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MOVABLE-WALL COKE OVEN TESTS AND RELATED  
ANALYSES OF RAW AND CLEANED COAL SAMPLES  
FROM EWIN PASS SUBMITTED BY CROWS NEST  
RESOURCES LIMITED

Project No. 03-3-1/11-9  
Job No. 3366R

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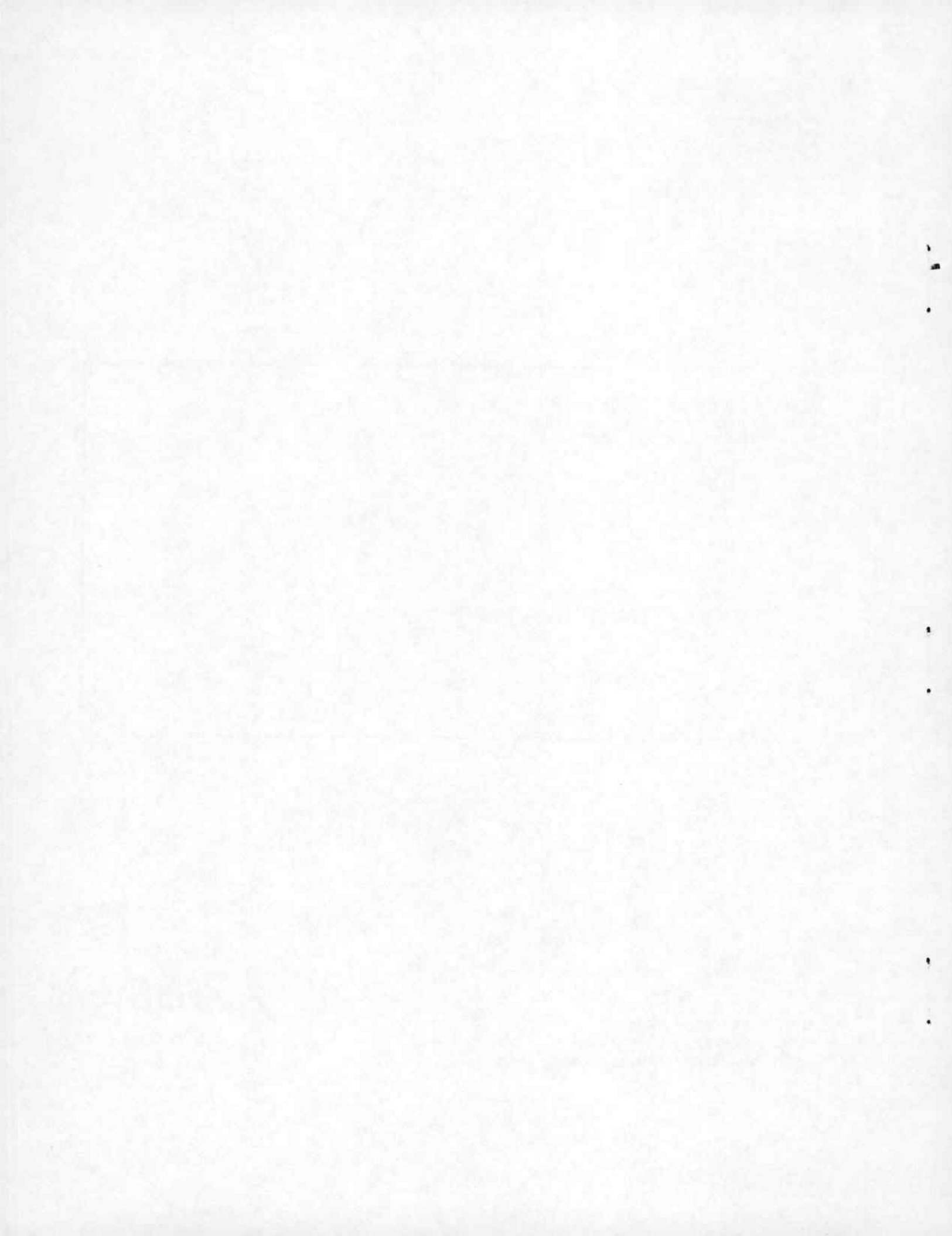
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Movable-wall Coke Oven Tests and Related Analyses  
of Raw and Cleaned Coal Samples from Ewin Pass  
Submitted by Crows Nest Resources Limited

Project No. 03-03-3-1/11-9

Job No. 3366R

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. 9 in the series and includes evaluation data on coals specified in a letter dated 3 September 1981 from H. S. Stellmach, Manager, Utilization Technology. A copy of this letter appears in Appendix 1.

The two coal samples from Ewin Pass Seam 5, Adit 4, one raw and one cleaned at Birtley Engineering, Calgary were received on September 18, 1981. The coal samples were crushed, blended and carbonized in the CANMET 12-inch width Movable-wall coke oven located at the CANMET/Energy Research Laboratories, Bells Corners Complex near Ottawa. Representative samples were taken for chemical, physical, thermal rheological, and petrographical analyses. The results are tabulated in Tables 1 to 6.

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Table 1 - Chemical Analyses of Component Coals

<u>Identification</u>		
Laboratory Number.....	4019-81	4020-81
Description.....	Clean Seam 5 Adit 4	Raw Seam 5 Adit 4
<u>Classification</u>		
Rank (ASTM).....	mvb	mvb
International System.....	434	433
Specific Volatile Index....	181	183
Carbon (dmmfb).....%	87.8	88.3
<u>Proximate Analysis (db)</u>		
Ash.....%	5.3	8.3
Volatile Matter.....%	26.7	25.6
Fixed Carbon.....%	68.0	66.1
<u>Gross Calorific Value (db)</u>		
Btu/per pound.....	14580	14110
<u>Ultimate Analysis (db)</u>		
Carbon.....%	82.6	80.1
Hydrogen.....%	4.6	4.4
Sulphur.....%	0.61	0.59
Nitrogen.....%	1.1	1.1
Ash.....%	5.3	8.3
Oxygen (by difference)....%	5.8	5.5
<u>Ash Analysis (db)</u>		
SiO <sub>2</sub> .....%	47.5	55.7
Al <sub>2</sub> O <sub>3</sub> .....%	26.6	30.7
Fe <sub>2</sub> O <sub>3</sub> .....%	12.0	1.7
TiO <sub>2</sub> .....%	1.5	1.5
P <sub>2</sub> O <sub>5</sub> .....%	3.5	2.9
CaO.....%	4.3	3.4
MgO.....%	0.6	0.0
SO <sub>3</sub> .....%	1.0	0.5
Na <sub>2</sub> O.....%	0.2	0.1
K <sub>2</sub> O.....%	0.4	0.7

Table 2 - Physical Tests and Fusibility of Ash of Component Coals

Identification

Laboratory Number.....	4019-81	4020-81
Description.....	Clean Seam 5 Adit 4	Raw Seam 5 Adit 4

Coal Pulverization

Sieve Analysis

<u>Passing</u>	<u>Retained On</u>		
	1/4 in. %	0.3	0.5
1/4 in.	1/8 in. %	13.4	15.1
1/8 in.	1/16 in. %	18.9	20.9
1/16 in.	1/32 in. %	20.4	20.9
1/32 in.	.....%	47.0	42.6
Total Passing	1/8 in. %	86.3	84.4

Grindability

Hardgrove Index .....	76	75
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Fusibility of Ash

Initial Deformation Temp .....	2215	2700+
Softening Temp. Spherical.....	2475	2700+
Softening Temp. Hemispherical...	2600	2700+
Fluid Temp .....	2640	2700+

Table 3 - Thermal Rheological Properties of Component Coals

Identification

Laboratory Number.....	4019-81	4020-81
Description.....	Clean Seam 5 Adit 4	Raw Seam 5 Adit 4

Linear Expansion

Bd. 52 lb/ft<sup>3</sup> at 2% moisture...%

Gieleler Plasticity

Start.....°C	423	428
Fusion Temp.....°C	437	438
Max Fluid Temp.....°C	462	461
Final Fluid Temp.....°C	488	487
Solidification Temp.....°C	491	491
Melting Range.....°C	65	59
Max Fluidicity.....dd/m	215	180
Torque.....g.in.	40	40

Dilatation

T <sub>i</sub> - Softening Temp.....°C	395	393
T <sub>ii</sub> - Max Contraction.....°C	438	440
T <sub>iii</sub> - Max Dilatation Temp....°C	470	473
Contraction.....%	25	26
Dilatation.....%	66	50

Free Swelling Index

F.S.I.....	8 $\frac{1}{2}$	8
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Table 4 - Petrographic Analysis of Component Coals

<u>Identification</u>			
Laboratory Number.....	4019-81		4020-81
Description .....	Clean		Raw
	Seam 5		Seam 5
	Adit 4		Adit 4
<u>Distribution of Vitrinite Types</u>			
V-6.....%			
V-7.....%			
V-8.....%			
V-9.....%	2.0		2.0
V-10.....%	38.7		33.3
V-11.....%	24.7		30.0
V-12.....%	1.3		
V-13.....%			
V-14.....%			
V-15.....%			
V-16.....%			
V-17.....%			
V-18.....%			
<u>Reactive Components</u>			
Total Vitrinite.....%	66.7		65.3
Reactive Semi-fusinite (1/2)....%	11.1		10.9
Exinite.....%	1.8		1.4
Total.....%	79.6		77.6
<u>Inert Components</u>			
Inert Semi-fusinite (1/2).....%	11.1		10.9
Micrinite.....%	3.1		2.8
Fusinite.....%	3.2		4.0
Mineral Matter.....%	3.0		4.7
Total.....%	20.4		22.4
<u>Petrographic Indices</u>			
Mean Reflectance.....%	1.09		1.09
Balance Index.....	0.74		0.84
Strength Index.....	4.07		4.14
Stability Index.....	55.3		57.3

Table 5 - Carbonization Data

Test Identification Number.....	876	875		
Date of Test.....	30/09/81	29/09/81		
Laboratory Number.....				
Description.....	Ewin Pass Seam 5 Adit 4 Clean Coal	Ewin Pass Seam 5 Adit 4 Raw Coal		
<u>Carbonization Data</u>				
Net Weight of Charge (wet).....lb	554.8	563.3		
Moisture in Charge.....	3.1	3.0		
ASTM Bulk Density (wet).....lb/ft <sup>3</sup>	-	-		
Oven Bulk Density (db).....lb/ft <sup>3</sup>	49.3	50.1		
<u>Carbonization Results</u>				
Gross Coking Time.....hr:min	9:30	9:30		
Maximum Wall Pressure.....lb/in <sup>2</sup>	0.87	0.83		
Coke Yield Actual.....%	74.9	75.6		
Mean Coke Size.....in	1.92	1.99		
Apparent Specific Gravity.....	0.87	0.92		
<u>Screen Analysis of Coke</u> (cumulative percentage retained on)				
3 inch sieve.....	2.6	7.1		
2 inch sieve.....	40.5	46.1		
1 1/2 inch sieve.....	77.0	75.3		
1 inch sieve.....	94.7	92.2		
3/4 inch sieve.....	96.2	95.1		
1/2 inch sieve.....	96.9	96.0		
Percentage - 1/2 inch (breeze).....	3.1	4.0		
<u>Tumbler Test (ASTM)</u>				
Stability Factor.....	54.9	44.4		
Hardness Factor.....	65.7	64.4		
<u>Japanese Drum Test (JIS)</u> (cumulative percentage retained on)				
50 mm sieve.....	14.4	3.2	10.2	0.8
25 mm sieve.....	87.5	70.5	80.1	57.9
15 mm sieve.....	92.8	81.2	90.6	76.8
	*30 revs	**150 revs		

Table 6 - Analyses of Coke Oven Charges and Resultant Cokes

Identification

Test Number.....	876	875
Date Charged.....	30/09/81	29/09/81
Description.....	Clean Seam 5 Adit 4	Raw Seam 5 Adit 4

Coke Oven Charge

Laboratory Number.....	4019-81	4020-81
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Proximate Analysis (db)

Ash.....%	5.3	8.3
Volatile Matter....%	26.7	25.6
Fixed Carbon.....%	68.0	66.1
Sulphur (db) .....%	0.61	0.59

Resultant Coke

Laboratory Number.....	4131-81	4130-81
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Proximate Analysis (db)

Ash.....%	7.1	10.8
Volatile Matter....%	1.4	1.5
Fixed Carbon.....%	91.5	87.7
Sulphur (db).....%	0.55	0.51

STRENGTH INDEX

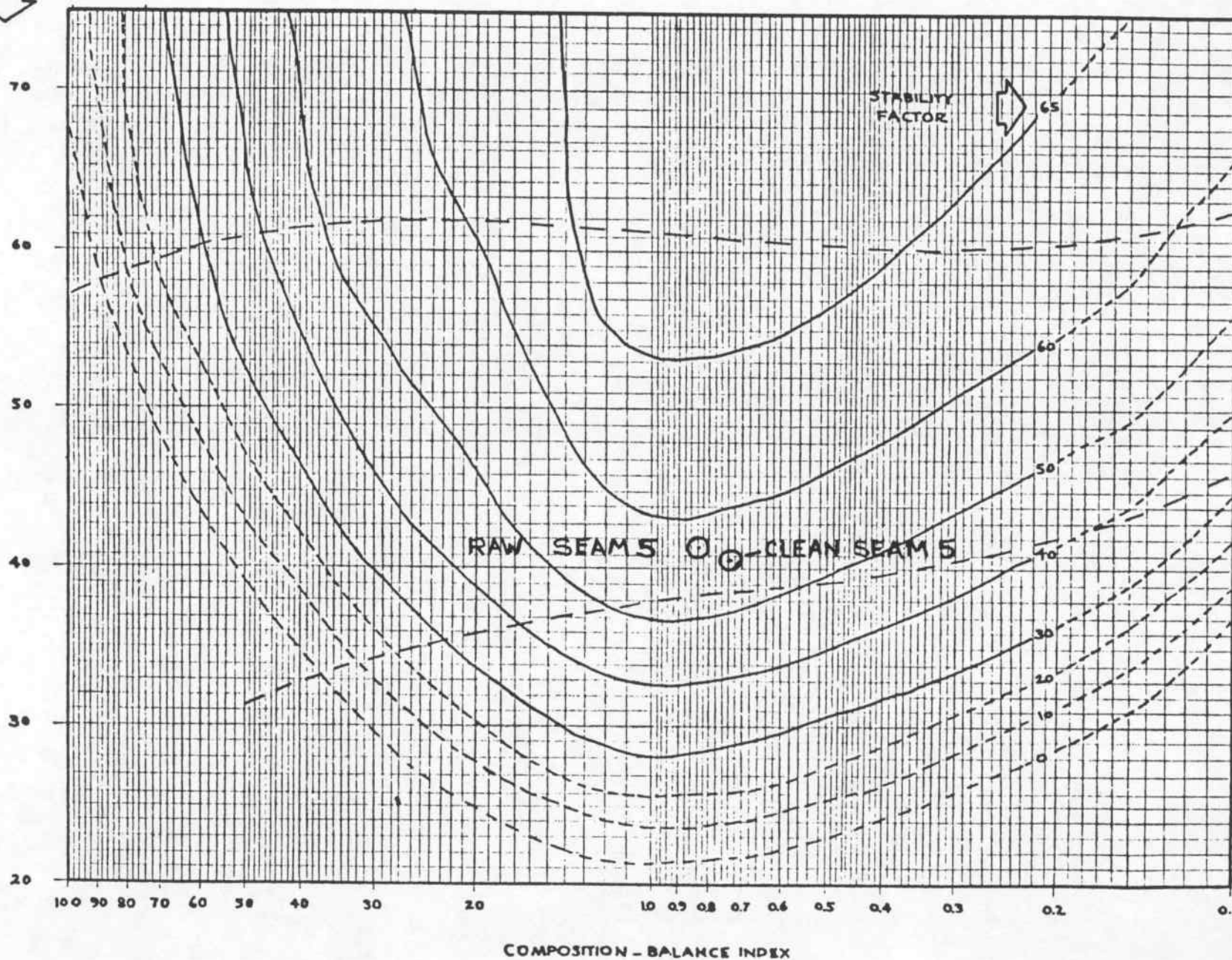
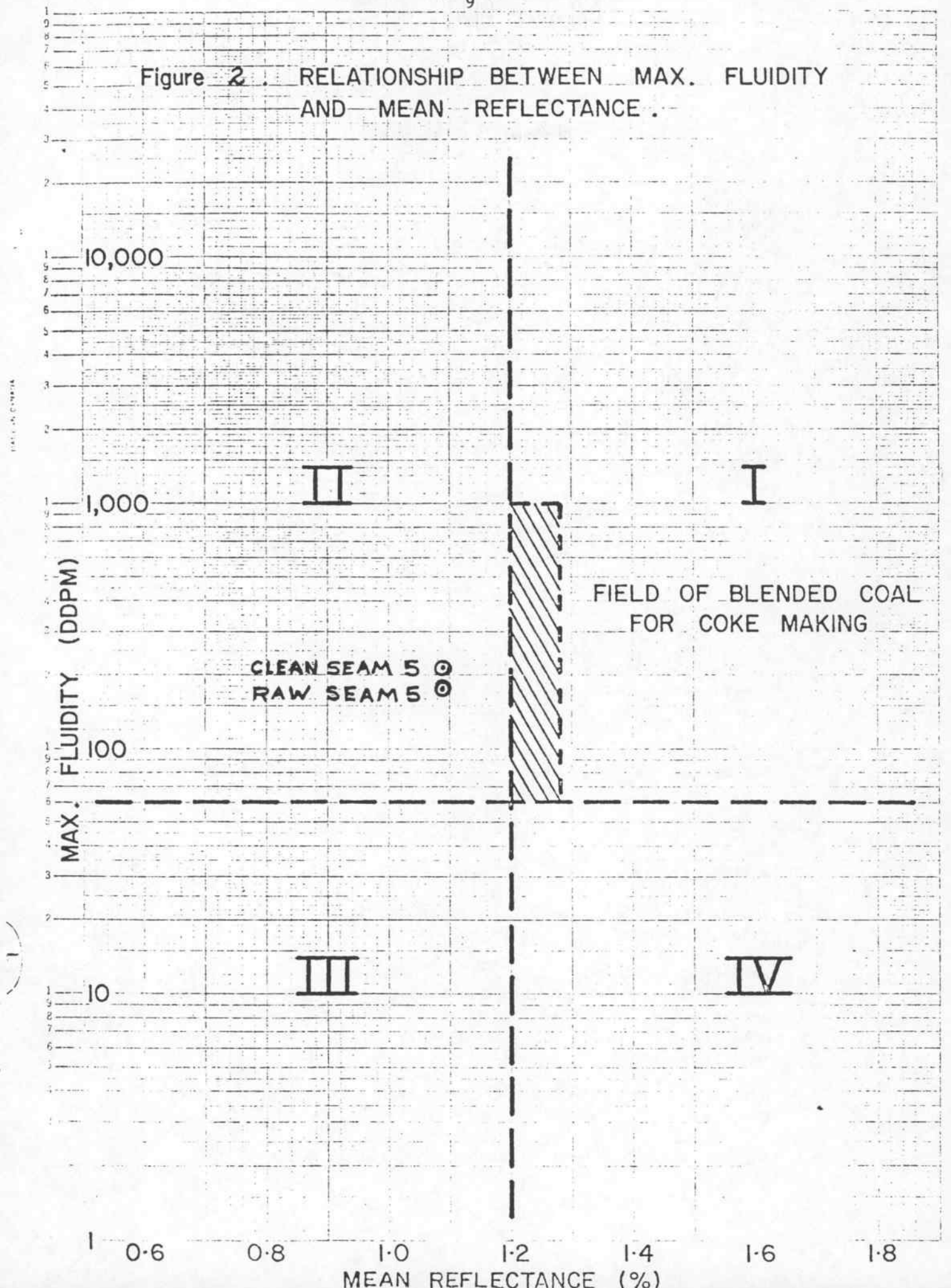


Fig. 1 - Predicted stability factors from petrographic data of component coals

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



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APPENDIX 1

Letter dated September 3, 1981 from  
H. S. Stellmach, Manager - Utilization Technology





# Crows Nest Resources

Eau Claire Place, 525 - 3rd Avenue S.W., Calgary, Alberta (403) 232-4355 **LIMITED**  
P.O. Box 2699, Station M, Calgary, Alberta T2P 2M7 Telex 03-822505

September 3, 1981

Mr. J. Jorgensen  
Energy Research Laboratories  
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555 Booth Street  
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K1A 0G1

Dear John:

Further to our discussions of September 2, 1981, this memo (and enclosed release against blanket purchase order) confirms my verbal request to:

- a) perform complete analyses (chemical, physical, thermal, rheological and petrographic) and carbonization tests according to your standard procedures on two coal samples:
  1. Ewin Pass raw coal (8.5% ash) from Seam 5, Adit 4 (two drums shipped).
  2. Ewin Pass washed coal (5.3% ash) from Seam 5, Adit 4 (two drums shipped).
- b) Determine a petrographic reflectance distribution (below 2%) for the semi-fusinite fraction of the washed coal sample. Macerals with reflectance above 2% may be lumped together.

Yours truly,

H.S. Stellmach  
Manager - Utilization Technology

HSS:mt

att:

