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AN INVESTIGATION OF THE CAKING AND COKING PROPERTIES
OF THREE SMOKY RIVER COAL SAMPLES
SUBMITTED BY MCINTYRE MINES LIMITED

Project No. 03-5-1/20-8
Job No. 3370R

J. G. Jorgensen, T. A. Lloyd and A. B. Fung
Combustion and Carbonization Research Laboratory
Western Research Laboratory

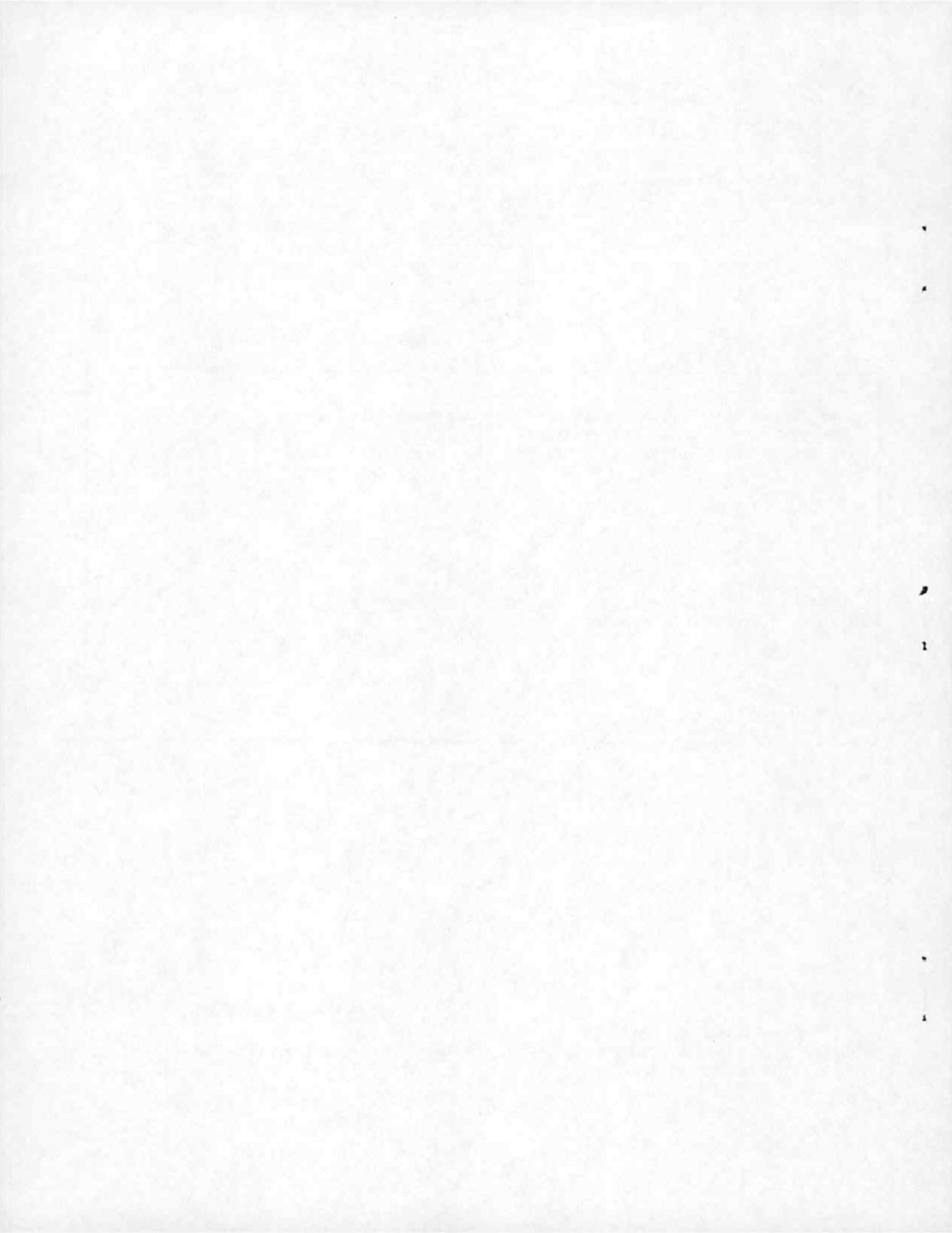
JUNE 1982

ENERGY RESEARCH PROGRAM
ENERGY RESEARCH LABORATORIES
DIVISION REPORT 82-30 (CF)


Declassification Date:
July 1983

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An Investigation of the Caking and Coking
Properties of Three Smoky River Coal Samples

Submitted by
McIntyre Mines Limited

Project 03-5-1/20-8
Job No. 337OR

by

J.G. Jorgensen*, T.A. Lloyd**, and A.B. Fung***

INTRODUCTION

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

This report includes evaluation data on three coal samples identified as No. 572-CM, No. 717-CM, and a 3:1 blend of samples No. 1002:572 from the Smoky River Property. The project was initiated by G. Grant Smith, Senior Staff Engineer, McIntyre Mines Limited in a letter dated October 19, 1981. A copy of this letter is included in Appendix 1.

The cleaned coal samples received from Birtley Coal and Mineral Testing, Calgary, were crushed, blended and carbonized in the 18 inch width Carbolite movable-wall coke oven located at the Western Research Laboratory at Edmonton. Representative samples were taken for chemical, physical, thermal rheological, and petrographical analyses which were carried out at the Energy Research Laboratories located at the CANMET Bells Corners Complex near Ottawa. The results of the testing program are tabulated in Tables 1 to 6.

*Head, Petrographic Section, **Head, Conventional Cokemaking Section, Combustion and Carbonization Research Laboratory, Energy Research Laboratories

***Carbonization Engineer, Western Research Laboratory, Coal Research Laboratories, CANMET, Department of Energy, Mines and Resources, Ottawa, Canada. K1A 0G1

TABLE 1 Chemical Analyses of Component Coals

<u>Identification</u>			
Laboratory Number	2191-82	2192-82	2695-82
Description	572-CM	717-CM	75% 1002-CM 25% 572-CM
<u>Classification</u>			
Rank (ASTM)	1vb	1vb	1vb
International System	321	321	332
Specific Volatile Index	225	222	206
Carbon (dmmfb)	93.5	93.1	91.6
<u>Proximate Analysis (db)</u>			
Ash	6.7	6.8	7.1
Volatile Matter	15.5	16.3	18.1
Fixed Carbon	77.8	76.9	74.8
<u>Gross Calorific Value (db)</u>			
Btu per pound	14600	14610	14425
<u>Ultimate Analysis (db)</u>			
Carbon	86.6	86.1	84.4
Hydrogen	4.3	4.3	4.1
Sulphur	0.46	0.48	0.34
Nitrogen	1.1	1.3	0.9
Ash	6.7	6.8	7.1
Oxygen (by difference)	0.8	1.0	3.2
<u>Ash Analysis (db)</u>			
SiO ₂	63.8	58.1	53.6
Al ₂ O ₃	23.6	25.9	29.8
Fe ₂ O ₃	6.1	6.3	4.9
TiO ₂	1.1	1.2	1.4
P ₂ O ₅	0.9	2.1	1.2
CaO	2.1	3.1	3.0
MgO	0.7	0.5	0.3
SO ₃	1.1	0.8	1.6
Na ₂ O	0.5	0.8	0.8
K ₂ O	0.3	0.3	0.3

TABLE 2 Physical Tests and Fusibility of Ash of Component Coals

<u>Identification</u>				
Laboratory Number	2191-82	2192-82	2695-82	
Description	572-CM	717-CM	75% 1002-CM 25% 572-CM	
<u>Coal Pulverization</u>				
Sieve Analysis				
Passing	Retained On			
	1/4 in.	%	6.3	2.7
1/4 in.	1/8 in.	%	14.7	10.9
1/8 in.	1/16 in.	%	20.9	18.9
1/16 in.	1/32 in.	%	16.2	16.1
1/32 in.	%	41.9	51.4
Total Passing	1/8 in.	%	79.0	86.4
				81.7
<u>Grindability</u>				
Hardgrove Index	90	100	89	
<u>Fusibility of Ash</u>				
Initial Deformation Temp. ...	^o F	2360	2415	2530
Softening Temp. Spherical ...	^o F	2700+	2640	2700+
Softening Temp. Hemispherical	^o F	2700+	2700+	2700+
Fluid Temp.	^o F	2700+	2700+	2700+

TABLE 3 Thermal Rheological Properties of Component Coals

<u>Identification</u>			
Laboratory Number	2191-82	2192-82	2695-82
Description	572-CM	717-CM	75% 1002-CM 25% 572-CM
<u>Linear Expansion</u>			
Bd. 52 lb/ft ³ at 2% moisture...%			
<u>Gieseler Plasticity</u>			
Start	-	-	467
Fusion Temp.	-	-	-
Max. Fluid Temp.	472	474	472
Final Fluid Temp.	-	-	484
Solidification Temp.	486	492	495
Melting Range	-	-	17
Max. Fluidity	0.5	0.6	1.2
Torque	40	40	40
<u>Dilatation</u>			
Ti - Softening Temp.	449	446	437
Tii - Max. Contraction Temp.	-	-	485
Tiii - Max. Dilatation Temp.	-	-	-
Contraction	11	17	25
Dilatation	Nil	Nil	Nil
	@500°C	@500°C	@500°C
<u>Free Swelling Index</u>			
F.S.I.	2½	3½	6½

TABLE 4 Petrographic Analysis of Component Coals

<u>Identification</u>			
Laboratory Number.....	2191-82	2192-82	2695-82
Description.....	572-CM	717-CM	75% 1002-CM 25% 752-CM
<u>Distribution of Vitrinite Types</u>			
V-6.....%			
V-7.....%			
V-8.....%			
V-9.....%			
V-10.....%			
V-11.....%			
V-12.....%			
V-13.....%			
V-14.....%			3.7
V-15.....%	5.9	7.3	22.8
V-16.....%	21.1	33.9	32.0
V-17.....%	13.5	19.4	3.0
V-18.....%	1.7		
<u>Reactive Components</u>			
Total Vitrinite.....%	42.2	60.6	61.5
Reactive Semi-fusinite (1/3).....%	23.7	13.4	13.0
Exinite.....%	0.0	0.0	0.0
Total.....%	65.9	74.0	74.5
<u>Inert Components</u>			
Inert Semi-fusinite (2/3).....%	23.7	13.4	13.0
Micrinite.....%	2.0	1.6	2.4
Fusinite.....%	4.7	7.1	6.2
Mineral Matter.....%	3.7	3.9	3.9
Total.....%	34.1	26.0	25.5
<u>Petrographic Indices</u>			
Mean Reflectance.....%	1.67	1.66	1.60
Balance Index.....	6.44	4.33	3.70
Strength Index.....	7.08	7.25	7.16
Stability Index.....	30.6	46.5	52.0

TABLE 5- Carbonization Conditions

Test Identification Number.....	C-119	C-120	C-129
Date of Test.....	Dec.3/81	Dec.8/81	Feb.11/82
Coke Oven Identification.....			
Description.....	572-CM	717-CM	75% 1002-CM 25% 572-CM

CHARGE PROPERTIES

Proximate Analysis (db) Ash.....%	6.7	6.8	7.1
Volatile Matter.....%	15.5	16.3	18.1
Fixed Carbon.....%	77.8	76.9	74.8
Moisture in Charge.....%	2.6	2.5	3.1
Minus 1/8 in. (6 mesh).....%	79.0	86.4	81.7
Other:.....			
.....			

CARBONIZATION CONDITIONS

Net Weight of Charge (wet).....lb	654.6	653.7	642.5
ASTM Cone Bulk Density (wet).....lb/ft ³	49.5	49.0	48.7
Calc. Charge Dry Bulk Density in Oven...lb/ft ³	51.4	51.4	50.2
Flue Temp Control.....			
Charge Push (Centre Temp:Soak Time).....°C:hr	950:3	950:3	950:3
Quenched Coke Conditioning Drop.....ft	10	10	10

CARBONIZATION RESULTS

Gross Coking Time (at Push).....hr:min	19:51	19:41	18:25
Final Centre Temp.....°C	1064	1073	1059
Time to 900°C Centre Temp.....hr:min	16:21	16:08	15:10
Time to 950°C Centre Temp.....hr:min	16:51	16:41	15:25
Time to 1000°C Centre Temp.....hr:min	17:44	17:26	17:08
Maximum Wall Pressure.....lb/in ²	0.57	0.73	3.94
Coke Yield Actual.....%	79.4	78.0	78.9

TABLE 6 - Coke Properties

Test Identification Number.....	C-119	C-120	C-129
<u>SCREEN ANALYSIS OF COKE</u>			
(cum % retained on)			
4 inch sieve.....	5.0	4.7	4.5
3 inch sieve.....	18.4	19.5	25.3
2 inch sieve.....	39.7	46.3	71.6
1½ inch sieve.....	45.2	54.1	86.8
1 inch sieve.....	49.6	59.4	92.4
¾ inch sieve.....	51.0	60.3	93.4
½ inch sieve.....	45.2	61.1	94.2
Percentage -½ inch (breeze).....	47.6	38.9	5.8
Mean Coke Size.....in.	1.52	1.71	2.45
<u>COKE CHEMICAL ANALYSIS</u>			
Proximate Analysis (db)			
Ash.....%	7.9	8.2	8.1
Volatile Matter.....%	0.8	0.9	1.3
Fixed Carbon.....%	91.3	90.9	90.6
Sulphur (db).....%	0.35	0.39	0.30
<u>COKE APPARENT SPECIFIC GRAVITY.....</u>	1.00	0.99	0.93
<u>ASTM COKE TUMBLER TEST</u>			
Stability Factor.(cum % + 1 in.).....	23.2	32.4	53.1
Hardness Factor.(cum % + 1/4 in.).....	36.5	40.7	61.4
<u>JIS COKE TUMBLE TEST</u>			
(cum % retained on)			
30 revs: 50 mm sieve.....	9.7	15.8	22.0
25 mm sieve.....	52.3	66.0	89.1
15 mm sieve.....	59.1	71.5	92.9
150 revs: 50 mm sieve.....	0.0	1.7	5.8
25 mm sieve.....	28.1	40.8	72.3
15 mm sieve.....	36.9	49.2	78.4

OTHER

STRENGTH INDEX

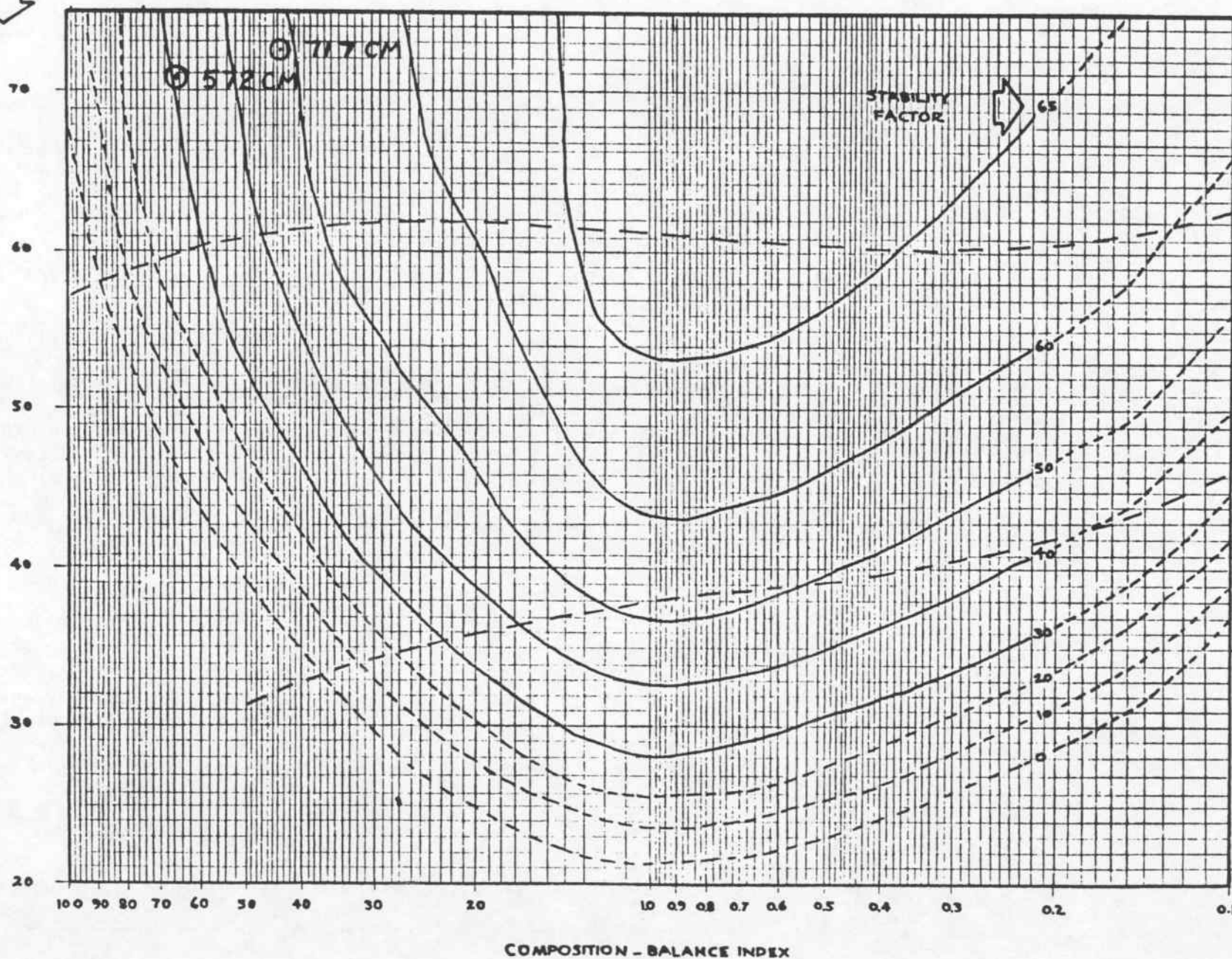


Figure 1. Plot of Predicted Stability Factors of Component Coals from Petrographic Data.

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APPENDIX 1

Letter dated October 19, 1981 from G. Grant Smith, Senior Staff
Officer, McIntyre Mines Limited.

MCINTYRE MINES

EXECUTIVE OFFICES
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October 19, 1981

Department of Energy, Mines & Resources
Western Research Laboratory
P.O. Box 3294
Sherwood Park, Alberta
T8A 2A6

Attention: Ms. Jackie Picard

Dear Ms. Picard:

McIntyre is currently extensively evaluating four (4) bulk samples of Smoky River coals. The sampling/testing program was previously discussed with Dr. Ross Leader and more recently (October 6, 1981), in telephone conversation with Mr. A. Fung. Two (2) bulk samples have been dispatched to Birtley Coal & Mineral Testing for washing and testing, (refer to attached letter). Two (2) additional samples will be delivered to Birtley within the next few weeks.

When suitable clean coal is available, McIntyre wishes to proceed with a complete carbonization analysis of each sample. Could you please advise us of the disposition of your Western Research Laboratory to conduct a comprehensive analysis of these four (4) samples in a manner similar to that of your project 03-5-1/20-7 - for our coal sample from Mine 9A-4 at Smoky River, (refer to attached report ERP/ERL 81-11 (CT)). Please arrange carbonization testing and costing for this project in accordance with our association with the Canadian Carbonization Research Association.

Upon your advice, I shall arrange to have the drums of clean coal delivered to the Western Research Laboratory. Furthermore, I shall forward all test reports provided by Birtley in accordance with the attached letter.

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Ms. J. Picard
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We are anxious to expedite this coal evaluation program and would appreciate if you would telephone me (267-4534) if further clarification is required.

Yours truly,



G. Grant Smith
Senior Staff Engineer

cc: J.G. Jorgensen,
CANMET

A.B. Fung,
Dept. of Energy, Mines & Resources

GGS/sds
Attachments

