



**CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY
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RESULTS OF MICROSCOPICALLY DETERMINING LEVELS OF COKE FINE
ADDITIONS RELATING TO THE STELCO-ANTIFISSURANT PROGRAM,
UTILIZING AN AUTOMATIC SCANNING METHOD

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INTRODUCTION

The addition of coke fines to coal, within certain limits, can improve both the strength and hardness of the resultant coke. In an attempt to maximize these factors, the amount of coke added (ideally between 4 and 8 per cent) plays a major role. Particle size also appears to be significant⁽¹⁾. If samples are prepared into pellets using ASTM D-2797-72⁽²⁾, differences between the reported values from the blending in the pilot plant and those from microscopic analysis become apparent. Because the percentage of coke fine additions is very small, even small variances can affect the stability and hardness.

Samples of coal-coke blends in the Stelco-Antifissurant Program (Project No. 03-3-0/18-10) were analysed by an automatic scanning method in which a program is constructed to scan the surface of the pellet and record the various reflectance values on a Servogor recorder. The reflectance values are determined by a Zeiss Universal microscope with photometer attachment. Details of this method, and its advantages, may be found in Divisional Report MREC 74/67⁽³⁾.

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TEST PROGRAM AND RESULTS

Two analyses of each sample were made under conditions outlined in Figure 1. The number of reflectance values in excess of 4%, (corresponding to coke particles) were recorded and the results of the two analyses were averaged. Regression analysis for different particle sizes has provided equations to express this number into a weight percentage of the total sample. Tables have been made for coke fine additions between 0 and 12% and may be found in the appendix.

Description of the samples and the results of the analysis appear in Table 1.

Results indicate that the automatic scanning method is more accurate than the manual point count method. Automatic scanning takes relatively little time to complete, involves attention only every 5-10 minutes and covers $2\frac{1}{2}$ times as many surface points as the manual method.

With reference to the samples in the Stelco-Antifissurant Program, the automatic scanning method indicates that the blending operations are quite accurate. For the few samples that exceeded experimental error, the tests were repeated, but confirmed the original analyses. Why these differences occur, is impossible to determine. Sampling techniques may also be considered.

FIGURE 1

Summary of the Automatic Scanning Method

1. Standardize Photometer, Amplifier and Recorder.
2. Set program co-ordinates - 2500 steps.
3. Begin automatic scanning, record reflectance values.

4. Check focus every 5 minutes or 80, until program ends.
5. Determine the number of coke reflectances by counting all valves greater than or equal to 4%.
6. Determine maximum particle size.
7. Determine the percentage of coke in the sample from the appropriate table.

Program Co-ordinates	50 x 50	25 mm ²
Step Displacement	10	0.1 mm
Recorder Speed	10 mm/min	0.17 mm/sec
Time per step	1 sec/step	

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TABLE 1

Automatic Scanning Method Results

Sample Number	Components (%)						Mesh No.	Coke by Automatic Scanning (%)	Difference (%)
	Poca	SHV	Mathies	Madison	Chisholm	Coke			
2527-74	15	51	10	21		3	35	3.2	0.2
2528-74	12	51	10	21		6	35	6.3	0.3
3698-74	12	51	10	21		6	35	6.0	0.0
2677-74	9	51	10	21		9	35	9.3	0.3
3770-74	9	51	10	21		9	35	7.0	2.0
4010-74	9	51	10	21		9	35	9.6	0.6
2355-74	22	47	9	19		3	35	2.0	1.0
2368-74	19	47	9	19		6	35	5.9	0.1
2529-74	16	47	9	19		9	35	8.6	0.4
2659-74	15	51	10	21		3	65	3.5	0.5
2660-74	12	51	10	21		6	65	7.6	1.6
3699-74	12	51	10	21		6	65	5.2	0.8
3925-74	12	51	10	21		6	65	8.3	2.3
4203-74	12	51	10	21		6	65	5.5	0.5
2678-74	9	51	10	21		9	65	9.5	0.5
3771-74	9	51	10	21		9	65	9.0	0.0
3926-74	9	51	10	21		9	65	8.8	0.2
2369-74	22	47	9	19		3	65	3.1	0.1
2526-74	19	47	9	19		6	65	6.2	0.2
4008-74	19	47	9	19		6	65	6.4	0.2
2661-74	16	47	9	19		9	65	9.6	0.6
3527-74	16	47	9	19		9	65	8.7	0.3
4205-74	19		9	19	47	6	65	5.0	1.0
4206-74	19		9	37.8	28.2	6	65	4.3	1.7
3356-74	12	51	10	21		6	100	3.8	2.2
3357-74	12	51	10	21		6	100	5.8	0.2

REFERENCES

1. Morris, C.G., "Coke Fine Additions to Coal Blends in a 30 lb. Slot-Type Oven", Metals Reduction and Energy Centre, Divisional Report MREC 72-85, Mines Branch, Dept. of Energy, Mines and Resources, Ottawa, Canada.
2. ASTM Designation: D2797-72, "Preparing Coal Samples for Microscopic Analysis by Reflected Light".
3. Carr, A.J., "Results of Microscopically Determining Levels of Coke Fine Additions to Coal Blends Utilizing an Automatic Method", Metals Reduction and Energy Centre, Divisional Report MREC 74/67, Mines Branch, Dept. of Energy, Mines and Resources, Ottawa, Canada.

APPENDIX

Automatic Scanning Coke
Conversion Tables

No.	%	No.	%	No.	%	No.	%
		26	2.0	51	6.6	76	11.3
		27	2.2	52	6.8	77	11.5
		28	2.3	53	7.0	78	11.6
		29	2.5	54	7.2	79	11.8
		30	2.7	55	7.4	80	12.0
		31	2.9	56	7.6		
		32	3.1	57	7.7		
		33	3.3	58	7.9		
		34	3.5	59	8.1		
		35	3.6	60	8.3		
		36	3.8	61	8.5		
		37	4.0	62	8.7		
		38	4.2	63	8.9		
		39	4.4	64	9.0		
0-15	0.0	40	4.6	65	9.2		
16	0.1	41	4.8	66	9.4		
17	0.3	42	4.9	67	9.6		
18	0.5	43	5.1	68	9.8		
19	0.7	44	5.3	69	10.0		
20	0.9	45	5.5	70	10.2		
21	1.0	46	5.7	71	10.3		
22	1.2	47	5.9	72	10.5		
23	1.4	48	6.1	73	10.7		
24	1.6	49	6.3	74	10.9		
25	1.8	50	6.4	75	11.1		

TABLE 1 Automatic Scanning - Coke Conversion Table for 16 Mesh Particles

No.	%	No.	%	No.	%	No.	%
		26	2.0	51	5.8	76	9.6
		27	2.2	52	6.0	77	9.8
		28	2.3	53	6.1	78	9.9
		29	2.5	54	6.3	79	10.1
		30	2.6	55	6.4	80	10.2
		31	2.8	56	6.6	81	10.4
		32	2.9	57	6.7	82	10.5
		33	3.1	58	6.9	83	10.7
		34	3.2	59	7.0	84	10.8
		35	3.4	60	7.2	85	11.0
		36	3.5	61	7.4	86	11.2
0-12	0.0	37	3.7	62	7.5	87	11.3
13	0.1	38	3.9	63	7.7	88	11.5
14	0.2	39	4.0	64	7.8	89	11.6
15	0.4	40	4.2	65	8.0	90	11.8
16	0.5	41	4.3	66	8.1	91	11.9
17	0.7	42	4.5	67	8.3	92	12.1
18	0.8	43	4.6	68	8.4		
19	1.0	44	4.8	69	8.6		
20	1.1	45	4.9	70	8.7		
21	1.3	46	5.1	71	8.9		
22	1.4	47	5.2	72	9.0		
23	1.6	48	5.4	73	9.2		
24	1.7	49	5.5	74	9.3		
25	1.9	50	5.7	75	9.5		

TABLE 2 Automatic Scanning - Coke Conversion Table for 35 Mesh Particles

No.	%	No.	%	No.	%	No.	%	No.	%
		26	1.6	51	7.0	76	9.2	101	11.2
		27	1.7	52	7.2	77	9.2	102	11.3
0-3	0.0	28	1.8	53	7.3	78	9.3	103	11.4
4	0.1	29	1.9	54	7.4	79	9.4	104	11.6
5	0.1	30	2.0	55	7.5	80	9.4	105	11.7
6	0.2	31	2.3	56	7.6	81	9.5	106	11.8
7	0.3	32	2.6	57	7.7	82	9.5	107	11.9
8	0.4	33	3.0	58	7.8	83	9.6	108	12.0
9	0.5	34	3.3	59	7.9	84	9.6		
10	0.6	35	3.5	60	8.0	85	9.7		
11	0.7	36	3.8	61	8.1	86	9.7		
12	0.8	37	4.0	62	8.2	87	9.8		
13	0.9	38	4.3	63	8.3	88	9.8		
14	1.0	39	4.6	64	8.4	89	9.9		
15	1.0	40	5.0	65	8.5	90	9.9		
16	1.1	41	5.3	66	8.6	91	10.0		
17	1.1	42	5.5	67	8.7	92	10.1		
18	1.2	43	5.8	68	8.8	93	10.2		
19	1.2	44	6.0	69	8.8	94	10.3		
20	1.3	45	6.2	70	8.9	95	10.4		
21	1.3	46	6.4	71	8.9	96	10.6		
22	1.4	47	6.6	72	9.0	97	10.7		
23	1.4	48	6.7	73	9.0	98	10.8		
24	1.5	49	6.8	74	9.1	99	10.9		
25	1.5	50	6.9	75	9.1	100	11.1		

TABLE 3 Automatic Scanning - Coke Conversion Table for 65 Mesh Particles

No.	%	No.	%	No.	%	No.	%	No.	%
		26	2.0	51	4.9	76	7.8	101	10.8
		27	2.1	52	5.0	77	8.0	102	10.9
		28	2.2	53	5.1	78	8.1	103	11.0
		29	2.3	54	5.3	79	8.2	104	11.1
		30	2.5	55	5.4	80	8.3	105	11.2
		31	2.6	56	5.5	81	8.4	106	11.3
		32	2.7	57	5.6	82	8.5	107	11.5
		33	2.8	58	5.7	83	8.7	108	11.6
0-9	0.0	34	2.9	59	5.9	84	8.8	109	11.7
10	0.1	35	3.0	60	6.0	85	8.9	110	11.8
11	0.2	36	3.2	61	6.1	86	9.0	111	11.9
12	0.3	37	3.3	62	6.2	87	9.1	112	12.1
13	0.5	38	3.4	63	6.3	88	9.2		
14	0.6	39	3.5	64	6.4	89	9.4		
15	0.7	40	3.6	65	6.6	90	9.5		
16	0.8	41	3.7	66	6.7	91	9.6		
17	0.9	42	3.9	67	6.8	92	9.7		
18	1.1	43	4.0	68	6.9	93	9.8		
19	1.2	44	4.1	69	7.0	94	9.9		
20	1.3	45	4.2	70	7.1	95	10.1		
21	1.4	46	4.3	71	7.3	96	10.2		
22	1.5	47	4.4	72	7.4	97	10.3		
23	1.6	48	4.6	73	7.5	98	10.4		
24	1.8	49	4.7	74	7.6	99	10.5		
25	1.9	50	4.8	75	7.7	100	10.6		

TABLE 4 Automatic Scanning - Coke Conversion Table for 100 Mesh Particles