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MOVABLE-WALL COKE OVEN TESTS AND RELATED ANALYSES OF COAL SAMPLES FROM SEAM NO. 4 AND A BLEND OF SEAM NO. 8 AND SEAM NO. 4 FROM EWIN PASS SUBMITTED BY CROWS NEST RESOURCES LIMITED

Project No. 03-3-1/11-7
Job No. 3303R

J.G. JORGENSEN, T.A. LLOYD AND W. GARDINER
COAL RESOURCE AND PROCESSING LABORATORY

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by

J.G. Jorgensen*, T.A. Lloyd* and W. Gardiner*

INTRODUCTION

This investigation deals with the carbonization and related analyses of cleaned coal samples from Seam No. 4 (Adit No. 2) and a blend of 66.7 percent Seam No. 8 (Adit No. 1) and 33.3 percent Seam No. 4 (Adit No. 2) taken from Ewin Pass in the Upper Elk Coal Field. The project was initiated by R. Crisafio, Senior Metallurgist, Crows Nest Resources Limited, Calgary, Alberta in a letter dated August 1, 1980 which appears in Appendix 1.

The cleaned bulk coal samples were carbonized in the 12-inch width movable-wall coke oven located at the CANMET Bells Corners Complex near Ottawa. Representative samples of the coals were taken and analyzed for chemical, physical, thermal rheological and petrographical properties. The results of the testing and analyses are listed in Tables 1 to 6.

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*Heads, Coal Petrology Section, Coal Treatment and Rheology Section, and Carbonization Operations Section, respectively, Coal Resource and Processing Laboratory, Energy Research Laboratories, CANMET, Department of Energy, Mines and Resources, Ottawa, Canada.

TABLE 1 Chemical Analyses of Component Coals

Identification		
Laboratory Number	4244-80	4284-80
Description	Adit 2 Seam 4	Blend 66.7% Seam 8 33.3% Seam 4
Classification		
Rank (ASTM)	mvb	mvb
International System	533	533
Specific Volatile Index	184	182
Carbon (dmmfb) .....%	89.1	88.1
Proximate Analysis (db)		
Ash .....%	8.6	7.7
Volatile Matter .....%	27.4	27.8
Fixed Carbon .....%	64.0	64.5
Gross Calorific Value (db)		
Btu per pound	14160	14270
Ultimate Analysis (db)		
Carbon .....%	80.7	80.6
Hydrogen .....%	4.7	5.0
Sulphur .....%	0.33	0.38
Nitrogen .....%	1.1	1.3
Ash .....%	8.6	7.7
Oxygen (by difference) .....%	4.6	5.0
Ash Analysis (db)		
SiO_2 .....%	55.3	53.0
Al_2O_3 .....%	26.9	28.2
Fe_2O_3 .....%	7.9	6.3
TiO_2 .....%	1.4	1.4
P_2O_5 .....%	0.9	1.1
CaO .....%	1.6	2.9
MgO .....%	1.0	0.8
SO_3 .....%	1.2	2.4
Na_2O .....%	0.1	0.3
K_2O .....%	1.3	1.0

TABLE 2 Physical Tests and Fusibility of Ash of Component Coals

Identification				
Laboratory Number			4244-80	4284-80
Description			Adit 2 Seam 4	Blend 66.7% Seam 8 33.3% Seam 4
Coal Pulverization				
Sieve Analysis				
Passing	Retained On			
	1/4 in.	%	0.3	0.1
1/4 in.	6 mesh	%	13.4	11.1
6 mesh	12 mesh	%	21.0	17.7
12 mesh	20 mesh	%	21.7	20.0
20 mesh	.....	%	43.6	51.1
Total Passing	6 mesh	%	86.3	88.8
Grindability				
Hardgrove Index			71	80
Fusibility of Ash				
Initial Deformation Temp. ...		°F	2340	2420
Softening Temp. Spherical ...		°F	2670	2700+
Softening Temp. Hemispherical		°F	2700+	2700+
Fluid Temp.		°F	2700+	2700+

TABLE 3 Thermal Rheological Properties of Component Coals

Identification		
Laboratory Number	4244-80	4284-80
Description	Adit 2 Seam 4	Blend 66.7% Seam 8 33.3% Seam 4
Linear Expansion		
Bd. 52 lb/ft^3 at 2% moisture...%		
Gieseler Plasticity		
Start .....°C	427	429
Fusion Temp. .....°C	440	441
Max. Fluid Temp. .....°C	462	463
Final Fluid Temp. .....°C	485	488
Solidification Temp. .....°C	488	491
Melting Range .....°C	58	59
Max. Fluidity .....dd/m	158	139
Torque .....g.in.	40	40
Dilatation		
Ti - Softening Temp. .....°C	388	394
Tii - Max. Contraction Temp. °C	441	436
Tiii - Max. Dilatation Temp. .°C	466	469
Contraction .....%	25	28
Dilatation .....%	20	49
Free Swelling Index		
F.S.I.	8	8

TABLE 4 Petrographic Analysis of Component Coals

Identification		
Laboratory Number.....	4244-80	4284-80
Description.....	Adit 2 Seam 4	Blend 66.7% Seam 8 33.3% Seam 4
Distribution of Vitrinite Types		
V-6.....%		
V-7.....%		
V-8.....%	1.4	0.7
V-9.....%	6.4	2.1
V-10.....%	46.3	36.1
V-11.....%	17.2	31.9
V-12.....%		
V-13.....%		
V-14.....%		
V-15.....%		
V-16.....%		
V-17.....%		
V-18.....%		
Reactive Components		
Total Vitrinite.....%	71.3	70.8
Reactive Semi-fusinite (1/3)...%	5.1	5.1
Exinite.....%	3.3	2.0
Total.....%	79.7	77.9
Inert Components		
Inert Semi-fusinite (2/3).....%	10.1	10.1
Micrinite.....%	2.0	1.9
Fusinite.....%	3.4	5.8
Mineral Matter.....%	4.8	4.3
Total.....%	20.3	22.1
Petrographic Indices		
Mean Reflectance.....%	1.06	1.08
Balance Index.....	0.70	0.82
Strength Index.....	3.92	4.11
Stability Index.....	52.6	56.7

TABLE 5 - Carbonization Data

Test Identification Number.....	810		814	
Data of Test.....	Oct. 1/80		Oct. 21/80	
Laboratory Number.....				
Description.....	100% Adit 2 Seam 4		Blend 66.7% Seam 8 33.3% Seam 4	
CARBONIZATION DATA				
Net Weight of Charge (wet).....lb	570.5		548.1	
Moisture in Charge.....%	2.0		3.0	
ASTM Bulk Density (wet).....lb/ft^3	49.0		49.2	
Oven Bulk Density (db).....lb/ft^3	51.58		49.05	
CARBONIZATION RESULTS				
Gross Coking Time.....hr:min	9:05		9:25	
Maximum Wall Pressure.....lb/in^2	0.95		1.30	
Coke Yield Actual.....%	75.1		78.9	
Mean Coke size.....in	2.02		1.86	
Apparent Specific Gravity.....	0.934		0.922	
Screen Analysis of Coke (cumulative percentage retained on)				
3 inch sieve.....	8.4		3.1	
2 inch sieve.....	48.2		34.6	
1 1/2 inch sieve.....	74.5		72.3	
1 inch sieve.....	92.6		93.3	
3/4 inch sieve.....	95.0		95.6	
1/2 inch sieve.....	96.5		96.7	
Percentage -1/2 inch (breeze).....	3.5		3.3	
Tumbler Test (ASTM)				
Stability Factor.....	39.3		51.9	
Hardness Factor.....	65.2		67.1	
Japanese Drum Test (JIS) (cumulative percentage retained on)	*	**	*	**
50 mm sieve.....	8.2	0.8	6.0	1.0
25 mm sieve.....	74.4	49.0	83.6	66.0
15 mm sieve.....	90.0	76.3	91.8	80.5

*30 revs **150 revs

TABLE 6

Analyses of Coke Oven Charges and Resultant Cokes

Identification		
Test Number.....	810	814
Date Charged.....	1/10/80	21/10/80
Description.....	Adit 2 Seam 4	Blend 66.7% Seam 8 33.3% Seam 4
Coke Oven Charge		
Laboratory Number.....	4244-80	4284-80
Proximate Analysis (db)		
Ash.....%	8.6	7.7
Volatile Matter.....%	27.4	27.8
Fixed Carbon .....%	64.0	64.5
Sulphur (db).....%	0.33	0.38
Resultant Coke		
Laboratory Number.....	4344-80	4745-80
Proximate Analysis (db)		
Ash.....%	11.6	10.4
Volatile Matter.....%	1.6	0.9
Fixed Carbon.....%	86.8	88.7
Sulphur (db).....%	0.26	0.36

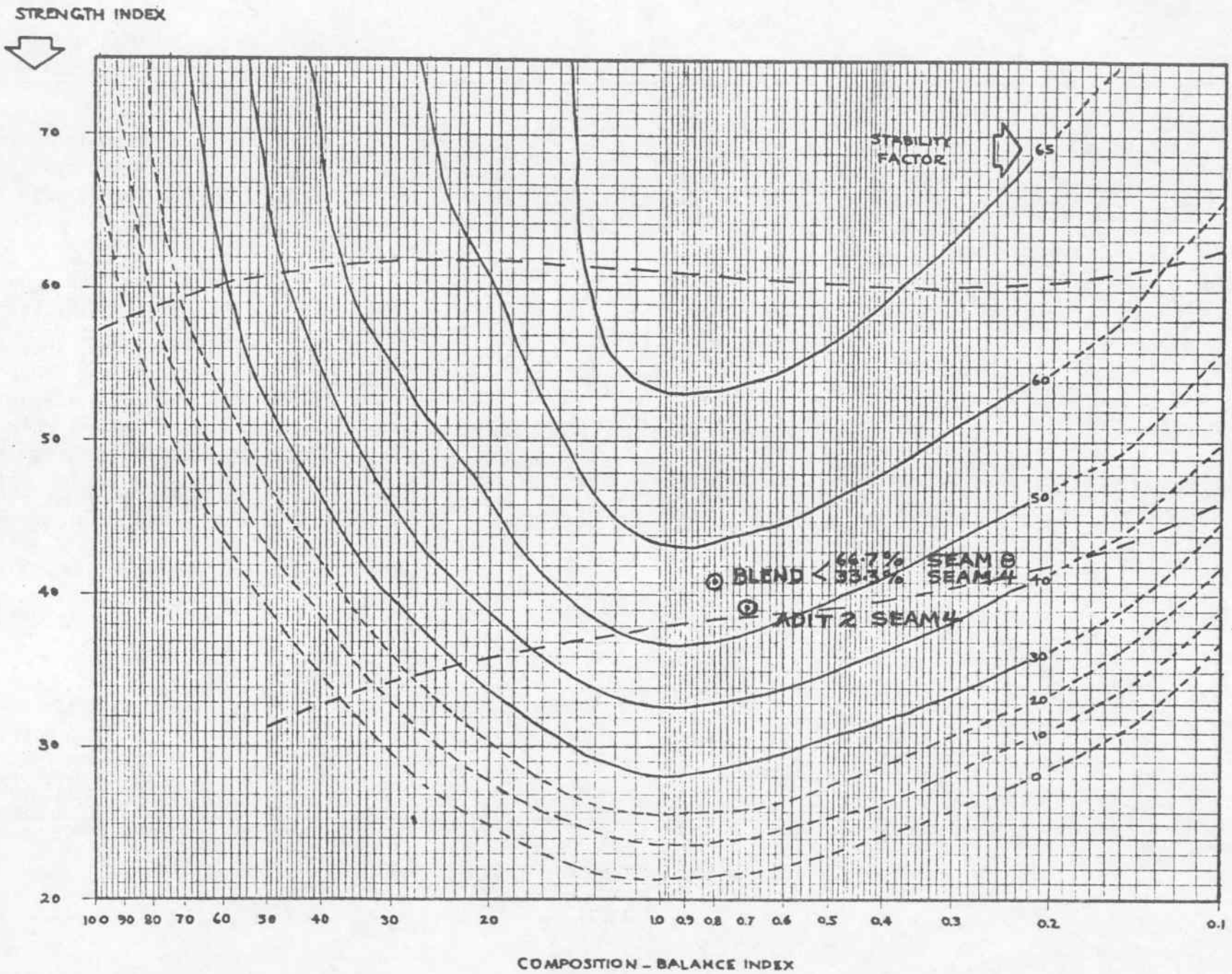
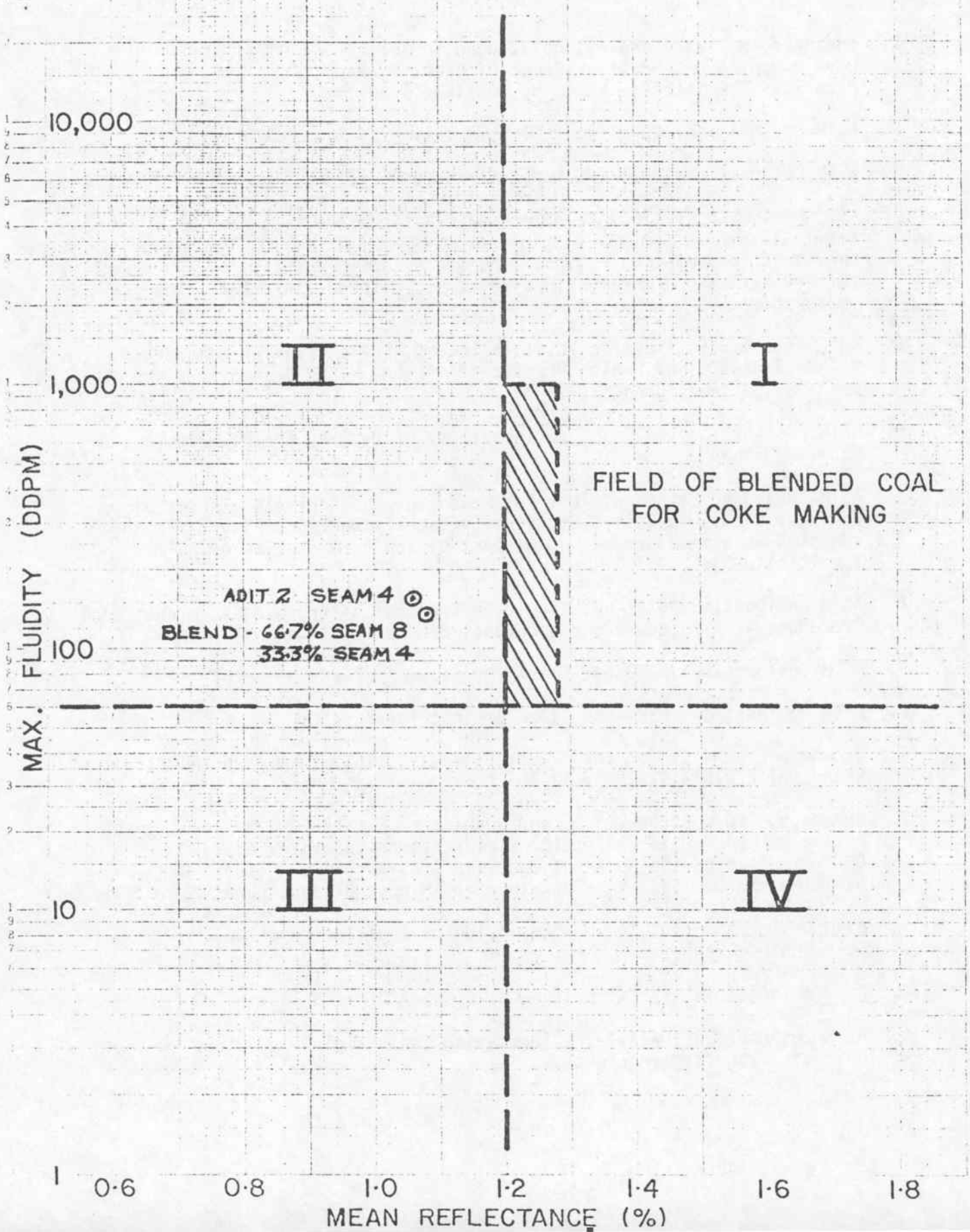


Figure 1. Plot of Predicted Stability Factors of Component Coals from Petrographic Data.

Figure 2. RELATIONSHIP BETWEEN MAX. FLUIDITY AND MEAN REFLECTANCE.



BIBLIOGRAPHY

1. Eddinger, R. Tracy and Mitchell, John, "Pilot-Scale Coke Ovens - Development and Operation; Proc. of Blast Furnace, Coke Oven and Raw Materials Committee", AIME, 15, 148-163 (1956).

2. ASTM Designation: D388-66, "Classification of Coals by Rank".

3. ASTM Designation: D720-67, "Test for Free Swelling Index of Coal".

4. ASTM Designation: D2639-71, "Test of Plastic Properties of Coal by the Constant-Torque Gieseler Plastometer." (Constant torque plastometer used with a torque of 40 gram-inch; start, 1 dd/m; fusion, 5 dd/m; final, 1 dd/m; solidification, no movement; range-temp., between start and final temperatures).

5. Burrough, E.J., "Specific Volatile Index", Fuels Division Memorandum 97/58-CG, Fuels and Mining Practice Division, Mines Branch, Dept. of M. and T.S., Ottawa, Canada (1958).

6. ASTM Designation: D409-71, "Grindability of Coal by the Hardgrove-Machine Method".

7. ASTM "Proposed Method of Test for Measuring the Coking Pressures of Coals by a Movable-Wall Slot Oven" (presently under consideration for adoption as a standard method of test by Sub-Committee XV of ASTM Committee D-5).

8. ASTM Designation: D291-60, "Cubic Foot Weight of Crushed Bituminous Coal" Procedure A - Procedure for Uncompacted Cubic Foot Weight).

9. ASTM Designation: D293-69, "Test for Sieve Analysis of Coke".

10. ASTM Designation: D294-64, "Tumbler Test for Coke".

11. Japanese Drum Test for Coke, Designated as J.I.S. (Japanese Industrial Standard) K 2151-1972, pp. 12-16).

12. Burrough, E.J., Strong, R.A. and Swartzman, E., "Report of Investigation on the Method Now in Use at the Fuel Research Laboratories for Determination of the Apparent Specific Gravity of Coke", R.I. C.S. 35, Division of Fuel Testing, Department of Mines, Ottawa, August 24, 1934.

13. ASTM Designation: D2014-71, "Expansion or Contraction of Coal by the Sole-Heated Oven".

14. German Industrial Specification No. DIN 51739/March 1951.

15. ASTM Designation: D-2797-72, "Preparing Coal Samples for Microscopical Analysis by Reflected Light".

16. ASTM Designation: D-2798-72, "Microscopical Determination of the Reflectance of the Organic Components in a Polished Specimen of Coal".

17. ASTM Designation: D-2799-72, "Microscopical Determination of Volume Percent of Physical Components of Coal".

18. Schapiro, N., Gray, R.J., "Petrographic Classification Applicable to Coals of all Ranks", Proc. 111, Min. Inst., 1960, 68, 83-97.

19. H. Hoffmann, and K. Hoehne, Brenstoff Chemie, 35, (1954), pp 202, 236, 269 and 298.

APPENDIX 1

Letter dated August 1, 1980 from R. Crisafio, Senior Metallurgist, Crows Nest Resources Limited, Calgary, Alberta.

Crows Nest Resources LIMITED
Shell Centre, 400 - 4th Avenue S.W., Calgary, Alberta (403) 232-4355
P.O. Box 2699 Stn. M, Calgary, Alberta T2P 2M7 Telex 038-24792

August 1, 1980

Mr. J. Jorgensen,
Energy Research Laboratories,
CANMET,
555 Booth Street,
Ottawa, Ontario.
K1A 0G1.

Dear John:

With reference to our telephone conversation of July 31, hereunder outlined are tests as conceived:

Ewin Pass

Complete analysis and carbonization as follows:

a) Blend of 2 parts #8 seam and 1 part #4 seam

b) Seam #4

These are fresh samples to be shipped in September:

Horseshoe Ridge

a) Adit 13 - Seam #8 Upper
Adit 13 - Seam #8 - Lower
Adit 14 - Seam #8 Rider

These are presently at E.M.R.

b) Adit #19 - Seam #7

This will be shipped late September.

Enclosed is a new P.O. for Ewin Pass tests.

Kindly forward location forms which we will complete and return covering all our adit sites.

Regards,

R. Crisafio,
Senior Metallurgist.

RC/ljr
Enc.