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A STUDY OF THE CAKING AND COKING CHARACTERISTICS OF CLEANED ADIT SAMPLES FROM SEAMS B1, B4, B5 AND B9 FROM THE MONKMAN COAL PROJECT IN N.E. BRITISH COLUMBIA SUBMITTED BY PETRO-CANADA

Project 03-3-1/29-2
Job No. 3227R

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by

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

INTRODUCTION

This investigation deals with the evaluation of four cleaned adit coal samples from seams B1, B4, B5 and B9 from the Monkman Coal Project in Northeastern British Columbia. The project was initiated by J.Y. Wright, Chief Geologist, Petro-Canada, in a letter dated June 6, 1979, which is reproduced in Appendix 1.

The raw adit samples were cleaned by Birtley Engineering (Canada) Ltd., Calgary. The bulk samples were carbonized in the 12-inch width movable-wall coke oven located at the CANMET Bells Corners Complex near Ottawa. Representative samples were taken and analysed for complete 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, Petrography Section, Carbonization Operations Section, and Coal Treatment and Rheology 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	3805-79	3806-79	3852-79	4120-79
Description	79-B-4	79-B-1	79-B-5	79-B-9
Classification				
Rank (ASTM)	mvb	mvb	mvb	mvb
International System	432	433	432	433
Specific Volatile Index	195	199	191	184
Carbon (dmmfb) %	92.1	90.5	89.7	89.2
Proximate Analysis (db)				
Ash %	7.1	6.3	8.7	7.7
Volatile Matter %	22.4	22.3	22.7	25.9
Fixed Carbon %	70.5	71.4	68.6	66.4
Gross Calorific Value (db)				
Btu per pound	14455	14645	14105	14240
Ultimate Analysis (db)				
Carbon %	84.9	84.2	81.0	81.6
Hydrogen %	5.0	4.7	4.4	4.7
Sulphur %	0.26	0.79	0.55	0.51
Nitrogen %	1.0	1.0	1.1	0.8
Ash %	7.1	6.3	8.7	7.7
Oxygen (by difference) %	1.7	3.0	4.2	4.7
Ash Analysis (db)				
SiO_2 %	53.9	57.4	49.7	56.2
Al_2O_3 %	23.3	25.6	26.3	25.6
Fe_2O_3 %	4.6	7.1	5.3	5.6
TiO_2 %	1.4	1.0	1.2	1.2
P_2O_5 %	1.5	0.2	4.1	2.3
CaO %	4.0	1.0	4.4	2.7
MgO %	1.4	0.4	0.9	0.8
SO_3 %	4.7	1.3	1.9	0.9
Na_2O %	1.1	0.5	0.5	0.3
K_2O %	0.5	1.4	1.0	1.3

TABLE 2 Physical Tests and Fusibility of Ash of Component Coals

Identification					
Laboratory Number		3805-79	3806-79	3852-79	4120-79
Description		79-B-4	79-B-1	79-B-5	79-B-9
Coal Pulverization					
Sieve Analysis					
Passing	Retained On				
	1/4 in. %	0.2	0.1	0.1	0.1
1/4 in.	1/8 in. %	12.1	11.8	10.0	10.8
1/8 in.	1/16 in. %	17.2	18.3	15.6	18.2
1/16 in.	1/32 in. %	16.7	19.2	17.7	20.8
1/32 in.	.....%	53.8	50.6	56.6	50.1
Total Passing	1/8 in. %	87.7	88.1	89.9	89.1
Grindability					
Hardgrove Index		85	90	86	77
Fusibility of Ash					
Initial Deformation Temp. ...	°F	2160	2380	2240	2570
Softening Temp. Spherical ...	°F	2620	2700+	2600	2700+
Softening Temp. Hemispherical	°F	2700+	2700+	2700+	2700+
Fluid Temp.	°F	2700+	2700+	2700+	2700+

TABLE 3 Thermal Rheological Properties of Component Coals

Identification				
Laboratory Number	3805-79	3806-79	3852-79	4120-79
Description	79-B-4	Monkman 79-B-1	79-B-5	79-B-9
Linear Expansion				
Bd. 52 lb/ft^3 at 2% moisture...%	-12.5	-7.3	-14.7	-17.8
Gieseler Plasticity				
Start .....°C	439	429	432	428
Fusion Temp. .....°C	462	444	447	440
Max. Fluid Temp. .....°C	466	466	465	460
Final Fluid Temp. .....°C	482	491	487	481
Solidification Temp. .....°C	489	495	492	485
Melting Range .....°C	43	62	55	53
Max. Fluidity .....dd/m	8.1	117.5	35	49.2
Torque .....g.in.	40	40	40	40
Dilatation				
Ti - Softening Temp. .....°C	416	394	400	395
Tii - Max. Contraction Temp. °C	455	442	450	444
Tiii - Max. Dilatation Temp. .°C	474	470	479	468
Contraction .....%	24	26	26	28
Dilatation .....%	-16	35	-9	0
Free Swelling Index				
F.S.I.	6½	8	7	7

TABLE 4 Petrographic Analysis of Component Coals

Identification				
Laboratory Number.....	3805-79	3806-79	3852-79	4120-79
Description.....	79-B-4	79-B-1	79-B-5	79-B-9
Distribution of Vitrinite Types				
V-6.....%				
V-7.....%				
V-8.....%				
V-9.....%				
V-10.....%			1.1	10.9
V-11.....%	4.7	1.8	4.6	33.9
V-12.....%	32.2	17.0	40.1	9.9
V-13.....%	15.1	37.7	10.9	
V-14.....%		4.3	0.6	
V-15.....%				
V-16.....%				
V-17.....%				
V-18.....%				
Reactive Components				
Total Vitrinite.....%	52.0	60.8	57.3	54.7
Reactive Semi-fusinite (1/2)...%	14.6	12.5	12.6	13.3
Exinite.....%	0.0	0.0	0.0	0.6
Total.....%	66.6	73.3	69.9	68.6
Inert Components				
Inert Semi-fusinite (1/2).....%	14.6	12.6	12.7	13.4
Micrinite.....%	6.9	6.8	6.4	4.6
Fusinite.....%	8.0	3.7	6.1	9.1
Mineral Matter.....%	3.9	3.6	4.9	4.3
Total.....%	33.4	26.7	30.1	31.4
Petrographic Indices				
Mean Reflectance.....%	1.26	1.31	1.25	1.15
Balance Index.....	2.15	1.80	1.80	1.47
Strength Index.....	4.94	5.60	4.90	4.34
Stability Index.....	52.4	59.5	54.5	53.4

TABLE 5 - Carbonization Data

Test Identification Number	746		742		758		747	
Data of Test	10 Dec./79		15 Nov./79		8 Feb./80		11 Dec./79	
Laboratory Number	3805-79		3806-79		3852-79		4120-79	
Description	79-B-4		79-B-1		79-B-5		79-B-9	
CARBONIZATION DATA								
Net Weight of Charge (wet)....lb	567.5		538.1		554.8		551.8	
Moisture in Charge....%	3.0		3.0		2.8		3.0	
ASTM Bulk Density (wet)....lb/ft^3	-		-		-		-	
Oven Bulk Density (db)....lb/ft^3	51.8		49.1		50.7		50.3	
CARBONIZATION RESULTS								
Gross Coking Time....hr:min	9:20		8:45		8:45		9:05	
Maximum Wall Pressure....lb/in^2	0.7		1.2		0.3		0.4	
Coke Yield Actual....%	77.9		77.9		77.5		75.2	
Mean Coke size....in	1.86		1.96		1.94		1.89	
Apparent Specific Gravity	0.99		0.93		0.95		0.96	
Screen Analysis of Coke (cumulative percentage retained on)								
3 inch sieve	5.8		7.1		6.6		4.8	
2 inch sieve	36.6		40.7		42.9		39.9	
1 1/2 inch sieve	67.4		72.4		71.4		69.3	
1 inch sieve	92.7		93.9		92.0		92.8	
3/4 inch sieve	94.9		96.3		94.3		95.3	
1/2 inch sieve	95.7		97.2		95.2		96.4	
Percentage -1/2 inch (breeze)	4.3		2.8		4.8		3.6	
Tumbler Test (ASTM)								
Stability Factor	52.7		59.5		52.1		45.5	
Hardness Factor	65.1		71.5		64.7		63.9	
Japanese Drum Test (JIS) (cumulative percentage retained on)	*	**	*	**	*	**	*	**
50 mm sieve	9.1	1.6	19.9	4.0	17.3	2.0	15.3	-
25 mm sieve	86.4	68.0	86.2	71.3	86.6	70.5	85.3	66.2
15 mm sieve	92.6	81.2	96.6	83.2	93.2	81.0	91.8	77.5

*30 revs **150 revs

TABLE 6

Analyses of Coke Oven Charges and Resultant Cokes

Identification				
Test Number.....	746	742	758	747
Date Charged.....	10/12/79	15/11/79	8/2/80	11/12/79
Description.....	79-B-4	79-B-1	79-B-5	79-B-9
Coke Oven Charge				
Laboratory Number.....	3805-79	3806-79	3852-79	4120-79
Proximate Analysis (db)				
Ash.....%	7.1	6.3	8.7	7.7
Volatile Matter.....%	22.4	22.3	22.7	25.9
Fixed Carbon .....%	70.5	71.4	68.6	66.4
Sulphur (db).....%	0.26	0.79	0.55	0.51
Resultant Coke				
Laboratory Number.....	2032-80	2028-80	2034-80	2033-80
Proximate Analysis (db)				
Ash.....%	8.7	8.0	11.1	9.9
Volatile Matter.....%	2.0	1.8	1.3	1.8
Fixed Carbon.....%	89.3	90.2	87.6	88.3
Sulphur (db).....%	0.20	0.70	0.52	0.45

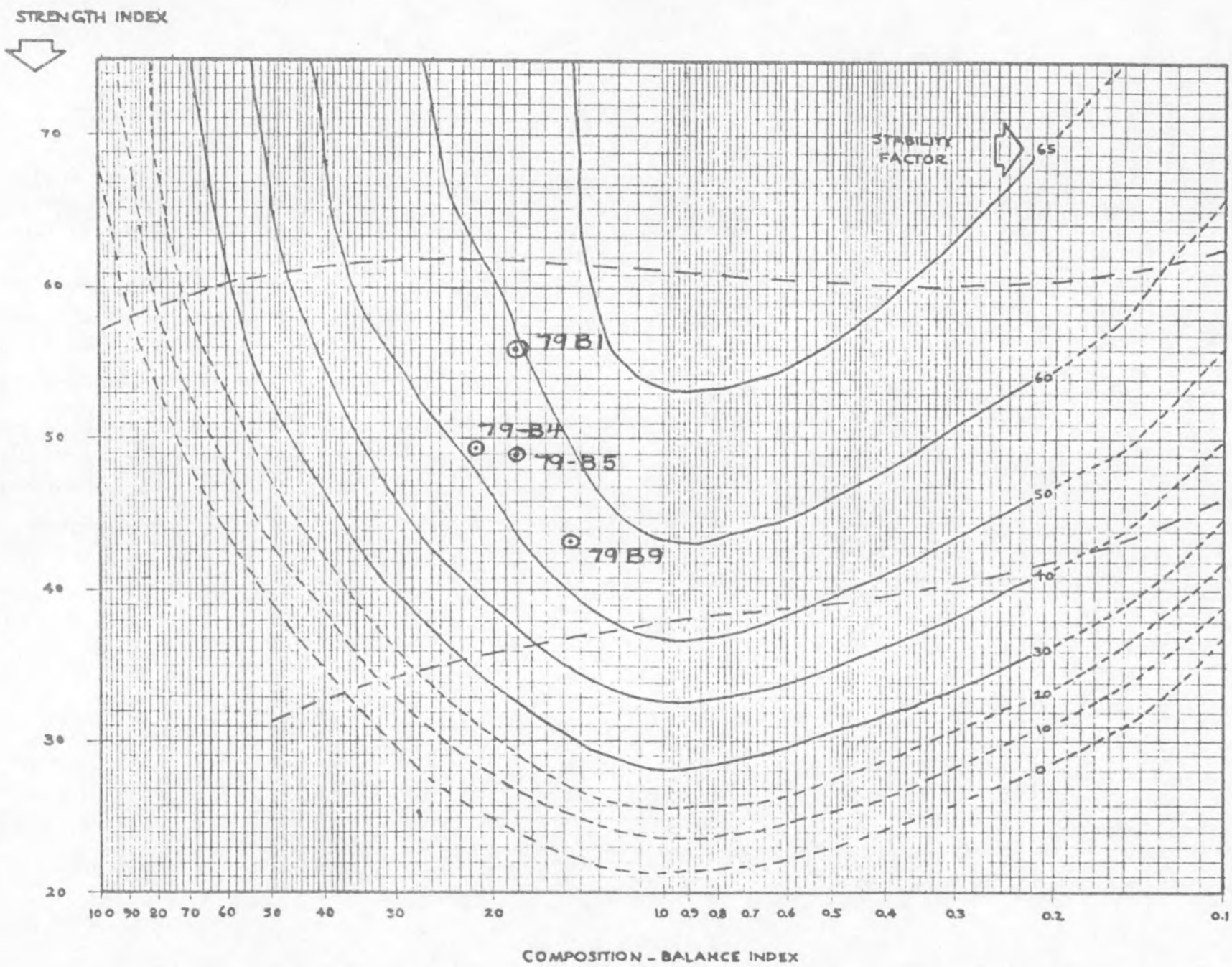

Figure 1. Plot of Predicted Stability Factors from Petrographic Data for Component Coals.

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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).

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APPENDIX 1

Letter dated June 6, 1979 from J.Y. Wright, Chief Geologist, Mining Department, Petro-Canada.

Petro-Canada

June 6, 1979

Mr. Jack Botham
CANMET
555 Booth Street
OTTAWA, Ontario
K1A 0G1

Dear Jack:

Re: Monkman Coal Project -
Bulk Samples

This is in confirmation of our telephone conversation of this morning. We are planning to produce four bulk samples from the Monkman property this year. It is expected that the first washed coal will reach you in early September, the rest arriving at intervals of two to three weeks. We shall be requiring the same testing program as last year.

Yours very truly,

PETRO-CANADA

J. Y. Wright
Chief Geologist

JYW/my