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MOVABLE-WALL COKE OVEN TESTS AND RELATED ANALYSES
OF TWO COMPONENT COALS FROM THE LINE CREEK EXTENSION
PROJECT SUBMITTED BY CROWS NEST RESOURCES LIMITED

Project No. 03-3-1/11-10
Job No. 3377-R

J.G. JORGENSEN AND T.A. LLOYD
COMBUSTION AND CARBONIZATION RESEARCH
LABORATORY

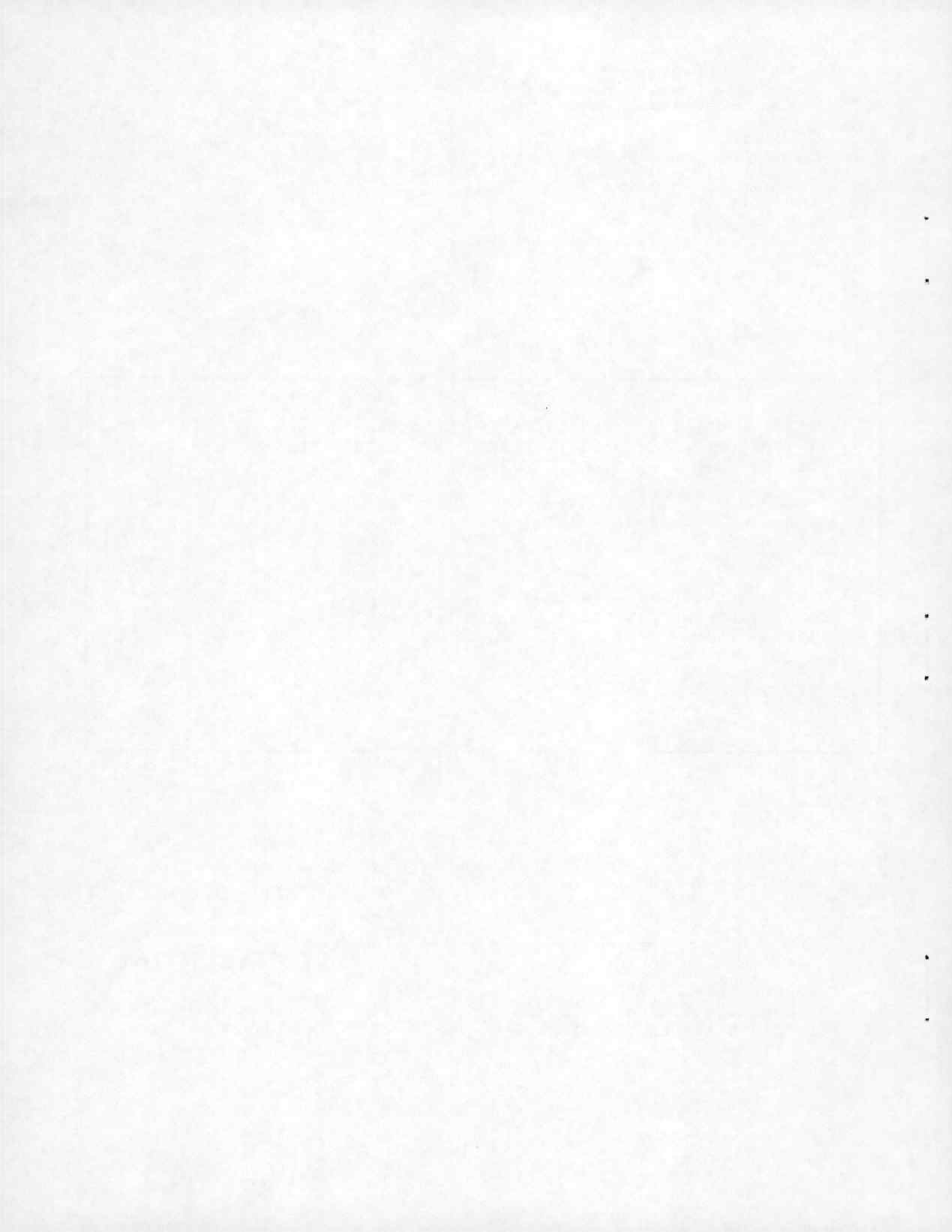
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by

J.G. Jorgensen* and T.A. Lloyd**

INTRODUCTION

The evaluation of coals for Crows Nest Resources Limited is a continuing divisional project in which periodic investigations are undertaken as requested by the company.

This report is Investigation No. 10 in the series and includes evaluation data on coals specified in a letter dated December 4, 1981 from H.S. Stellmach, Manager, Utilization Technology, Crows Nest Resources Limited. A copy of this letter appears in Appendix 1. The two component coals from the Line Creek Extension Project are indentified as:

- (a) Seam 4U, Adit 21.
- (b) Seam 3L, Adit 22.

The coal samples were cleaned at Birtley Engineering, Calgary and sent to the Energy Research Laboratories, CANMET Bells Corners Complex near Ottawa. The samples were crushed, blended and carbonized in the CANMET 12-inch width Movable-Wall coke oven. Representative samples were taken for chemical, physical, thermal rheological and petrographical analyses. The results are tabulated in Tables 1 to 6.

*Head, Petrographic Section, **Head, Conventional Carbonization Section, Combustion and Carbonization Research Laboratory, Energy Research Laboratories, CANMET, Energy, Mines and Resources, Ottawa, Canada. KIA OGI

TABLE 1 Chemical Analyses of Component Coals

<u>Identification</u>		
Laboratory Number	2189-82	2250-82
Description	Seam 4u Adit 21	Seam 3L Adit 22
<u>Classification</u>		
Rank (ASTM)	mvb	mvb
International System	433	532
Specific Volatile Index	188	173
Carbon (dmmfb)	89.3	87.3
<u>Proximate Analysis (db)</u>		
Ash	8.9	9.4
Volatile Matter	23.6	26.7
Fixed Carbon	67.5	63.9
<u>Gross Calorific Value (db)</u>		
Btu per pound	14045	13720
<u>Ultimate Analysis (db)</u>		
Carbon	80.5	78.3
Hydrogen	4.4	4.5
Sulphur	0.68	0.40
Nitrogen	1.2	1.7
Ash	8.9	9.4
Oxygen (by difference)	4.3	5.7
<u>Ash Analysis (db)</u>		
SiO ₂	54.7	55.8
Al ₂ O ₃	27.7	25.3
Fe ₂ O ₃	3.4	5.8
TiO ₂	1.5	1.4
P ₂ O ₅	4.9	2.3
CaO	3.6	2.7
MgO	0.5	0.7
SO ₃	0.6	2.3
Na ₂ O	0.1	0.1
K ₂ O	0.9	1.3

TABLE 2 Physical Tests and Fusibility of Ash of Component Coals

<u>Identification</u>			
Laboratory Number		2189-82	2250-82
Description		Seam 4K Adit 21	Seam 3L Adit 22
<u>Coal Pulverization</u>			
Sieve Analysis			
Passing	Retained On		
	1/4 in. %	0.1	0.2
1/4 in.	1/8 in. %	13.2	13.7
1/8 in.	1/16 in. %	20.2	21.3
1/16 in.	1/32 in. %	22.0	22.7
1/32 in.%	44.5	42.1
Total Passing	1/8 in. %	86.7	86.1
<u>Grindability</u>			
Hardgrove Index		93	78
<u>Fusibility of Ash</u>			
Initial Deformation Temp. ... ^o F		2600	2275
Softening Temp. Spherical ... ^o F		2700+	2700
Softening Temp. Hemispherical ... ^o F		2700+	2700+
Fluid Temp. ^o F		2700+	2700+

TABLE 3 Thermal Rheological Properties of Component Coals

<u>Identification</u>		
Laboratory Number	2189-82	2250-82
Description	Seam 4U Adit 21	Seam 3L Adit 22
<u>Linear Expansion</u>		
Bd. 52 lb/ft ³ at 2% moisture...%		
<u>Gieseler Plasticity</u>		
Start	°C 430	427
Fusion Temp.	°C 444	442
Max. Fluid Temp.	°C 464	458
Final Fluid Temp.	°C 484	475
Solidification Temp.	°C 490	481
Melting Range	°C 54	48
Max. Fluidity	dd/m 74	29
Torque	g.in. 40	40
<u>Dilatation</u>		
Ti - Softening Temp.	°C 395	402
Tii - Max. Contraction Temp.	°C 449	453
Tiii - Max. Dilatation Temp.	°C 479	476
Contraction	% 28	27
Dilatation	% 19	-15
<u>Free Swelling Index</u>		
F.S.I.	8	7½

TABLE 4 Petrographic Analysis of Component Coals

<u>Identification</u>		
Laboratory Number.....	2189-82	2250-82
Description.....	Seam 4U Adit 21	Seam 3L Adit 22
<u>Distribution of Vitrinite Types</u>		
V-6.....%		
V-7.....%		
V-8.....%		
V-9.....%		2.3
V-10.....%	19.4	52.5
V-11.....%	42.2	20.1
V-12.....%	5.3	
V-13.....%		
V-14.....%		
V-15.....%		
V-16.....%		
V-17.....%		
V-18.....%		
<u>Reactive Components</u>		
Total Vitrinite.....%	66.9	74.9
Reactive Semi-fusinite (1/3).....%	10.9*	4.8
Exinite.....%	0.4	0.4
Total.....%	78.2	80.1
<u>Inert Components</u>		
Inert Semi-fusinite (2/3).....%	10.9**	9.5
Micrinite.....%	1.3	1.2
Fusinite.....%	4.6	3.9
Mineral Matter.....%	5.0	5.3
Total.....%	21.8	19.9
<u>Petrographic Indices</u>		
Mean Reflectance.....%	1.12	1.07
Balance Index.....	0.86	0.70
Strength Index.....	4.34	3.97
Stability Index.....	60.2	53.4

*Reactive Semi-fusinite (1/2) **Inert Semi-fusinite (1/2)

TABLE 5 - Carbonization Data

Test Identification Number.....	878	879
Data of Test.....	1982-01-20	1982-01-27
Laboratory Number.....		
Description.....	Seam 44 Adit 21	Seam 3L Adit 22
<u>CARBONIZATION DATA</u>		
Net Weight of Charge (wet).....lb	566.5	565.0
Moisture in Charge.....%	3.1	3.1
ASTM Bulk Density (wet).....lb/ft ³	48.5	48.7
Oven Bulk Density (db).....lb/ft ³	50.4	50.2
<u>CARBONIZATION RESULTS</u>		
Gross Coking Time.....hr:min	9:40	10:10
Maximum Wall Pressure.....lb/in ²	0.56	0.37
Coke Yield Actual.....%	75.5	73.5
Mean Coke size.....in	1.90	2.08
Apparent Specific Gravity.....	0.933	0.928
<u>Screen Analysis of Coke</u> (cumulative percentage retained on)		
3 inch sieve.....	4.8	9.3
2 inch sieve.....	48.0	52.0
1 1/2 inch sieve.....	81.1	78.9
1 inch sieve.....	94.4	93.7
3/4 inch sieve.....	95.8	95.4
1/2 inch sieve.....	96.6	96.4
Percentage -1/2 inch (breeze).....	3.4	3.6
<u>Tumbler Test (ASTM)</u>		
Stability Factor.....	55.7	46.6
Hardness Factor.....	66.9	61.0
<u>Japanese Drum Test (JIS)</u> (cumulative percentage retained on)		
	* **	* **
50 mm sieve.....	17.0 1.5	19.6 1.7
25 mm sieve.....	88.3 73.3	84.6 63.4
15 mm sieve.....	93.5 82.0	91.7 77.2
	*30 revs **150 revs	

TABLE 6

Analyses of Coke Oven Charges and Resultant Cokes

<u>Identification</u>		
Test Number.....	878	879
Date Charged.....	1982-01-20	1982-01-27
Description.....	Seam 44 Adit 21	Seam 3L Adit 22
<u>Coke Oven Charge</u>		
Laboratory Number.....	2189-82	2250-82
<u>Proximate Analysis (db)</u>		
Ash.....%	8.9	9.4
Volatile Matter.....%	23.6	26.7
Fixed Carbon.....%	67.5	63.9
Sulphur (db).....%	0.68	0.40
<u>Resultant Coke</u>		
Laboratory Number.....	2496-82	2497-82
<u>Proximate Analysis (db)</u>		
Ash.....%	11.4	12.6
Volatile Matter.....%	1.7	2.2
Fixed Carbon.....%	86.9	85.2
Sulphur (db).....%	0.54	0.39

STRENGTH INDEX

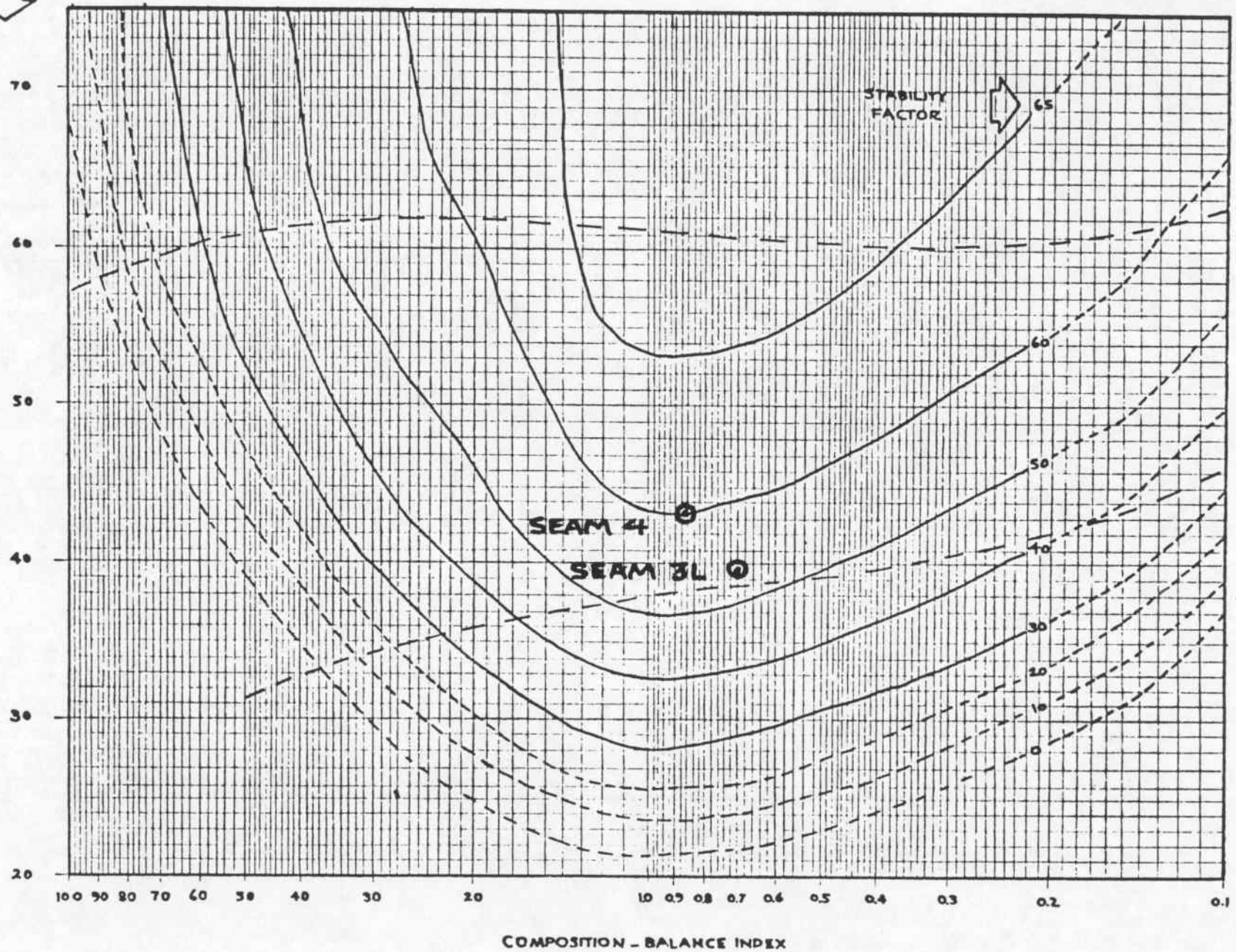
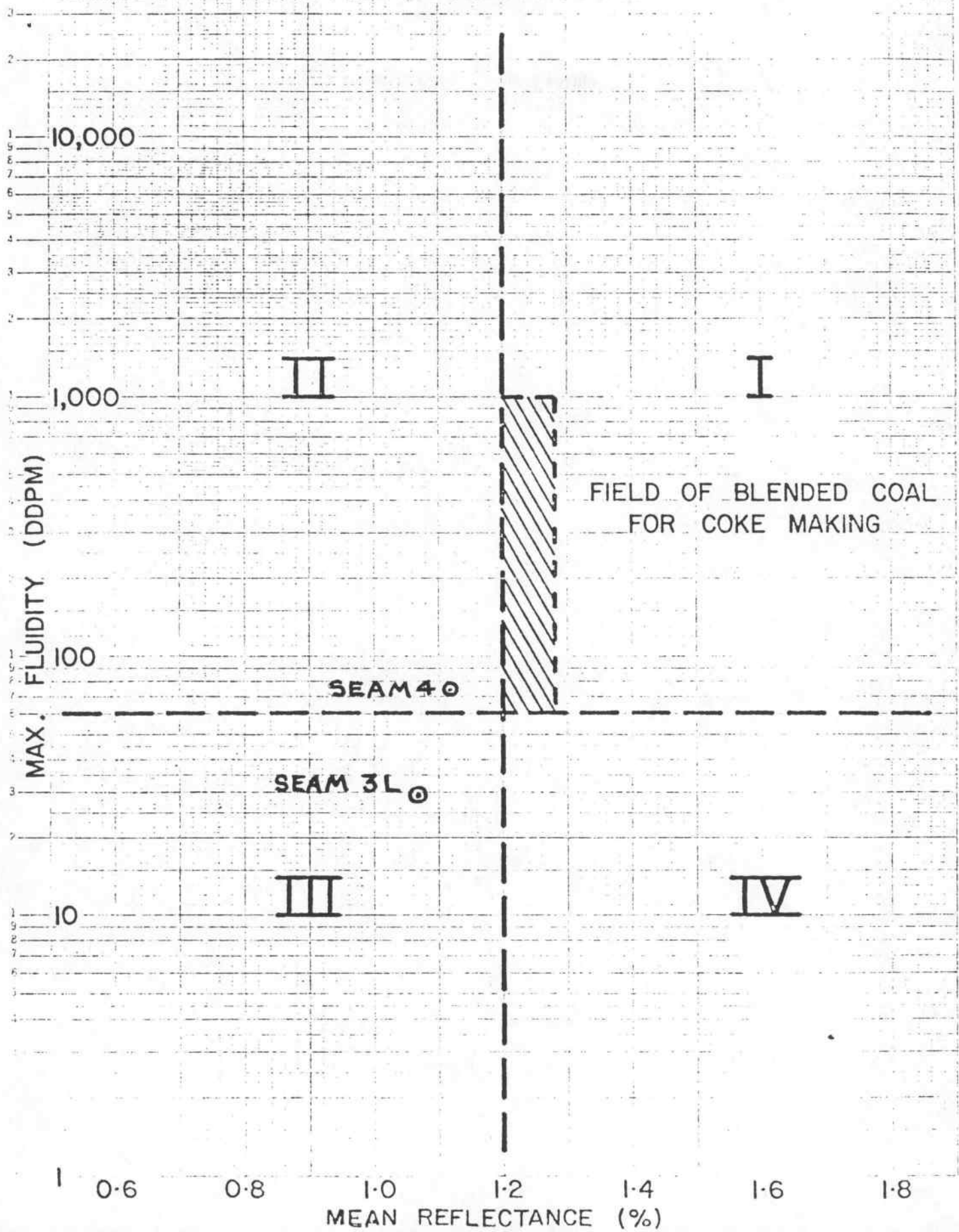


Figure 1 - Plot of Predicted Stability Factors of Component Coals from Petrographic Data.

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



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APPENDIX 1

Letter dated December 4, 1981 from H.S. Stellmach, Manager,
Utilization Technology, Crows Nest Resources Limited.



Crows Nest Resources

Eau Claire Place, 525 3rd Avenue S.W., Calgary, Alberta (403) 232-4355
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LIMITED

December 4, 1981

Dr. B.I. Parsons
Director
Energy Research Laboratories
CANMET, 555 Booth Street
Ottawa, Ontario



Dear Dr. Parsons:

Further to my conversation of December 4, 1981 with J. Jorgensen, this memo (and enclosed release against blanket purchase order) confirms my verbal request to perform complete analyses (chemical, physical, thermal, rheological and petrographic) and carbonization tests according to your standard procedures, on two coal samples being shipped to you in December:

- a) Line Creek Extension, Seam 4U, Adit 21.
- b) Line Creek Extension, Seam 3L, Adit 22.

We will be shipping at least six additional Line Creek Extension samples during January and February, 1982 for carbonization. Several carbonizations of blends will also be required. A purchase order to cover the costs of these tests will be forwarded at the time of shipment.

The early receipt of test results will be of great value to us as these results will have a direct bearing on plant and mine design currently in progress. Therefore, we would appreciate your giving us preliminary results verbally as soon as they are available.

The Line Creek Extension project is at a very early stage of development and we believe that release of test results to open file after a period of only one year would seriously prejudice our interests. We therefore would appreciate your extending the confidentiality period for all our carbonization trials **to two years from completion of the final report.**

For reasons of confidentiality we are also reluctant to complete and return your very detailed "Sample Description Form". I would like to discuss the end-use of this information with your staff before responding to your request.

Best wishes for a happy Holiday Season.

Yours truly,

H. S. Stellmach
Manager, Utilization
Technology

Enclosure

