Wt. (kg.) | 2.6 | 1.8 | 1.3 | 0.9 | 0.7 |
| Wt. % | 66.2 | 58.5 | 41.7 | 30.0 | 19.7 |
| Moisture | 4.3 | 5.2 | 3.3 | 4.4 | 5.3 |
| Ash | 37.6 | 40.1 | 47.4 | 55.9 | 63.1 |
| Sulphur | 0.89 | 0.83 | 0.91 | 0.94 | 0.91 |
| Btu / lb. | 6,405 | 6,006 | 5,093 | - | - |
| Dry Basis | | | | | |
| Ash | 39.3 | 42.3 | 49.0 | 58.5 | 66.6 |
| Sulphur | 0.93 | 0.88 | 0.94 | 0.98 | 0.96 |
| Btu / lb. | 6,689 | 6,333 | 5,269 | - | - |

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 Y

LAB. NO. - 77 - 9015 After Wet Attrition

ANALYSIS OF CLEAN COAL - 28 x 100 M Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 |
|---|---|---|---|---|---|
| Wt. % (Cum.) | 3.7 | 4.6 | 11.7 | 15.1 | 20.6 |
| Wt. (kg.) | 0.02 | 0.03 | 0.1 | 0.1 | 0.1 |
| As Run | | | | | |
| Moisture | 3.0 | 3.9 | 2.8 | 2.0 | 2.5 |
| Ash | 7.2 | 7.7 | 10.2 | 15.4 | 24.0 |
| Sulphur | 0.58 | 0.58 | 0.61 | 0.66 | 0.67 |
| Btu / lb. | 11,296 | 10,819 | 10,540 | 9,784 | 8,444 |
| Dry Basis | | | | | |
| Ash | 7.5 | 8.1 | 10.5 | 15.8 | 24.6 |
| Sulphur | 0.60 | 0.60 | 0.63 | 0.67 | 0.69 |
| Btu / lb. | 11,648 | 11,264 | 10,846 | 9,987 | 8,661 |
| Dry, Ash Free Basis | | | | | |
| Btu / lb. | 12,587 | 12,251 | 12,116 | 11,854 | 11,484 |
| Cum. Sink | | | | | |
| As Run | | | | | |
| Wt. (kg.) | 0.5 | 0.6 | 0.5 | 0.5 | 0.5 |
| Wt. % | 96.3 | 95.4 | 88.3 | 84.9 | 79.4 |
| Moisture | 5.9 | 5.1 | 6.0 | 6.9 | 9.2 |
| Ash | 58.2 | 61.5 | 63.9 | 64.0 | 64.3 |
| Sulphur | 0.59 | 0.56 | 0.54 | 0.56 | 0.53 |
| Btu / lb. | - | - | - | - | - |
| Dry Basis | | | | | |
| Ash | 61.8 | 64.7 | 68.0 | 68.7 | 70.9 |
| Sulphur | 0.63 | 0.59 | 0.58 | 0.60 | 0.58 |
| Btu / lb. | - | - | - | - | - |

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Sample Identification: Hat Creek Bulk Sample W77 Y
Size fraction: ½" × ¼"
Lab. No. (s): 77 - 9015 After Wet Attrition
Wt % of head sample: 8.8

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash (Dry) | Sulphur | Weight | Ash | Sulphur |
| | 1.40 | 54.0 | 9.2 | | 54.0 | 9.2 | | 100.0 | 16.8 | |
| 1.40 | 1.45 | 18.8 | 17.3 | | 72.8 | 11.3 | | 46.0 | 25.7 | |
| 1.45 | 1.50 | 9.9 | 21.3 | | 82.7 | 12.5 | | 27.2 | 31.4 | |
| 1.50 | 1.60 | 9.9 | 27.5 | | 92.6 | 14.1 | | 17.3 | 37.2 | |
| 1.60 | 1.80 | 5.2 | 46.1 | | 97.8 | 15.8 | | 7.4 | 50.3 | |
| 1.80 | | 2.2 | 60.2 | | 100.0 | 16.8 | | 2.2 | 60.2 | |
| TOTAL | | 100.0 | 16.8 | | | | | | | |

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Sample Identification: Hat Creek Bulk Sample W 77 Y
Size fraction: ¼" x 28 M
Lab. No. (s): 77 - 9015 After Wet Attrition
Wt % of head sample: 38.9

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash Dry | Sulphur | Weight | Ash | Sulphur |
| | 1.40 | 33.8 | 8.3 | | 33.8 | 8.3 | | 100.0 | 27.8 | |
| 1.40 | 1.45 | 7.7 | 16.0 | | 41.5 | 9.7 | | 66.2 | 37.7 | |
| 1.45 | 1.50 | 16.8 | 20.5 | | 58.3 | 12.8 | | 58.5 | 40.6 | |
| 1.50 | 1.60 | 11.7 | 27.2 | | 70.0 | 15.2 | | 41.7 | 48.6 | |
| 1.60 | 1.80 | 10.3 | 38.6 | | 80.3 | 18.2 | | 30.0 | 57.0 | |
| 1.80 | | 19.7 | 66.6 | | 100.0 | 27.8 | | 19.7 | 66.6 | |
| | TOTAL | 100.0 | 27.8 | | | | | | | |

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Sample Identification: Hat Creek Bulk Sample W 77 Y
Size fraction: 28 M x 100 M
Lab. No. (s): 77 - 9015 After Wet Attrtion
Wt % of head sample: 13.1

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash Dry | Sulphur | Weight | Ash | Sulphur |
| | 1.40 | 3.7 | 7.5 | | 3.7 | 7.5 | | 100.0 | 61.4 | |
| 1.40 | 1.45 | 0.9 | 10.8 | | 4.6 | 8.1 | | 96.3 | 63.4 | |
| 1.45 | 1.50 | 7.1 | 12.0 | | 11.7 | 10.5 | | 95.4 | 63.9 | |
| 1.50 | 1.60 | 3.4 | 34.0 | | 15.1 | 15.8 | | 88.3 | 68.1 | |
| 1.60 | 1.80 | 5.5 | 48.9 | | 20.6 | 24.6 | | 84.9 | 69.5 | |
| 1.80 | | 79.4 | 70.9 | | 100.0 | 61.4 | | 79.4 | 70.9 | |
| | TOTAL | 100.0 | 61.4 | | | | | | | |

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SECTION 7

ANALYSIS OF SAMPLE W77X

Report of Analysis of

Hat Creek Bulk Sample W 77 X

Includes Wet Attrition

PART III. "X" only

Submitted,

John Kay, C. Eng., M. Inst. F.
Manager of Laboratory

## Introduction

The Hat Creek Project took the form of a work program to the instructions of Simon Carves of Canada.

This was to examine, using the Warnock Hersey Professional Services Laboratory at Calgary, Canada, the physical properties of the three samples.

This analysis took the form of grading, float & sink characteristics, proximate analysis.

Also included was a scheme whereby the breakdown of the coal / clay could be measured using a Wet Attrition drum constructed to, and complying with, the standards of the Australian Method AS 1161 1977 p. 42/3.

## Description of Samples and Methods Used

One sample marked "Z" which was derived from trench "Z" weighing 11115 kgms. packed into 73 steel drums was delivered to Calgary on August 11, 1977. On opening these drums, it was immediately noticeable that polythene liners had not been used. A separate moisture sample was not delivered.

The methods used to obtain these samples were outside the terms of reference to Warnock Hersey Professional Services Ltd.

After air drying the coals very few lumps of clay were to be seen and even after separting the + 4 " material the amounts of pure clay was very small. Discrete inorganic material could be seen occluded in the clay, and when samples were placed in water, the coal could be seen to separate according to the clay content. High coal content pieces would stay in their original shape, but low coal content pieces, i.e. due to larger amounts of clay occlusions, broke up rapidly and became a slurry. After filtering, it was possible to settle the dispersion easily and a clear supernatent could be decanted.

Grading, using a Gilson mechanical sieving apparatus to separate the fractions, and Float & Sink analysis, in organic solutions at prescribed gravities were used to separate the coals further. Drying on downdraught benches was followed by preparation of samples for analysis. Riffling was accomplished by means of a manual riffle.

The Flow sheet was supplied by Simon Carves and this was generally adhered to except some shale analysis had to be added, and moisture contents prior to analysis had also to be added to the flow sheets. All three samples were treated in the same way. The weights and % weights are also reported. In some cases a very small fractional weight resulted, but the test was completed noting this. A Float & Sink test on the + 4 " was carried out on "X" and "Z" samples only - "Y" did not produce a fraction at + 4 ". Since separate moisture samples were not received, air drying followed by loss in weight at 107 $^{o}$ techniques were used to determine total moisture.

During the processing of sample "Z" a Simon Carves representative was present in the lab and again during some of the later stages only.

No Ash Examination was requested.

A mechanical type of wet screening apparatus was not available, so careful control over water supplies and hand manipulation had to be used to separate the fines into respective size fractions. It was found that "conditioning" i.e. soaking in water prior to screening ensured the best separation and each sample was subjected to 10 minutes in water before screening.

Reference to the flow sheet will show a reserve sample was requested after the initial grading at + 4 " - this amounted to:

3,360 kgms. for "X"

13,000 kgms. for "Y"

800 kgms. for "Z"

Further requests from the flow sheet asked for hand selecting to be used for "bright, dull clay and rock". In practice this was less than feasible since we found agglomerates of these materials with coal and a reduction in particle size would have accompanied any mechanical breakage. The Simon Carves representative was present during this operation and was in agreement with what was done.

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400

## RAW COAL SIZE / ASH DISTRIBUTION

| | WT. % | DRY ASH % | CUM. WT. % | CUM. ASH % | WEIGHT (kg.) |
|---|---|---|---|---|---|
| + 4 " | 0.4 | 24.9 | 0.4 | 24.9 | 35.8 |
| 4 " x 2 " | 2.2 | 36.5 | 2.6 | 34.7 | 192.5 |
| 2" x 1 " | 16.6 | 35.6 | 19.2 | 35.5 | 1241.6 (SUB) |
| 1 " x ½ " | 28.0 | 40.9 | 47.2 | 38.7 | 2092.0 (SUB) |
| ½ " x ¼ " | 18.3 39.2% | 43.2 | 65.5 | 40.0 | 242.1 (SUB) |
| ¼" x 1/8" | 9.3 12.6% | 46.7 | 74.8 | 40.8 | 33.7 (SUB) |
| 1/8" x 1/16" | 14.2 26.9% | 52.9 | 89.0 | 42.7 | 25.3 (SUB) |
| 1/16" x 28 M | 4.0 7.6% | 58.2 | 93.0 | 43.4 | 4.4 (SUB) |
| 28 M x 0 | 7.0 13.3% | 61.9 | 100.0 | 44.7 | 7.6 (SUB) |
| Total | 100.0 | 44.7 | | | |

50.1

10.53 MJ/kg As Received Basis

For Fines 1/2" Minus 9.16 MJ/kg

As Received Basis

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. HYDRO

SAMPLE - HAT CREEK - Bulk Sample W - 77 - X

LAB. NO. - 77 - 8400

## RAW COAL FRACTIONS - ANALYSIS % - Dry Screen

| Size | + 4 | 4" x 2" | 2" x 1 " | 1" x ½ " | 4" x 0 | ½ x 0 |
|---|---|---|---|---|---|---|
| Wt. % Head | 0.4 | 2.2 | 16.6 | 28.0 | 99.6 | 52.8 |
| Air Dried Loss | 0.7 | 7.1 | 9.4 | 7.7 | 6.5 | 8.2 |
| Inherent Moisture | 18.8 | 21.6 | 21.0 | 20.5 | 19.7 | 17.4 |
| Total Moisture | 19.4 | 27.2 | 28.4 | 26.6 | 24.9 | 24.2 |
| Ash (Air Dried) | 20.2 | 28.6 | 28.2 | 32.5 | 34.9 | 41.4 |
| Sulphur (Air Dried) | 2.10 | - | - | - | 1.11 | 1.24 |
| Btu / lb.(Air Dried) | 7,410 | 5,841 | 5,972 | 5,407 | 5,347 | 4,449 |
| DRY BASIS | | | | | | |
| Ash | 24.9 | 36.5 | 35.6 | 40.9 | 43.4 | 50.1 |
| Sulphur | 2.59 | - | - | - | 1.38 | 1.50 |
| Btu / lb. | 9,122 | 7,454 | 7,555 | 6,803 | 6,662 | 5,386 |
| DRY, ASH FREE BASIS | | | | | | |
| Btu / lb. | 12,150 | 11,738 | 11,733 | 11,512 | 11,778 | 10,788 |

CLIENT - B.C. HYDRO

SAMPLE - HAT CREEK - Bulk Sample X

LAB. NO. - 77 - 8400

RAW COAL FRACTIONS - ANALYSIS % - Dry Screen

| Size | ½" x ¼" | ¼" x 1/8" | 1/8" x 1/16" | 1/16" x 28 | 28 M x 0 |
|---|---|---|---|---|---|
| Wt. % Head | 18.3 | 9.3 | 14.2 | 4.0 | 7.0 |
| Air Dried Loss | 13.2 | 4.2 | 4.2 | 3.8 | 9.3 |
| Inherent Moisture | 19.1 | 18.8 | 17.5 | 11.4 | 13.5 |
| Total Moisture | 29.8 | 22.2 | 21.0 | 14.8 | 21.5 |
| Ash (Air Dried) | 34.9 | 37.9 | 43.6 | 51.6 | 53.5 |
| Sulphur (Air Dried) | 1.25 | 1.13 | 1.17 | 1.12 | 1.29 |
| Btu / lb. (Air Dried) | 5,270 | 4,972 | 4,176 | 3,705 | 2,791 |
| DRY BASIS | | | | | |
| Ash | 43.2 | 46.7 | 52.9 | 58.2 | 61.9 |
| Sulphur | 1.55 | 1.39 | 1.42 | 1.26 | 1.49 |
| Btu / lb. | 6,516 | 6,125 | 5,064 | 4,180 | 3,227 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 11,469 | 11,496 | 10,744 | 9,992 | 8,468 |

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. HYDRO

Sample Identification - Hat Creek - Bulk Sample W 77 X

LAB. NO. - 77 - 8400

## RAW COAL SIZE / ASH DISTRIBUTION

Wet Screen Analysis of ½" x 0

| Size | Wt. % | Dry Ash % | Cum. Wt. % | Cum. Ash % | Wt. % Head |
|---|---|---|---|---|---|
| ½ x ¼ " | 22.1 | 31.8 | 22.1 | 31.8 | 11.7 |
| ¼ x 1/8" | 13.1 | 45.3 | 35.2 | 36.8 | 6.9 |
| 1/8 x 1/16" | 10.6 | 53.1 | 45.8 | 40.6 | 5.6 |
| 1/16 x 28M | 10.5 | 59.4 | 56.3 | 44.1 | 5.6 |
| 28 x 45 M | 2.9 | 58.8 | 59.2 | 44.8 | 1.5 |
| 45 x 65 M | 6.7 | 57.1 | 65.9 | 46.1 | 3.5 |
| 65 x 100 M | 8.2 | 61.4 | 74.1 | 47.8 | 4.3 |
| 100 x 200 M | 11.1 | 69.1 | 85.2 | 50.5 | 5.9 |
| 200 x 0 | 14.8 | 70.7 | 100.0 | 53.5 | 7.8 |
| Total | 100.0 | 53.5 | | | 52.8 |

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400

RAW COAL FRACTIONS - ANALYSIS % - Wet Screened

| Size | ½" x ¼" | ¼" x 1/8" | 1/8" x 1/16" | 1/16" x 28 M | 28 x 45 M |
|---|---|---|---|---|---|
| Weight (kg.) | 2.15 | 1.28 | 1.03 | 1.02 | 0.060 (SUB) |
| Wt. % Head | 11.7 | 6.9 | 5.6 | 5.6 | 1.5 |
| Moisture (As Run) | 4.1 | 5.5 | 9.1 | 4.8 | 2.8 |
| Ash | 30.5 | 42.8 | 48.3 | 56.6 | 57.2 |
| Sulphur | 1.51 | 1.46 | 1.35 | 1.46 | 1.38 |
| Btu / lb. | 7,072 | 5,606 | 4,513 | 3,845 | 3,817 |
| DRY BASIS | | | | | |
| Ash | 31.8 | 45.3 | 53.1 | 59.4 | 58.8 |
| Sulphur | 1.57 | 1.55 | 1.49 | 1.53 | 1.42 |
| Btu / lb. | 7,372 | 5,933 | 4,965 | 4,037 | 3,927 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 10,810 | 10,846 | 10,585 | 9,943 | 9,540 |

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400

RAW COAL FRACTIONS - ANALYSIS % - Wet Screened

| Size | 45 x 65 M | 65 x 100 M | 100 x 200 M | 200 M x 0 |
|---|---|---|---|---|
| Weight (kg.) | 0.140 | 0.170 | 0.230 | 0.310 |
| Wt. % Head | 3.5 | 4.3 | 5.9 | 7.8 |
| Moisture (As Run) | 2.7 | 5.8 | 3.4 | 5.4 |
| Ash | 55.5 | 57.9 | 66.7 | 66.9 |
| Sulphur | 1.26 | 1.32 | 1.37 | 0.79 |
| Btu / lb. | 3,827 | n.d. | n.d. | n.d. |
| DRY BASIS | | | | |
| Ash | 57.1 | 61.4 | 69.1 | 70.7 |
| Sulphur | 1.30 | 1.40 | 1.42 | 0.84 |
| Btu / lb. | 3,935 | - | - | - |
| DRY, ASH FREE BASIS | | | | |
| Btu / lb. | 9,173 | - | - | - |

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400

ANALYSIS OF CLEAN COAL -- +4" Size Fraction

| Elem Float | 1.40 | 1.40-1.45 | 1.45-1.50 | 1.50-1.60 | 1.60-1.80 | 1.80-Sink |
|---|---|---|---|---|---|---|
| Wt. % (Cum.) | 80.2 | 5.8 | NIL | 8.6 | NIL | 5.4 |
| Wt. (Kg.) | 22.3 | 1.6 | NIL | 2.4 | NIL | 1.5 |
| As Run | | | | | | |
| Moisture | 21.9 | 17.5 | | 14.5 | | 9.5 |
| Ash | 18.4 | 23.1 | | 43.7 | | 65.2 |
| Sulphur | 1.08 | 0.86 | | 0.86 | | 0.77 |
| Btu / lb. | 7,177 | 7,038 | | 4,594 | | N.D. |
| Dry Basis | | | | | | |
| Ash | 23.5 | 28.0 | | 51.1 | | 72.1 |
| Sulphur | 1.33 | 1.04 | | 1.01 | | 0.85 |
| Btu / lb. | 9,193 | 8,529 | | 5,372 | | - |
| Dry, Ash Free Basis | | | | | | |
| Btu / lb. | 12,022 | 11,844 | | 10,980 | | - |

Cum. Sink

As Run

Wt.

Wt. %

Moisture

Ash

Sulphur

Btu / lb.

Dry Basis

Ash

Sulphur

Btu / lb.

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400

ANALYSIS OF CLEAN COAL 4" x ½" Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 | 1.80 Sink |
|---|---|---|---|---|---|---|
| Wt. % (Cum.) | 43.2 | 53.5 | 62.6 | 71.0 | 87.0 | 100.0 |
| Wt. (kg.) | 64.4 | 81.8 | 93.1 | 109.5 | 123.5 | - |
| As Run | | | | | | |
| Moisture | 25.3 | 26.1 | 24.9 | 24.4 | 24.6 | 15.0 |
| Ash | 11.4 | 13.7 | 16.0 | 18.9 | 25.0 | 68.3 |
| Sulphur | 0.97 | 1.02 | 1.15 | 1.20 | 1.20 | 0.99 |
| Btu / lb. | 7,677 | 7,252 | 7,084 | 6,821 | 6,021 | - |
| Dry Basis | | | | | | |
| Ash | 15.3 | 18.5 | 21.4 | 25.0 | 33.1 | 80.3 |
| Sulphur | 1.30 | 1.38 | 1.53 | 1.59 | 1.59 | 1.16 |
| Btu / lb. | 10,283 | 9,809 | 9,438 | 9,024 | 7,891 | - |
| Dry, Ash Free Basis | | | | | | |
| Btu / lb. | 12,139 | 12,041 | 12,003 | 12,024 | 11,932 | - |
| Cum. Sink | | | | | | |
| As Run | | | | | | |
| Wt. (kg.) | 84.6 | 71.2 | 55.6 | 44.8 | 18.5 | - |
| Wt. % | 56.8 | 46.5 | 37.4 | 29.0 | 13.0 | - |
| Moisture | 21.2 | 20.4 | 19.5 | 18.5 | 15.0 | - |
| Ash | 45.4 | 50.7 | 55.5 | 61.8 | 68.3 | - |
| Sulphur | 1.29 | 1.32 | 1.21 | 1.08 | 0.99 | - |
| Dry Basis | | | | | | |
| Ash | 57.7 | 63.7 | 69.0 | 75.8 | 80.3 | - |
| Sulphur | 1.64 | 1.66 | 1.50 | 1.33 | 1.16 | - |

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400

ANALYSIS OF CLEAN COAL - ½" x ¼" Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 | 1.80 Sink |
|---|---|---|---|---|---|---|
| Wt. % (Cum.) | 35.5 | 44.7 | 55.2 | 66.3 | 83.7 | 100.0 |
| Wt. (kg.) | 11.0 | 14.0 | 16.0 | 18.9 | 25.6 | - |
| As Run | | | | | | |
| Moisture | 26.9 | 26.7 | 22.5 | 22.1 | 22.4 | 12.4 |
| Ash | 10.5 | 12.8 | 16.3 | 20.2 | 27.2 | 70.3 |
| Sulphur | 1.05 | 1.05 | 1.15 | 1.18 | 1.16 | 1.41 |
| Btu / lb. | 7,498 | 7,284 | 7,277 | 6,853 | 5,972 | - |
| Dry Basis | | | | | | |
| Ash | 14.4 | 17.4 | 21.0 | 25.9 | 35.0 | 80.3 |
| Sulphur | 1.44 | 1.43 | 1.48 | 1.51 | 1.49 | 1.61 |
| Btu / lb. | 10,259 | 9,939 | 9,387 | 8,794 | 7,694 | - |
| Dry, Ash Free Basis | | | | | | |
| Btu / lb. | 11,987 | 12,040 | 11,887 | 11,873 | 11,846 | - |
| Cum. Sink | | | | | | |
| As Run | | | | | | |
| Wt. (kg.) | 20.0 | 17.3 | 13.0 | 9.6 | 5.0 | - |
| Wt. % | 64.5 | 55.3 | 44.8 | 33.7 | 16.3 | - |
| Moisture | 19.0 | 17.7 | 17.0 | 15.7 | 12.4 | - |
| Ash | 46.6 | 51.4 | 57.6 | 63.0 | 70.3 | - |
| Sulphur | 1.21 | 1.27 | 1.27 | 1.14 | 1.41 | - |
| Dry Basis | | | | | | |
| Ash | 57.5 | 62.4 | 69.4 | 74.8 | 80.3 | - |
| Sulphur | 1.49 | 1.54 | 1.53 | 1.35 | 1.61 | - |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel. ~~264-9128~~ 276 - 9138

Sample Identification: Hat Creek Bulk Sample W 77 X
Size fraction: + 4 "
Lab. No. (s): 77 - 8400
Wt % of head sample: 0.3 (coal)

| Specific Gravity Sink | Specific Gravity Float | weight (kg.) | FLOAT AND SINK ANALYSIS % Elementary Weight | Elementary Ash | Elementary ~~Sulphur~~ | Cumulative Float Weight | Cumulative Float Ash | Cumulative Float ~~Sulphur~~ | Cumulative Sink Weight | Cumulative Sink Ash | Cumulative Sink ~~Sulphur~~ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.40 | 22.3 | 80.2 | 23.5 | | 80.2 | 23.5 | | 100.0 | 28.8 | |
| 1.40 | 1.45 | 1.6 | 5.8 | 28.0 | | 86.0 | 23.8 | | 19.8 | 50.1 | |
| 1.45 | 1.50 | NIL | - | - | | 86.0 | 23.8 | | 14.0 | 59.2 | |
| 1.50 | 1.60 | 2.4 | 8.6 | 51.1 | | 94.6 | 26.3 | | 14.0 | 59.2 | |
| 1.60 | 1.80 | | - | - | | 94.6 | 26.3 | | 5.4 | 72.1 | |
| 1.80 | | 1.5 | 5.4 | 72.1 | | 100.0 | 28.8 | | 5.4 | 72.1 | |
| | TOTAL | | 100.0 | 28.8 | | | | | | | |

Warnock Hersey Professional Services Ltd.
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel 276 - 9138

Sample Identification: B. C. Hydro Hat Creek Bulk Sample W 77 X  Size fraction: 4 X ½"

Lab. No. (s): 77 - 8400  Wt % of head sample: 46.8

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash | Sulphur | Weight | Ash | Sulphur |
| | 1.40 | 43.2 | 15.3 | | 43.2 | 15.3 | | 100.0 | 39.2 | |
| 1.40 | 1.45 | 10.3 | 31.9 | | 53.5 | 18.5 | | 56.8 | 57.4 | |
| 1.45 | 1.50 | 9.1 | 38.4 | | 62.6 | 21.4 | | 46.5 | 63.6 | |
| 1.50 | 1.60 | 8.4 | 51.8 | | 71.0 | 25.0 | | 37.4 | 69.1 | |
| 1.60 | 1.80 | 16.0 | 69.0 | | 87.0 | 33.1 | | 29.0 | 74.1 | |
| 1.80 | | 13.0 | 80.3 | | 100.0 | 39.2 | | 13.0 | 80.3 | |
| | TOTAL | 100.0 | 39.2 | | | | | | | |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel 276 - 9138

Sample Identification: Hat Creek Bulk Sample W 77 X
Size fraction: ½ " x ¼ "
Lab. No. (s): 77 - 8400
Wt % of head sample: 18.3

FLOAT AND SINK ANALYSIS %

| Specific Gravity Sink | Specific Gravity Float | Elementary Weight | Elementary Ash | Elementary Sulphur | Cumulative Float Weight | Cumulative Float Ash | Cumulative Float Sulphur | Cumulative Sink Weight | Cumulative Sink Ash | Cumulative Sink Sulphur |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.40 | 35.5 | 14.4 | | 35.5 | 14.4 | | 100.0 | 42.4 | |
| 1.40 | 1.45 | 9.2 | 29.0 | | 44.7 | 17.4 | | 64.5 | 57.8 | |
| 1.45 | 1.50 | 10.5 | 36.3 | | 55.2 | 21.0 | | 55.3 | 62.6 | |
| 1.50 | 1.60 | 11.1 | 50.3 | | 66.3 | 25.9 | | 44.8 | 68.8 | |
| 1.60 | 1.80 | 17.4 | 69.7 | | 83.7 | 35.0 | | 33.7 | 74.8 | |
| 1.80 | | 16.3 | 80.3 | | 100.0 | 42.4 | | 16.3 | 80.3 | |
| | TOTAL | 100.0 | 42.4 | | | | | | | |

Hat Creek Bulk Sample W 77 X

Wet Attrition Test and Analysis

## Wet Attrition Test

The test apparatus consisted of a cylindrical drum, fabricated to the Australian Standards AS 1661 1977, with a measured volume of water and known amount of coal, together with steel cubes, the whole being subjected to rotation at a prescribed speed for a measured length of time. On completion of the test, the water was filtered through a specially designed cover made up from ½ mm wedge wire and the attrited coal then subjected to the anlysis as laid down per instructions.

The tumbling time was decided by the Hardgrove Index which was determined prior to the test being carried out. A calibration graph (also in the Australian Standards) was provided.

## Details

Drum - volume capacity - 200 litres
Steel Cubes - 18 each edge 50 mm
Speed - 20 R.P. M.
Amount coal used - 50 kgm.
Water volume - 150 litres

In practice, during early commissioning of the drum, the wedge wire screen was not used as a filter, the drum was allowed to stand for a short while until settlement had taken place and the water decanted off - this shortened the time slightly and this water was collected and used for the subsequent wet screening.

We have in hand a slight alteration to the driving mechanism in so far as an additional crank, which will enable the drum to be slowly turned by hand in order to facilitate emptying.

Determined Hardgrove Indexes

| "X" | "Y" | "Z" |
|---|---|---|
| 53.9 | 49.7 | 56.7 |

The tumbling times from the calibration graph fall under the lowest point of the curve. However, in order to comply with the instructions issued by Simon Carves the tumbling times used were 30 seconds in all three cases.

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400

## RAW COAL SIZE / ASH DISTRIBUTION

Wet Screen Analysis After Wet Attrition

| Size | Wt.% | Dry Ash % | Cum. Wt. % | Cum. Ash % | Weight (kg.) |
|---|---|---|---|---|---|
| 4" x ½" | 27.9 | 26.7 | 27.9 | 26.7 | 11.7 |
| ½" x ¼" | 16.9 | 34.1 | 44.8 | 29.5 | 7.1 |
| ¼" x 1/8" | 15.8 | 42.5 | 60.6 | 32.9 | 6.65 |
| 1/8" x 1/16" | 10.6 | 52.8 | 71.2 | 35.8 | 4.45 |
| 1/16" x 28 M | 6.3 | 57.0 | 77.5 | 37.6 | 2.64 |
| 28 x 45 M | 3.5 | 57.3 | 81.0 | 38.4 | 0.118 (Sub) |
| 45 x 65 M | 4.4 | 58.2 | 85.4 | 39.4 | 0.150 (Sub) |
| 65 x 100 M | 0.7 | 56.7 | 86.1 | 39.6 | 0.025 (Sub) |
| 100 x 200 M | 1.9 | 61.0 | 88.0 | 40.0 | 0.80 |
| 200 M x 0 | 12.0 | 77.9 | 100.0 | 44.6 | 5.06 |
| Total | 100.0 | 44.6 | | | |

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400

RAW COAL FRACTIONS - ANALYSIS % - After Wet Attrition

| Size | 4" x 0 | 4" x ½" | ½" x ¼" | ¼" x 28 M | ¼" x 0 |
|---|---|---|---|---|---|
| Weight (kg.) | - | 11.7 | 7.1 | - | - |
| Wt. % Head | 99.6 | 27.9 | 16.9 | 32.7 | 81.2 |
| Moisture (As Run) | 10.9 | 17.6 | 16.5 | 8.3 | 5.9 |
| Ash | 40.5 | 22.0 | 28.5 | 44.6 | 53.2 |
| Sulphur | 1.17 | 1.23 | 1.27 | 1.16 | 1.05 |
| Btu / lb. | 5,481 | 7,340 | 6,416 | 5,240 | 4,384 |
| DRY BASIS | | | | | |
| Ash | 44.4 | 26.7 | 34.1 | 48.6 | 56.5 |
| Sulphur | 1.31 | 1.49 | 1.52 | 1.26 | 1.12 |
| Btu / lb. | 6,156 | 8,907 | 7,682 | 10,200 | 4,660 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 11,300 | 12,154 | 11,657 | 11,126 | 10,716 |

Warnock Hersey Professional Services Ltd.

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W77 X

LAB. NO. - 77 - 8400

RAW COAL FRACTIONS - ANALYSIS % - After Wet Attrition

| Size | ¼" x 1/8" | 1/8" x 1/16" | 1/16" x 28M | 28M x 45M | 45 x 65M |
|---|---|---|---|---|---|
| Weight (kg.) | 6.7 | 4.5 | 2.6 | 0.1 | 0.2 |
| Wt. % Head | 15.8 | 10.6 | 6.3 | 3.5 | 4.4 |
| Moisture (As Run) | 10.7 | 8.1 | 2.8 | 4.3 | 3.9 |
| Ash | 37.9 | 48.6 | 55.4 | 54.8 | 56.0 |
| Sulphur | 1.38 | 0.99 | 0.96 | 1.06 | 1.10 |
| Btu / lb. | 5,854 | 4,807 | 4,396 | 4,479 | 4,215 |
| DRY BASIS | | | | | |
| Ash | 42.5 | 52.9 | 56.9 | 57.3 | 58.2 |
| Sulphur | 1.55 | 1.08 | 0.99 | 1.11 | 1.14 |
| Btu / lb. | 6,556 | 5,228 | 4,186 | 5,254 | 4,386 |
| DRY, ASH FREE BASIS | | | | | |
| Btu / lb. | 11,398 | 11,089 | 10,507 | 10,959 | 10,500 |

CLIENT - B. C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400

RAW COAL FRACTIONS - ANALYSIS % - After Wet Attrition

| Size | 65 x 100M | 100 x 200 M | 200M x 0 | 28 x 100M |
|---|---|---|---|---|
| Weight (kg.) | 0.03 | 0.8 | 5.1 | - |
| Wt. % Head | 0.7 | 1.9 | 12.0 | 8.6 |
| Moisture (As Run) | 3.3 | 2.6 | 1.3 | 4.0 |
| Ash | 54.8 | 59.4 | 76.9 | 53.4 |
| Sulphur | 1.05 | 1.25 | 0.62 | 1.05 |
| Btu / lb. | 4,555 | 3,877 | - | 4,372 |
| DRY BASIS | | | | |
| Ash | 56.7 | 61.0 | 77.9 | 55.7 |
| Sulphur | 1.09 | 1.28 | 0.63 | 1.09 |
| Btu / lb. | 4,708 | 3,979 | - | 4,555 |
| DRY, ASH FREE BASIS | | | | |
| Btu / lb. | 10,866 | 10,197 | - | 10,276 |

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400 After Wet Attrition

ANALYSIS OF CLEAN COAL ½" x ¼" Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 |
|---|---|---|---|---|---|
| Wt. % (Cum.) | 40.2 | 47.4 | 59.6 | 75.0 | 88.6 |
| Wt. (kg.) | 0.5 | 0.5 | 0.7 | 0.9 | 1.0 |
| As Run | | | | | |
| Moisture | 5.0 | 4.5 | 5.5 | 5.4 | 4.8 |
| Ash | 10.1 | 12.4 | 16.0 | 20.9 | 26.7 |
| Sulphur | 1.19 | 0.96 | 0.93 | 1.2 | 1.19 |
| Btu / lb. | 10,274 | 9,904 | 9,271 | 8,584 | 7,772 |
| Dry Basis | | | | | |
| Ash | 10.6 | 13.0 | 16.9 | 22.1 | 28.0 |
| Sulphur | 1.25 | 1.01 | 0.98 | 1.27 | 1.25 |
| Btu / lb. | 10,812 | 10,368 | 9,813 | 9,070 | 8,167 |
| Dry, Ash Free Basis | | | | | |
| Btu / lb. | 12,094 | 11,918 | 11,812 | 11,647 | 11,349 |
| Cum. Sink | | | | | |
| As Run | | | | | |
| Wt. (kg.) | 0.7 | 0.6 | 0.5 | 0.3 | 0.1 |
| Wt. % | 59.8 | 52.6 | 40.4 | 25.0 | 11.4 |
| Moisture | 4.4 | 4.4 | 3.2 | 3.5 | 3.9 |
| Ash | 44.8 | 48.7 | 53.4 | 61.8 | 66.4 |
| Sulphur | 1.38 | 1.57 | 1.86 | 1.75 | 2.10 |
| Btu / lb. | 5,701 | 5,137 | 4,583 | - | - |
| Dry Basis | | | | | |
| Ash | 46.9 | 50.9 | 55.2 | 64.0 | 69.1 |
| Sulphur | 1.44 | 1.64 | 1.92 | 1.81 | 2.19 |
| Btu / lb. | 5,960 | 5,373 | 4,734 | - | - |

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400 After Wet Attrition

ANALYSIS OF CLEAN COAL - ¼" x 28 M Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 |
|---|---|---|---|---|---|
| Wt. % (Cum.) | 15.5 | 25.4 | 27.4 | 37.6 | 57.1 |
| Wt. (kg.) | 0.4 | 0.6 | 0.7 | 1.0 | 1.6 |
| As Run | | | | | |
| Moisture | 4.3 | 5.1 | 4.3 | 5.5 | 7.9 |
| Ash | 8.7 | 11.5 | 12.9 | 18.6 | 25.2 |
| Sulphur | 1.01 | 1.11 | 1.11 | 1.12 | 1.10 |
| Btu / lb. | 10,436 | 9,890 | 9,712 | 8,716 | 7,550 |
| Dry Basis | | | | | |
| Ash | 9.1 | 12.1 | 13.5 | 19.7 | 27.4 |
| Sulphur | 1.06 | 1.17 | 1.16 | 1.18 | 1.19 |
| Btu / lb. | 10,909 | 10,417 | 10,145 | 9,221 | 8,201 |
| Dry, Ash Free Basis | | | | | |
| Btu / lb. | 12,006 | 11,847 | 11,728 | 11,476 | 11,294 |
| Cum. Sink | | | | | |
| As Run | | | | | |
| Wt. (kg.) | 2.3 | 1.8 | 1.9 | 1.7 | 1.2 |
| Wt. % | 84.5 | 74.6 | 72.6 | 62.4 | 42.9 |
| Moisture | 9.3 | 6.4 | 7.5 | 6.5 | 5.8 |
| Ash | 49.2 | 55.4 | 55.6 | 59.8 | 71.3 |
| Sulphur | 1.12 | 1.14 | 1.11 | 1.08 | 1.08 |
| Btu / lb. | 4,468 | 4,090 | - | - | - |
| Dry Basis | | | | | |
| Ash | 54.2 | 59.2 | 60.0 | 63.9 | 75.7 |
| Sulphur | 1.24 | 1.22 | 1.20 | 1.16 | 1.15 |
| Btu / lb. | 4,925 | 4,371 | - | - | - |

Warnock Hersey Professional Services Ltd.

CLIENT - B.C. Hydro

Sample Identification - Hat Creek Bulk Sample W 77 X

LAB. NO. - 77 - 8400 After Wet Attrition

ANALYSIS OF CLEAN COAL - 28 x 100 M Size Fraction

| Cum. Float | 1.40 | 1.45 | 1.50 | 1.60 | 1.80 |
|---|---|---|---|---|---|
| Wt. % (Cum.) | 4.4 | 7.6 | 12.0 | 18.7 | 33.2 |
| Wt. (kg.) | 0.02 | 0.04 | 0.06 | 0.1 | 0.2 |
| As Run | | | | | |
| Moisture | 4.5 | 4.4 | 2.7 | 2.8 | 2.8 |
| Ash | 8.8 | 11.3 | 15.7 | 21.7 | 29.5 |
| Sulphur | 0.96 | 0.87 | 1.09 | 0.96 | 0.88 |
| Btu / lb. | 10,607 | 10,153 | 9,650 | 8,827 | 7,670 |
| Dry Basis | | | | | |
| Ash | 9.2 | 11.8 | 16.1 | 22.3 | 30.3 |
| Sulphur | 1.01 | 0.91 | 1.12 | 0.99 | 0.91 |
| Btu / lb. | 11,108 | 10,620 | 9,917 | 9,081 | 7,889 |
| Dry, Ash Free Basis | | | | | |
| Btu / lb. | 12,230 | 12,042 | 11,820 | 11,684 | 11,328 |
| Cum. Sink | | | | | |
| As Run | | | | | |
| Wt. (kg.) | 0.6 | 0.5 | 0.5 | 0.5 | 0.4 |
| Wt. % | 95.6 | 92.4 | 88.0 | 81.3 | 66.8 |
| Moisture | 6.8 | 3.9 | 5.7 | 5.6 | 7.5 |
| Ash | 55.5 | 58.8 | 59.2 | 61.5 | 64.9 |
| Sulphur | 0.81 | 0.8 | 0.89 | 0.90 | 0.82 |
| Btu / lb. | - | - | - | - | - |
| Dry Basis | | | | | |
| Ash | 59.6 | 61.2 | 62.8 | 65.2 | 70.2 |
| Sulphur | 0.87 | 0.92 | 0.94 | 0.95 | 0.89 |
| Btu / lb. | - | - | - | - | - |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel. 276-9138

Sample Identification: Hat Creek Bulk Sample W77 X
Size fraction: ½" × ¼"
Lab. No. (s): 77 – 84 00 After Wet Attrition
Wt % of head sample: 16.9

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash | Sulphur | Weight | Ash | Sulphur |
| | 1.40 | 40.2 | 10.6 | | 40.2 | 10.6 | | 100.0 | 32.7 | |
| 1.40 | 1.45 | 7.2 | 26.4 | | 47.4 | 13.0 | | 59.8 | 47.5 | |
| 1.45 | 1.50 | 12.2 | 32.0 | | 59.6 | 16.9 | | 52.6 | 50.4 | |
| 1.50 | 1.60 | 15.4 | 42.2 | | 75.0 | 22.1 | | 40.4 | 56.0 | |
| 1.60 | 1.80 | 13.6 | 60.5 | | 88.6 | 28.0 | | 25.0 | 64.4 | |
| 1.80 | | 11.4 | 69.1 | | 100.0 | 32.7 | | 11.4 | 69.1 | |
| | TOTAL | 100.0 | 32.7 | | | | | | | |

Warnock Hersey Professional Services Ltd.
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel. 276-9138

Sample Identification: Hat Creek Bulk Sample W 77 X
Size fraction: ¼" x 28 M
Lab. No. (s): 77 – 8400 After Wet Attrition
Wt % of head sample: 32.7

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash | Sulphur | Weight | Ash | Sulphur |
| | 1.40 | 15.5 | 9.1 | | 15.5 | 9.1 | | 100.0 | 48.1 | |
| 1.40 | 1.45 | 9.9 | 16.8 | | 25.4 | 12.1 | | 84.5 | 55.3 | |
| 1.45 | 1.50 | 2.0 | 31.3 | | 27.4 | 13.5 | | 74.6 | 60.4 | |
| 1.50 | 1.60 | 10.2 | 36.0 | | 37.6 | 19.6 | | 72.6 | 61.2 | |
| 1.60 | 1.80 | 19.5 | 42.4 | | 57.1 | 27.4 | | 62.4 | 65.3 | |
| 1.80 | | 42.9 | 75.7 | | 100.0 | 48.1 | | 42.9 | 75.7 | |
| | TOTAL | 100.0 | 48.1 | | | | | | | |

**Warnock Hersey Professional Services Ltd.**
1423 D 45th Avenue N.E. Calgary Alberta T2E 2P3 Tel. 276-9138

Sample Identification: Hat Creek Bulk Sample W 77 X
Size fraction: 28 x 100 M
Lab. No. (s): 77 - 8400
Wt % of head sample: 8.6

| Specific Gravity | | FLOAT AND SINK ANALYSIS % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Elementary | | | Cumulative Float | | | Cumulative Sink | | |
| Sink | Float | Weight | Ash | Sulphur | Weight | Ash (Dry) | Sulphur | Weight | Ash | Sulphur |
| | 1.40 | 4.4 | 9.2 | | 4.4 | 9.2 | | 100.0 | 57.0 | |
| 1.40 | 1.45 | 3.2 | 15.4 | | 7.6 | 11.8 | | 95.6 | 59.2 | |
| 1.45 | 1.50 | 4.4 | 23.5 | | 12.0 | 16.1 | | 92.4 | 60.7 | |
| 1.50 | 1.60 | 6.7 | 33.4 | | 18.7 | 22.3 | | 88.0 | 62.6 | |
| 1.60 | 1.80 | 14.5 | 40.8 | | 33.2 | 30.4 | | 81.3 | 65.0 | |
| 1.80 | | 66.8 | 70.2 | | 100.0 | 57.0 | | 66.8 | 70.2 | |
| | TOTAL | 100.0 | 57.0 | | | | | | | |

# SECTION 8

# APPRAISAL OF PROCEDURES

## 8.1 Sampling

Trench samples give a lower coarse coal content: thus in practice results may lead to over estimation of fine coal and tailings problems. Incremental sampling from a mining operation is thus more reliable.

## 8.2 Moisture

Separate sealed moisture samples should be taken direct from the strata during any sampling operation.

## 8.3 Sample Requirements

Further review of sample size in the light of current standards and the 1977 programme will probably confirm that smaller sample weights will be acceptable for float and sink and associated washability work. (This to an extent assumes that the bulk of information required is for the 25mm x 0 size fractions.)

## 8.4 Size Analysis

Wet Screening of these difficult coals is obviously essential, as is mechanical equipment to expedite the tests within reasonable wetting periods. The results obtained appear consistent, but do not correlate well with the Wash Tests. (The results by Dry Screening are of little relevance and future tests should use Wet Screening throughout.)

## 8.5 Float and Sink Testing

The cumulative method has shown acceptable gravity/ash correlation for Hat Creek Coals - this has not been obtained with conventional methods.

The exception to this is for the 28 x 100 mesh size fractions. The quantities obtained from the Wet Attrition Test and the prolonged wetting during this test as performed may have adversely affected results. Also, Separation Funnels should be used for this size fraction.

# SECTION 8

# APPRAISAL OF PROCEDURES

## 8.6 Wet Attrition Procedure

Observations are recounted in some detail in Appendix B. A table is attached, Appendix D, which sets out the results alongside comparable values for the Wet Screening Tests and the Wash Tests.

Comparison of Sample A Wash Test with Sample Y Wet Attrition Test suggests the method has value, but X and Z tests are disappointing in not correlating with either the Wet Screening Tests or Wash Tests.

We do however, believe that the problems are related to test technique and the need for mechanical wet screening equipment. The associated visual observations are, however, quite conclusive if not scientifically analyzed: the Hat Creek Coals will be subject to substantial breakdown in any water borne washing process.

A further appreciation of this method may be possible when the E.M.R. Test Wash on the combined X and Y Bulk Sample is reported.

# APPENDIX D

## FINES SIZE CONSISTS ALTERNATIVE TESTS

| | (All figures Dry Basis) | | +28mesh | 28mesh x 0 | 45mesh x 0 | 65mesh x 0 | 100mesh x 0 |
|---|---|---|---|---|---|---|---|
| Sample | Test | Head Ash% | Wt.% | Wt.% | Wt.% | Wt.% | Wt.% |
| A | Wash Test (3/4" x 0) | 50.5 | 60.1 | 39.9 | | 22.9 | |
| | Washability (3/4" x 0) | 51.0 | 80.6 | 19.4 | | | |
| | Washability (2" x 0) | 51.2 | 85.6 | 14.4 | 7.5 | | 2.9 |
| | Washability (4" x 0) | 50.7 | 82.1 | 17.9 | | | 4.7 |
| Y | Dry Screening (4" x 0) | 42.1 | 94.1 | 5.9 | | | |
| | Wet Screening (4" x 0) | | 79.2 | 20.8 | 20.1 | 18.1 | 16.8 |
| | Wet Attrition (4" x 0) | 45.2 | 56.8 | 43.2 | 37.4 | 32.1 | 30.1 |
| X | Dry Screening (4" x 0) | 44.7 | 93.0 | 7.0 | | | |
| | Wet Screening (4" x 0) | | 77.0 | 23.0 | 21.5 | 18.0 | 13.7 |
| | Wet Attrition (4" x 0) | 44.6 | 77.5 | 22.5 | 19.0 | 14.6 | 13.9 |
| B | Wash Test (3/4" x 0) | 34.6 | 78.6 | 21.4 | | 8.5 | |
| | Washability(3/4" x 0) | 34.7 | 97.3 | 2.7 | | | |
| | Washability (2" x 0) | 36.3 | 88.8 | 11.2 | 6.0 | | 2.5 |
| | Washability (4" x 0) | 34.1 | 96.3 | 3.7 | | | 0.8 |
| C | Wash Test (3/4" x 0) | 27.7 | 72.1 | 27.9 | | 12.6 | |
| | Washability (3/4" x 0) | 28.0 | 81.4 | 18.6 | | | |
| | Washability (2" x 0) | 29.1 | 79.7 | 20.3 | 11.6 | | 4.0 |
| | Washability (4" x 0) | 27.7 | 87.4 | 12.6 | | | 5.0 |
| Z | Dry Screening (4" x 0) | 27.7 | 97.3 | 2.7 | | | |
| | Wet Screening (4" x 0) | | 87.2 | 12.8 | 11.6 | 9.3 | 7.0 |
| | Wet Attrition (4" x 0) | 28.7 | 90.1 | 9.9 | 8.7 | 8.1 | 8.0 |