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MOVABLE-WALL COKE OVEN TESTS OF SEVEN BLENDS SUBMITTED BY STELCO INC

Project No. 03-3-0/14-30
Job No. 3383R

J. G. Jorgensen and T. A. Lloyd
Combustion and Carbonization Research Laboratory

SEPTEMBER 1982

ENERGY RESEARCH PROGRAM
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DIVISION REPORT 82-50 (CF)

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Declassification Date:
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MOVABLE-WALL COKE OVEN TESTS OF SEVEN COAL BLENDS SUBMITTED BY STELCO INCORPORATED

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by

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

INTRODUCTION

This investigation is No. 30 in the continuing program of coal evaluation for STELCO Incorporated by the Energy Research Laboratories.

The scope of the investigation comprises of seven blend tests carbonized in the CANMET 12 inch width movable-wall coke oven. The blends tested are described in Table 1.

The project was initiated in letters dated 2 February, 1982 and 9 March, 1982 by I. Prevatto, Research and Development, STELCO INCORPORATED. Copies of these letters are included in Appendix 1. One additional coke oven test was requested by telephone.

The results of the coke oven tests and analyses are recorded in Tables 2 to 8. The results were transmitted to the company during the course of the investigation and this report is intended primarily for record purposes.

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*Head, Coal Petrography, **Conventional Coke-making, Combustion and Carbonization Laboratory, Energy Research Laboratories, CANMET, Energy, Mines and Resources, Ottawa, Canada.

TABLE 1 - Test Blends

Test No.	1	2	3	4	5	6	7	8
Oven Test No.	886 891	887 892	888 893	889 894	890 895	896	897	9/9
Blend Composition	%	%	%	%	%	%	%	%
Beckely	21	21	21	21	21	21	21	21
Jewell	7	7	7	7	7	5	5	0
Moss	22	20	17	14	7	25	25	33
Chisholm	25	24	20	16	7	34	34	46
Mathies	15	14	12	10	5	15	15	0
Madison	10	9	8	7	3	0	0	0
McClure	0	5	15	25	50	0	0	0

Special Conditions

Test No. 6 Moisture level as received, size consist as received

Test No. 7 Moisture level as received, crushed

Test No. 8 Moisture level as received, size consist as received

TABLE 2 - Physical Tests

Identification			
Laboratory No.		2691-82	2694-82
Description		Test No. 6 (not crushed)	Test No. 7 (crushed)
Coal Pulverization			
Sieve Analysis			
Passing	Retained On		
	1 in. %	6.7	
1	3/4 in. %	3.0	
3/4	½ in. %	4.3	
½	¼ in. %	14.5	0.5
¼	6 mesh %	15.5	15.5
6	12 mesh %	15.9	22.3
12	20 mesh %	13.1	21.9
20	..... %	27.0	39.8
Total Passing: 1/8 in.%		56.0	84.0

TABLE 3- Carbonization Conditions

Test Identification Number	886	891	887	892	888	893
Date of Test	82-03-03	82-03-11	82-03-04	82-03-12	82-03-05	82-03-16
Coke Oven Identification	12-71	12-71	12-71	12-71	12-71	12-71
Description						
Test....	No.1	No.1	No.2	No.2	No.3	No.3
CHARGE PROPERTIES						
Proximate Analysis (db) Ash.....%	6.3	6.3	6.1	6.1	6.3	6.3
Volatile Matter.....%	29.7	29.7	29.1	29.1	25.7	25.7
Fixed Carbon.....%	64.0	64.0	64.8	64.8	68.0	68.0
Moisture in Charge.....%						
Minus 1/8 in. (6 mesh).....%						
Other:.....						
.....(db)Sulphur....%	0.81	0.81	0.82	0.82	0.87	0.87
CARBONIZATION CONDITIONS						
Net Weight of Charge (wet).....lb	589.1	596.0	592.5	596.0	593.2	619.8
ASTM Cone Bulk Density (wet).....lb/ft^3						
Calc. Charge Dry Bulk Density in Oven...lb/ft^3	51.0	-	51.4	-	51.4	53.8
Flue Temp Control.....						
Charge Push (Centre Temp:Soak Time).....^{o}C:hr						
Quenched Coke Conditioning Drop.....ft						
CARBONIZATION RESULTS						
Gross Coking Time (at Push).....hr:min	9:25	9:48	9:23	9:50	9:35	10:05
Final Centre Temp.....^{o}F	1920	1940	1930	1935	1925	1920
Time to 900^{o}C Centre Temp.....hr:min	8:20	8:40	8:13	8:35	8:20	8:57
Time to 950^{o}C Centre Temp.....hr:min						
Time to 1000^{o}C Centre Temp.....hr:min						
Maximum Wall Pressure.....lb/in^2	1.9	1.9	2.1	2.4	2.4	3.0
Coke Yield Actual.....%	74.5	73.6	74.6	73.7	75.4	75.0

TABLE 4 - Coke Properties

Test Identification Number	886	891	887	892	888	893
SCREEN ANALYSIS OF COKE (cum % retained on)						
4 inch sieve	0.4	0.3	-	-	-	0.3
3 inch sieve	5.9	3.9	5.2	4.5	4.8	4.4
2 inch sieve	46.0	42.2	42.1	44.5	44.5	44.7
1½ inch sieve	75.6	76.3	74.2	76.1	75.3	77.1
1 inch sieve	94.5	93.8	94.4	94.3	93.9	94.1
3/4 inch sieve	96.6	96.4	96.7	96.2	96.0	96.0
½ inch sieve	97.2	97.0	97.3	97.2	96.9	97.0
Percentage -½ inch (breeze)	2.8	3.0	2.7	2.8	3.1	3.0
Mean Coke Size.....in.	2.00	1.95	1.95	1.97	1.96	1.97
COKE CHEMICAL ANALYSIS						
Proximate Analysis (db)						
Ash.....%	8.2	8.3	8.3	8.2	8.1	8.4
Volatile Matter.....%	1.2	1.0	1.1	0.6	0.9	0.6
Fixed Carbon.....%	90.6	90.7	90.6	91.2	91.0	91.0
Sulphur (db).....%	0.67	0.65	0.65	0.66	0.69	0.67
COKE APPARENT SPECIFIC GRAVITY	0.895	0.895	0.889	0.885	0.900	0.898
ASTM COKE TUMBLER TEST						
Stability Factor.(cum % + 1 in.)	56.8	55.8	56.7	56.5	57.3	59.1
Hardness Factor.(cum % + 1/4 in.)	68.4	69.6	68.3	69.8	69.2	70.0
JIS COKE TUMBLE TEST (cum % retained on)						
30 revs: 50 mm sieve	17.7	23.0	21.2	25.2	20.5	28.3
25 mm sieve	87.9	89.0	87.1	88.2	87.1	90.1
15 mm sieve	93.7	94.3	93.7	94.5	93.7	94.0
150 revs: 50 mm sieve	5.3	7.1	10.0	10.8	4.7	8.9
25 mm sieve	72.9	72.8	71.0	72.6	72.3	72.5
15 mm sieve	82.8	83.7	82.9	84.0	83.4	83.6
OTHER						

TABLE 5- Carbonization Conditions

Test Identification Number.....	889	894	890	895
Date of Test.....	82-03-08	82-03-17	82-03-07	82-03-18
Coke Oven Identification.....	12-71	12-71	12-71	12-71
Description.....				
Test.....	No. 4	No. 4	No. 5	No. 5
CHARGE PROPERTIES				
Proximate Analysis (db) Ash.....%	6.3	6.3	6.5	6.5
Volatile Matter.....%	24.8	24.8	22.9	22.9
Fixed Carbon.....%	68.9	68.9	70.6	70.6
Moisture in Charge.....%				
Minus 1/8 in. (6 mesh).....%				
Other:.....				
(db) Sulphur %	0.83	0.83	0.78	0.78
CARBONIZATION CONDITIONS				
Net Weight of Charge (wet).....lb	591.0	619.6	610.5	613.9
ASTM Cone Bulk Density (wet).....lb/ft^3				
Calc. Charge Dry Bulk Density in Oven...lb/ft^3		53.7	52.9	53.2
Flue Temp Control.....				
Charge Push (Centre Temp:Soak Time).....^{o}C:hr				
Quenched Coke Conditioning Drop.....ft				
CARBONIZATION RESULTS				
Gross Coking Time (at Push).....hr:min	10:10	10:15	10:18	10:12
Final Centre Temp.....^{o}F	1945	1920	1935	1910
Time to 900^{o}C Centre Temp.....hr:min	9:00	9:07	9:11	9:07
Time to 950^{o}C Centre Temp.....hr:min				
Time to 1000^{o}C Centre Temp.....hr:min				
Maximum Wall Pressure.....lb/in^2	3.1	3.3	6.4	6.2
Coke Yield Actual.....%	75.3	75.5	76.3	76.0

TABLE 6 - Coke Properties

Test Identification Number.....	889	894	890	895
SCREEN ANALYSIS OF COKE (cum % retained on)				
4 inch sieve.....	0.3	-	-	0.4
3 inch sieve.....	5.7	8.2	5.3	6.6
2 inch sieve.....	47.0	50.8	49.3	50.6
1½ inch sieve.....	77.5	79.6	78.4	80.2
1 inch sieve.....	94.2	94.6	94.8	94.8
3/4 inch sieve.....	96.7	96.4	96.3	96.1
½ inch sieve.....	97.1	97.3	97.3	97.0
Percentage -½ inch (breeze).....	2.9	2.7	2.7	7.9
Mean Coke Size.....in.	2.01	2.07	2.03	2.06
COKE CHEMICAL ANALYSIS				
Proximate Analysis (db)				
Ash.....%	8.0	8.3	8.1	7.9
Volatile Matter.....%	1.3	1.0	0.9	1.0
Fixed Carbon.....%	90.7	90.7	91.0	91.1
Sulphur (db).....%	0.65	0.68	0.63	0.62
COKE APPARENT SPECIFIC GRAVITY.....	0.900	0.901	0.894	0.893
ASTM COKE TUMBLER TEST				
Stability Factor.(cum % + 1 in.).....	57.9	58.8	60.9	61.0
Hardness Factor.(cum % + 1/4 in.).....	70.1	70.0	70.6	70.2
JIS COKE TUMBLE TEST (cum % retained on)				
30 revs: 50 mm sieve.....	18.2	24.8	25.0	24.2
25 mm sieve.....	89.6	89.5	90.0	90.9
15 mm sieve.....	94.4	94.9	94.8	95.0
150 revs: 50 mm sieve.....	3.7	8.0	10.0	9.6
25 mm sieve.....	75.5	74.2	77.1	76.7
15 mm sieve.....	84.9	85.0	85.0	85.3
OTHER				

TABLE 7 - Carbonization Conditions

Test Identification Number	896	897	919
Date of Test	82-03-24	82-03-25	82-04-03
Coke Oven Identification	12-71	12-71	12-71
Description			
Test	No. 6 (Not crushed)	No. 7 (Crushed)	No. 8 (Not Crushed)
CHARGE PROPERTIES			
Proximate Analysis (db) Ash, %	6.1	7.0	6.2
Volatile Matter, %	26.5	26.4	21.5
Fixed Carbon, %	67.4	66.6	72.3
Moisture in Charge, %	6.6	6.4	5.6
Minus 1/8 in. (6 mesh), %			
Other:			
(db) Sulphur, %	0.75	0.84	0.75
CARBONIZATION CONDITIONS			
Net Weight of Charge (wet), lb	563.6	543.4	567.5
ASTM Cone Bulk Density (wet), lb/ft^3	45.1	40.2	46.8
Calc. Charge Dry Bulk Density in Oven, lb/ft^3	46.6	45.0	47.4
Flue Temp Control			
Charge Push (Centre Temp:Soak Time), ^oC:hr			
Quenched Coke Conditioning Drop, ft			
CARBONIZATION RESULTS			
Gross Coking Time (at Push), hr:min	9:50	9:25	9:20
Final Centre Temp, ^oC	1905	1920	1940
Time to 900^{o}C Centre Temp, hr:min	8:42	8:17	8:15
Time to 950^{o}C Centre Temp, hr:min	8:57	8:32	8:27
Time to 1000^{o}C Centre Temp, hr:min	9:15	8:50	8:43
Maximum Wall Pressure, lb/in^2	0.45	0.29	0.85
Coke Yield Actual, %	75.4	74.2	76.3

TABLE 8 - Coke Properties

Test Identification Number.....	896	897	919
SCREEN ANALYSIS OF COKE (cum % retained on)			
4 inch sieve.....	4.0	1.4	1.7
3 inch sieve.....	15.6	15.8	12.8
2 inch sieve.....	54.9	62.9	55.6
1½ inch sieve.....	79.7	85.7	78.1
1 inch sieve.....	92.5	94.8	93.3
3/4 inch sieve.....	94.6	95.8	95.9
½ inch sieve.....	96.1	96.8	96.8
Percentage -½ inch (breeze).....	3.9	3.2	3.2
Mean Coke Size.....in.	2.20	2.28	2.16
COKE CHEMICAL ANALYSIS			
Proximate Analysis (db)			
Ash.....%	8.0	8.7	7.9
Volatile Matter.....%	0.7	1.0	1.8
Fixed Carbon.....%	91.3	90.3	90.3
Sulphur (db).....%	0.60	0.64	0.60
COKE APPARENT SPECIFIC GRAVITY.....	0.857	0.793	0.864
ASTM COKE TUMBLER TEST			
Stability Factor.(cum % + 1 in.).....	45.4	54.1	41.4
Hardness Factor.(cum % + 1/4 in.).....	63.8	62.6	65.1
JIS COKE TUMBLE TEST (cum % retained on)			
30 revs: 50 mm sieve.....	16.0	29.6	15.9
25 mm sieve.....	82.8	90.1	81.8
15 mm sieve.....	90.7	93.5	91.2
150 revs: 50 mm sieve.....	0.8	8.9	3.1
25 mm sieve.....	58.4	75.5	56.7
15 mm sieve.....	75.5	81.3	76.4
OTHER			

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APPENDIX 1

Letters dated 2 February, 1982, and
9 March, 1982 from I. Pevatto,
Research & Development, STELCO INC.

stelco

The Steel Company
of Canada, Limited

General Office
Stelco Tower
Hamilton, Ontario
L8N 3T1
(416) 528-2511

February 2, 1982

Mr. J. Jorgensen
Coal Resource & Processing Laboratory
Canada Centre for Mineral & Energy Technology
555 Booth Street
Ottawa, Ontario
K1A 0G1

Dear Mr. Jorgensen:

We have revised our original 12in oven test program from the one outlined in a previous letter (December 1, 1981).

The new test series is shown in the attached chart.

Would you please supply a cost estimate for this new proposal. Thank you.

Yours very truly,
Stelco Inc.

I. Pevatto
Research and Development

IP:EB
Attach.

OTTAWA 12" HW OVEN TEST SERIES

Coal	Test Number				
	1	2	3	4	5
	%	%	%	%	%
Beckely	21	21	21	21	21
Jewell	7	7	7	7	7
Moss	22	20	17	14	7
Chisholm	25	24	20	16	7
Mathies	15	14	12	10	5
Madison	10	9	8	7	3
McClure	0	5	15	25	50

Notes: (1) All tests to be replicated.
(2) Save blend samples from all tests.
(3) Tests to be done in random order.
(4) Conditions:
- 80% - 6m pulverization
- 2% moisture
- 51-52 lb/ft^3 approx. bulk density
- require a fast coking rate if possible - approaching 1.7 iph

MAR 16 1982

stelco

The Steel Company
of Canada, Limited

General Office
Stelco Tower
Hamilton, Ontario
L8N 3T1
(416) 528-2511

March 9, 1982

Mr. J. Jorgensen
Coal Resource & Processing Laboratory
Canada Centre for Mineral & Energy Technology
555 Booth Street
Ottawa, Ontario
K1A 0G1

Dear John:

We would like to fit in an additional two tests on our Ottawa 12 inch oven programme. The blend compositions are as follows:

Test No	1	2
Moss	25	25
Chisholm	34	34
Mathies	15	15
Beckley	21	21
Jewell	5	5
Test Moisture Req., %	As rec'd	As rec'd
Test Pulverization Req., %	85	As rec'd (not pulverized at all)

We are primarily interested in the effects, on oven wall pressures, of a non-pulverized coal mixture.

There will be an additional seven drums of coal shipped during the week of March 8-12, 1982 for these additional two tests.

Thank you.

Yours truly,
Stelco Inc.

I. Pevatto
Research & Development

IP:EB

Copy to: N. Daneliak
K. Wilson