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AN INVESTIGATION OF THE CAKING AND COKING CHARACTERISTICS OF COALS FROM SEAM 7, UPPER AND LOWEP FROM BALDY RIDGE SUBMITTED BY KAISER RESOURCES LIMITED, SPARWOOD, BRITISH COLUMBIA

Project No. 03-5-1/16-42A
Job No. 3293R

J.G. JORGENSEN, T.A. LLOYD AND A.B. FUNG
COAL RESOURCE AND PROCESSING LABORATORY

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ENERGY RESEARCH PROGRAM
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REPORT ERP/ERL 80-64 (CF)

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An Investigation of the Caking and Coking Characteristics of Coals from Seam 7, Upper and Lower from Baldy Ridge Submitted by Kaiser Resources Limited, Sparwood, British Columbia

Project No. 03-5-1/16-42A
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by

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

INTRODUCTION

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

This report is Investigation 42A in the series and includes evaluation data on coals specified in a letter dated June 25, 1980 from D.P. Sharma, Manager, Quality Control, Kaiser Resources Limited. A copy of this letter appears in Appendix 1.

The coals which were carbonized were identified as:

(1) Baldy Mine Entry, 7 Seam
Top half of X-cut @ 1200 ft (Oven Test No. 410-80)

(2) Baldy Mine Entry, 7 Seam
Bottom half of X-cut @ 1200 ft (Oven Test No. 416-80)

The cleaned coal samples received from Birtley Engineering, Calgary, were crushed, blended, and carbonized in the 12-inch width Koppers 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 Laboratory located at the CANMET Bells Corners Complex near Ottawa. The results of the testing program are tabulated in Tables 1 to 6.

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*Heads, Coal Petrography Section, Coal Treatment Section, respectively, **Carbonization Engineer, Western Research Laboratory (Edmonton), Coal Resource and Processing Laboratory, Energy Research Laboratories, Canada Centre for Mineral and Energy Technology (CANMET), Energy, Mines & Resources, Ottawa, Canada.

TABLE 1 Chemical Analyses of Component Coals

Identification		
Laboratory Number	2370-80	2372-80
Description		
Baldy Mine Entry	Seam 7 Upper	Seam 7 Lower
Classification		
Rank (ASTM)	mvb	mvb
International System	432	432
Specific Volatile Index	196	188
Carbon (dmmfb) .....%	90.1	88.9
Proximate Analysis (db)		
Ash .....%	12.9	7.8
Volatile Matter .....%	21.3	21.9
Fixed Carbon .....%	65.8	70.3
Gross Calorific Value (db)		
Btu per pound	13445	14150
Ultimate Analysis (db)		
Carbon .....%	77.2	81.2
Hydrogen .....%	4.4	4.6
Sulphur .....%	0.68	0.48
Nitrogen .....%	1.7	1.4
Ash .....%	12.9	7.8
Oxygen (by difference) .....%	3.1	4.5
Ash Analysis (db)		
SiO_2 .....%	56.0	50.9
Al_2O_3 .....%	29.9	29.6
Fe_2O_3 .....%	4.1	3.6
TiO_2 .....%	1.5	1.7
P_2O_5 .....%	1.4	3.9
CaO .....%	1.7	4.9
MgO .....%	0.4	0.0
SO_3 .....%	0.4	0.4
Na_2O .....%	0.0	0.0
K_2O .....%	1.5	0.7

TABLE 2 Physical Tests and Fusibility of Ash of Component Coals

Identification				
Laboratory Number			2370-80	2372-80
Description				
Baldy Mine Entry			Seam 7 Upper	Seam 7 Lower
Coal Pulverization				
Sieve Analysis				
Passing	Retained On			
	1/4 in.	%	1.7	9.1
1/4 in.	6 mesh	%	9.5	12.8
6 mesh	12 mesh	%	14.7	20.8
12 mesh	20 mesh	%	12.1	17.7
20 mesh	.....	%	62.0	39.6
Total Passing	6 mesh	%	88.8	78.1
Grindability				
Hardgrove Index			98	81
Fusibility of Ash				
Initial Deformation Temp. ...		°F	2700+	2570
Softening Temp. Spherical ...		°F	2700+	2700+
Softening Temp. Hemispherical		°F	2700+	2700+
Fluid Temp.		°F	2700+	2700+

TABLE 3 Thermal Rheological Properties of Component Coals

Identification		
Laboratory Number	2370-80	2372-80
Description		
Baldy Mine Entry	Seam 7 Upper	Seam 7 Lower
Linear Expansion		
Bd. 52 lb/ft^3 at 2% moisture...%		
Gieseler Plasticity		
Start .....°C	437	441
Fusion Temp. .....°C	451	460
Max. Fluid Temp. .....°C	468	466
Final Fluid Temp. .....°C	489	485
Solidification Temp. .....°C	494	490
Melting Range .....°C	52	44
Max. Fluidity .....dd/m	29.6	8.4
Torque .....g.in.	40	40
Dilatation		
Ti - Softening Temp. .....°C	407	414
Tii - Max. Contraction Temp. °C	453	461
Tiii - Max. Dilatation Temp. .°C	482	480
Contraction .....%	27	25
Dilatation .....%	-9	-20
Free Swelling Index		
F.S.I.	6	7

TABLE 4 Petrographic Analysis of Component Coals

Identification		
Laboratory Number.....	2370-80	2372-80
Description.....		
Baldy Mine Entry	Seam 7 Upper	Seam 7 Lower
Distribution of Vitrinite Types		
V-6.....%		
V-7.....%		
V-8.....%		
V-9.....%		
V-10.....%	2.6	
V-11.....%	2.6	2.7
V-12.....%	10.9	13.0
V-13.....%	28.7	35.8
V-14.....%	7.3	2.7
V-15.....%		
V-16.....%		
V-17.....%		
V-18.....%		
Reactive Components		
Total Vitrinite.....%	52.1	54.2
Reactive Semi-fusinite (1/2)...%	15.6	15.0
Exinite.....%	0.0	0.1
Total.....%	67.7	69.3
Inert Components		
Inert Semi-fusinite (1/2).....%	15.7	15.1
Micrinite.....%	2.0	1.9
Fusinite.....%	7.2	9.3
Mineral Matter.....%	7.4	4.4
Total.....%	32.3	30.7
Petrographic Indices		
Mean Reflectance.....%	1.31	1.32
Balance Index.....	2.31	2.18
Strength Index.....	5.52	5.51
Stability Index.....	54.5	55.1

TABLE 5 - Carbonization Data

Test Identification Number		410-80	416-80	
Data of Test		Jan. 28/80	Feb. 11/80	
Laboratory Number		2370-80	2372-80	
Description	Baldy Mine Entry	Seam 7 Upper	Seam 7 Lower	
CARBONIZATION DATA				
Net Weight of Charge (wet)	lb	400.9	401.5	
Moisture in Charge	%	2.9	2.8	
ASTM Bulk Density (wet)	lb/ft^3	48.9	49.9	
Oven Bulk Density (db)	lb/ft^3	51.6	51.8	
Flue Temp. Control	°F	1965		
CARBONIZATION RESULTS				
Gross Coking Time	hr:min	9:31	9:49	
Maximum Wall Pressure	lb/in^2	0.82	1.43	
Coke Yield Actual	%	78.7	78.1	
Mean Coke size	in	2.14	2.22	
Apparent Specific Gravity		0.98	0.98	
Screen Analysis of Coke (cumulative percentage retained on)				
3 inch sieve		14.8	15.2	
2 inch sieve		51.9	57.6	
1 1/2 inch sieve		79.5	80.7	
1 inch sieve		93.0	93.5	
3/4 inch sieve		95.9	95.5	
1/2 inch sieve		96.6	96.4	
Percentage -1/2 inch (breeze)		3.4	3.6	
Tumbler Test (ASTM)				
Stability Factor		55.3	52.0	
Hardness Factor		65.9	67.5	
Japanese Drum Test (JIS) (cumulative percentage retained on)		*	**	*	**
50 mm sieve		3.1	9.6	15.9	3.4
25 mm sieve		87.7	71.8	86.1	68.5
15 mm sieve		93.0	81.9	93.2	81.9

TABLE 6

Analyses of Coke Oven Charges and Resultant Cokes

Identification		
Test Number.....	410-80	416-80
Date Charged.....	Jan. 28/80	Feb. 11/80
Description.....		
Baldy Mine Entry ...	Seam 7 Upper	Seam 7 Lower
Coke Oven Charge		
Laboratory Number.....	2370-80	2372-80
Proximate Analysis (db)		
Ash.....%	12.9	7.8
Volatile Matter.....%	21.3	21.9
Fixed Carbon .....%	65.8	70.3
Sulphur (db).....%	0.68	0.48
Resultant Coke		
Laboratory Number.....	2379-80	2381-80
Proximate Analysis (db)		
Ash.....%	15.9	11.0
Volatile Matter.....%	2.4	1.8
Fixed Carbon.....%	81.7	87.2
Sulphur (db).....%	0.58	0.39

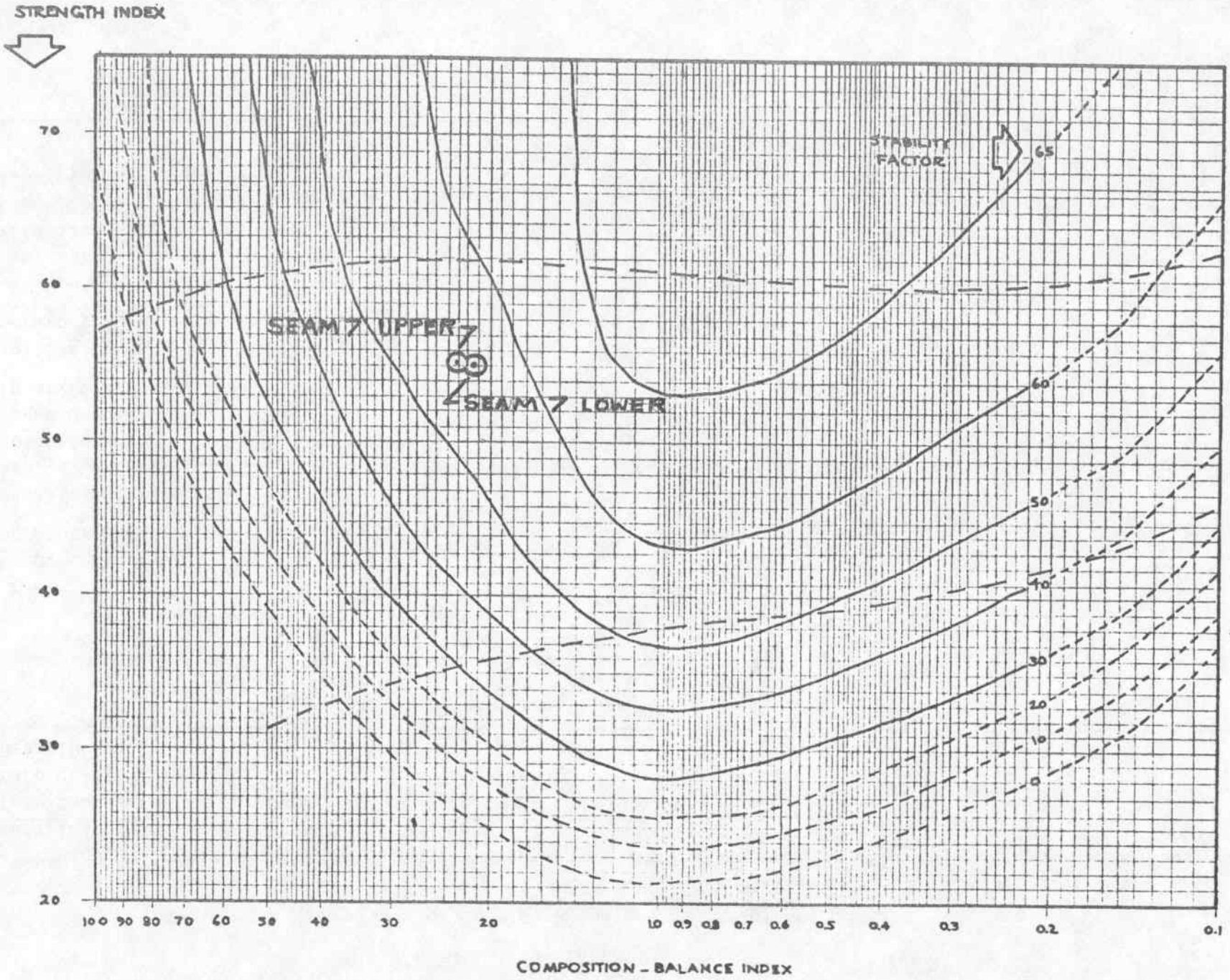
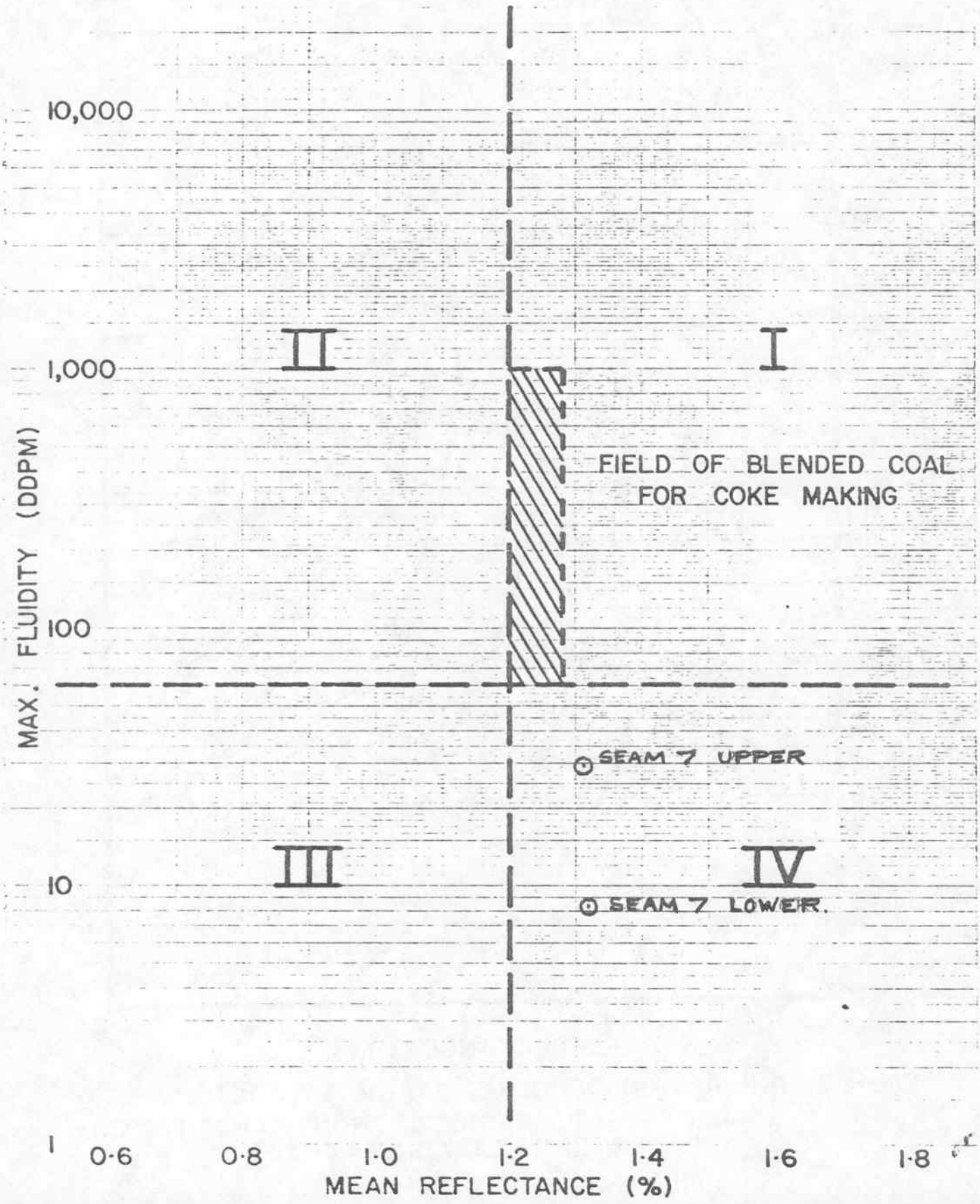


Figure 1. Plot of Predicted Stability Index of Component Coals from Petrographic Data.

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



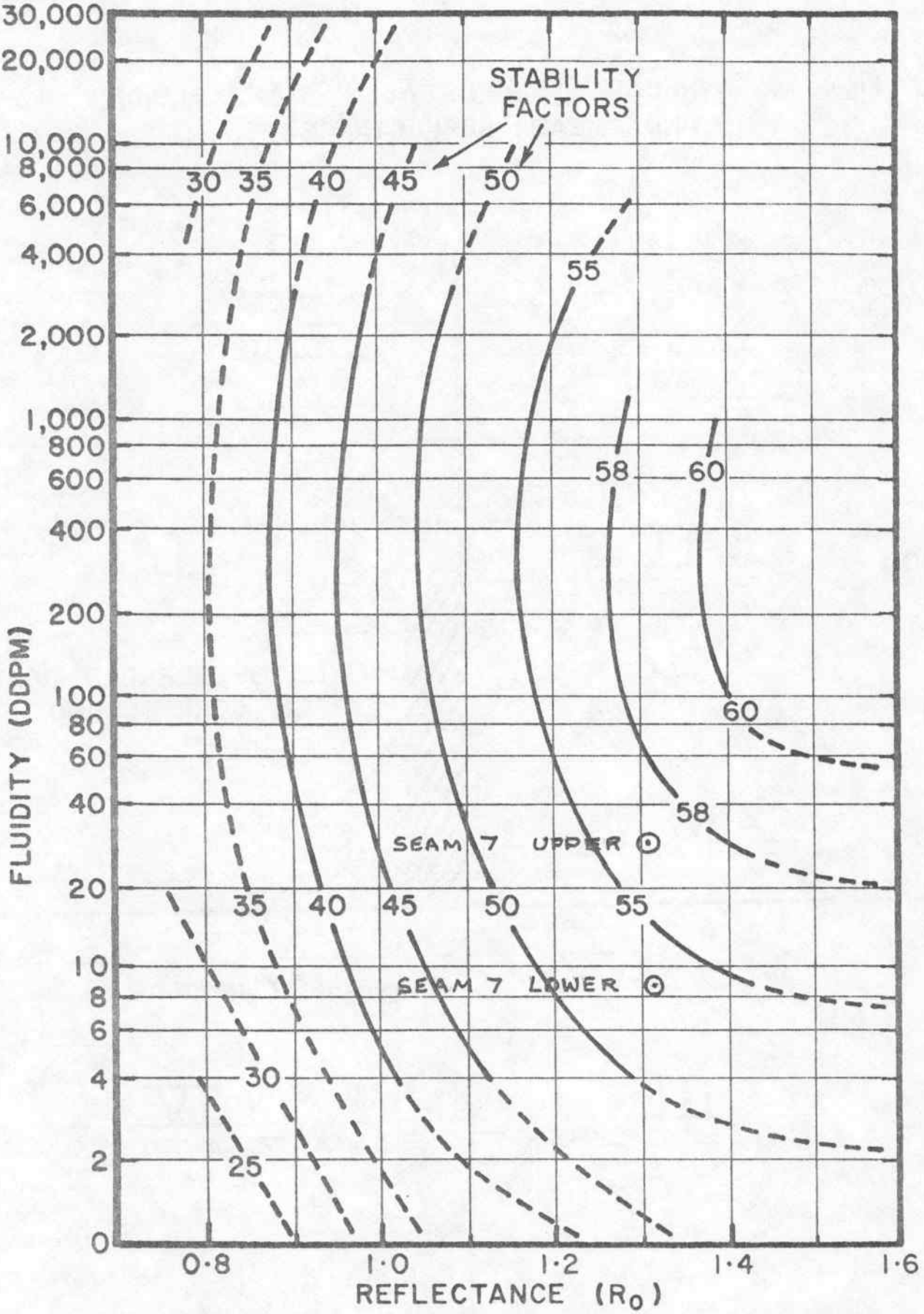


Figure 3. PREDICTION OF COKE STABILITY FACTORS.
- REGRESSION RESULTS FROM CANMET DATA ON WESTERN CANADIAN COALS.

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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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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).

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

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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.

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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.

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APPENDIX 1

Letter dated June 25, 1980 from D.P. Sharma, Manager, Quality Control, Kaiser Resources Ltd.

JJC

KAISER RESOURCES
COAL DIVISION

1980 06 25

Dr. T.D. Brown
Manager, Coal Resource and
Processing Laboratory
Energy Research Laboratories
555 Booth Street
Ottawa, Ontario K1A 0G1

Dear Dave,

Ref: Baldy Ridge, 7 Seam

I am writing you to confirm the following test work, which has already been completed. Please issue a separate report for this work:

(1) Baldy Mine Entry, 7 Seam
Top half of x-cut @ 1200 ft. Test No. 415-80.

(2) Baldy Mine Entry, 7 Seam
Bottom half of x-cut @ 1200 ft. Test No. 416-80.

Along with two carbonization tests the usual bench seal tests are also required.

Please bill us for the test work as per CCRA member rates.

Yours truly,
KAISER RESOURCES LTD.

D.P. Sharma,
Manager, Quality Control

DPS/cl