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 CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY  
 OTTAWA

ENERGY RESEARCH LABORATORIES  
 DIVISIONAL REPORT ERL 75/21-CMFRL

REPORT OF THE TECHNICAL COMMITTEE OF THE CCRA FOR THE  
 INTERIM PERIOD AUGUST 1, 1974 TO JANUARY 31, 1975  
 PREPARED FOR THE BOARD OF DIRECTORS MEETING  
 FEBRUARY 27, 1975

by  
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INTERIM REPORT OF THE TECHNICAL COMMITTEE  
PREPARED FOR THE CANADIAN CARBONIZATION RESEARCH ASSOCIATION  
BOARD OF DIRECTORS MEETING - FEBRUARY 27, 1975

1.0 INTRODUCTION

Re-organization within the Mines Branch was mentioned in the last report of the Technical Committee. The "matrix" management system is being implemented with three programs: information, minerals, and energy. Coal carbonization will form part of the processing project in the energy program. Because allocation of funds for research programs has now become a program responsibility, some future research studies (occasionally done on an 'ad hoc' basis for member companies in the past), which do not conform to the general program objectives may be subject to cost recovery. The Mines Branch received a new name, effective January 1st, 1975: Canada Centre for Mineral and Energy Technology (CANMET). This name reflects more truly the role of the organization in present-day R & D activities.

The Ferrous Industry Energy Research Association (FERA), modelled on CCRA, is now defining its research objectives. These include information dissemination, blast furnace modelling, and waste heat recovery. FERA may also supply energy information relating to the Canadian steel industry to such agencies as the EMR Office of Energy Conservation and IISI. However, the National Advisory Committee on Energy Research to which FERA would have provided advice, has not materialized. Because of uncertainties regarding the establishment of research accounts within the federal system, FERA has decided to incorporate itself by letters patent.

Interest has been shown in CCRA by the Department of Industry, Trade and Commerce and a representative from ITC attended a recent Technical Committee meeting to view government-industry co-operation at first hand. ITC has sponsored similar arrangements previously.

The Symposium on Coal held in Calgary at the end of October 1974 included several papers by CCRA members. The formed coke symposium at McMaster University (discussed at the Board of Directors meeting a year ago) which was to have been held in May, has been postponed in favour of one on external hot-metal desulphurization.

CCRA employees from CMFRL visited the carbonization and ironmaking facilities of DOFASCO and STELCO in Hamilton, as agreed at the last Board of Directors meeting. The Chairman of the Technical Committee has expressed his appreciation to both companies for their hospitality; the visit was certainly appreciated by the employees. The Chairman of the Technical Committee was a member of a Canadian coal technology group which visited the UK and West Germany in October 1974 and attended the International Coal Research Conference in London. Dr. J.H. Walsh, former Secretary of CCRA, has been the Canadian representative at several International Energy Agency meetings in Paris on coal, and proposes that CCRA play an advisory role to Canada's position on this committee which

was established as a rebuttal to the energy policies of the OPEC nations.

Under industrial developments, the main item of discussion during the last six months period has been preheating technology. Several members have described their favourable impressions of large-scale preheating tests done at the Emil plant of Bergbau-Forschung in Essen, West Germany. However, the consensus of opinion would appear to be that present technology would dictate the installation of new oven batteries rather than equipping old ones with preheating facilities. Preheating studies on the pilot-scale will continue at the Ottawa and Edmonton facilities.

## 2.0 MEETINGS

The Technical Committee held three meetings in Ottawa on September 18-19, November 20-21, 1974, and January 22-23, 1975. The last meeting did not require the 1½ days allotted; one day may suffice for future meetings, providing that more expedient lunch arrangements can be made.

Dr. J.H. Walsh was honoured at a special luncheon held during the September meeting. Mr. J.T. Collier presented Dr. Walsh with a book as a personal memento from members of the Board of Directors. Both Dr. Alex Ignatieff and Dr. C.H. Smith (Assistant Deputy Minister, Science and Technology, EMR) spoke on Dr. Walsh's contributions to CCRA.

## 3.0 PERSONNEL

Mr. R.R. Bell, previously a CCRA employee, has accepted a position on CANMET staff in Building No. 2.

Mr. I.T. Lau, the CCRA Formed Coke Research Associate, has continued satisfactorily with his development of the pilot-scale mixer-feeder system in the formed coke program. He is also working towards a Ph.D. degree (Chemical Engineering) in his own time. The Technical Committee would hope that the Board of Directors will extend Mr. Lau's appointment to continue this priority project, although his salary may require review because of recent federal contracts. Professor B.B. Pruden (Chemical Engineering, Ottawa University), will probably be retained by CANMET on a consultative basis to assist with development of the sandcoker facility.

Mr. M. Kilpatrick completed his workterm before Christmas and Mr. K. Jonasson started his after Christmas as CCRA-sponsored Waterloo Co-operative Program students. Both students worked with the high-temperature dilatometer and Mr. Jonasson is gaining experience in the pilot plant. The Waterloo University interviews were attended by Dr. B.J.P. Whalley and Mr. P.J. Readyhough (STELCO).

On the Technical Committee, Mr. N.R. Farkas of the Algoma Steel Corporation has been replaced by Mr. W.P. Dowhaniuk. Dr. J. Strasser of the Sydney Steel Corporation Ltd. has been attending meetings in anticipation of replacing Mr. J.T. Collier when his term of office as Chairman terminates. Dr. D.A. Reeve was appointed Secretary.

#### 4.0 COMPUTERIZATION OF CARBONIZATION DATA

Carbonization data for over 200 western Canadian coals are now in the EMR computer memory. Maps pertaining to many of these entries are also available.

#### 5.0 CANADIAN COAL PETROGRAPHER'S GROUP

This group had met immediately prior to the January Technical Committee meeting and resolved to seek affiliation with CCRA under Article 2, Section 7 (Affiliate Members), as discussed at the last CCRA Board of Directors meeting. The Petrographer's Group would then be a semi-autonomous body with respect to CCRA. The Chairman of the group is Dr. Alex Cameron, Geological Survey of Canada, Calgary, and the Secretary is Dr. B.N. Nandi of CANMET.

#### 6.0 PAPER ON "THE EVALUATION OF COAL BLENDS CONTAINING ANTIFISSURING AGENTS FOR COKEMAKING" FOR PRESENTATION AT THE 34TH AIME IRONMAKING CONFERENCE, TORONTO, APRIL 1975

As requested at the Board of Directors meeting one year ago, the above paper has been prepared by D.A. Reeve and H.N. Paulencu on behalf of the Technical Committee for presentation at the AIME Ironmaking Conference in April. Data presented are related to theoretical aspects of the behaviour of antifissurants during coal carbonization and results from blends containing antifissurants which had been preheated prior to carbonization are given.

#### 7.0 FACILITIES

The three pilot-scale movable-wall coke ovens have operated on a regular basis during the period under review. Of particular note is the high quality and consistency of results from the gas-fired oven in Edmonton. Two tests a week, including crushing, coal preparation, and coke testing are achieved routinely with only two staff members. This isothermal oven lends itself to preheating studies although the actual preheating of the charge requires to be done over the weekend in the coke-drying oven. Problems concerning air leakage into the 18-inch oven were reported a year ago; these were cured but carbonization data from this oven have not always been consistent. Serious consideration should be given to replacing the horseshoe with a roof and doors, similar to the Ottawa 12-inch oven.

The side-charge box is being used regularly for plastic-layer studies and canister testing (to be described later). This facility will lend itself to many research applications, one being a possible proposal from the Atlantic Group for Research in Industrial Metallurgy (AGRIM) on coke desulphurization with recirculated coke oven off-gases during carbonization. The Board of Directors might consider supporting AGRIM's research proposal.

The sole-heated oven has recently been required to be re-bricked. This has been completed.

A reasonable correlation appears to be obtainable for coal fluidities as measured by the completely automatic plastometer and the standard ASTM automatic method.

The high-temperature dilatometer has yet to give reproducible results; the problem appears to be due to sample size and a new crucible assembly is being designed.

The old Booth Street 12-inch oven is now partially installed next to the Koppers oven at Edmonton and the Technical Committee supports the view that this oven be re-commissioned using high-density silica brick (rather than silicon-carbide wall tiles) with an 18-inch slot width. This new oven would operate isothermally. (One member has kindly offered to donate sufficient bricks for this oven).

## 8.0 ACTIVITIES

### 8.1 Coking Tests

#### (i) Ottawa Facilities

In the current review period (July 1st, 1974 - January 31st, 1975), 67 tests were carried out in the technical-scale ovens.

The distribution of the technical-scale oven tests was as follows:

	<u>Tests</u>	<u>Per cent</u>
Confidential Studies	40	60
Research Studies	21	31
Resource Evaluations	6	9

The percentage of Resource Evaluations is reduced compared to previous years, probably because the Clover Bar facility is handling the major share of this work now. The advent of this facility has reduced the pressure on the Ottawa ovens and this, in conjunction with the reduction in the strength of the coke crew (now 3 men full time and 1 man part-time) explains the downward trend in the overall output of tests.

The 40 tests under "Confidential Studies" were all for member steel companies, and the 6 "Resource Evaluation" tests involved exploration samples for a member coal company. The 21 tests under "Research Studies" comprised side-charge tests in connection with canister tests, Clover Bar correlation tests and tests (two) to investigate the effect of changing the carbonization rate.

In the 30 lb. oven 13 tests were completed, and 42 tests were done in the sole-heated.

#### (ii) Clover Bar Facility

During the period under review, 33 tests were conducted in the Koppers oven:

- 8 tests in Correlation Series (4 Fording, 4 Coleman)
- 6 tests in Preheat Program (member steel company)
- 4 tests in Preheat Program (member steel company)
- 8 tests Resource Evaluation (Granridge Coal Project)
- 2 tests Confidential Program (member steel company)
- 5 tests Miscellaneous (experiments on preheating, etc.)

## 8.2 CCRA Priority Projects

### 8.2.1 Formed Coke

There have been no developments regarding the 100 ton HBNPC formed coke trial.

At CMFRL significant progress has been achieved in the development of both the pilot-scale and laboratory mixer-feeder hot briquetting facilities although delays have been incurred by heater burn out in the pilot-scale equipment and problems with the hydraulic system in the laboratory-scale press. An elutriation technique has been developed for the preparation of closely-sized char samples required for these systems. Inquiries have also been made regarding the possibility of obtaining industrial chars for this program. Mr. I.T. Lau has prepared a report on fluidization characteristics of the pilot-scale unit and this work may be presented later in the year at a conference in Toronto. It is hoped that the Board of Directors will agree to the provision of travel funds for Mr. Lau to present this paper, if it is accepted.

A stainless-steel shell has been installed in the sandcoker, allowing higher temperatures to be obtained.

### 8.2.2 Antifissurants

Results to date are summarized in the AIME paper.

The canister test has also been used to verify data from the recent 18-and 25-per cent low volatile base blend antifissurant program. In this test, coal blends (2 lb) are carbonized in perforated cans in a coal matrix in the side-charge box. The retrieved coke pieces, which have been subjected to the same thermal conditions as 500 lb tests, are shattered in a converted paint shaker. Size degradation after shattering is correlated to ASTM stability. Only two movable-wall oven tests were required to repeat the antifissurant program, the canister test indicating optimum low-volatile replacement by breeze of between 3 and 6 per cent.

### 8.2.3 Preheating

Of particular interest has been the increase in coke quality obtained by preheating (to 470<sup>o</sup>F) coal blends containing antifissurants. Results to date are presented in Appendix I.

A research program has been implemented at CMFRL to study some of the more fundamental aspects of preheating technology. This program will include such studies as the effect of preheating time, the effect of heat transfer through the plastic layer, and the effect of oven bulk density on coke quality. With regard to the latter, tests done using the side-charge box have indicated that with increasing bulk density, wall pressure increased but little change in coke stability is obtained. Carbonization time also increased with bulk density.

## 9.0 OTHER CCRA STUDIES

### 9.1 Preparation of Oil-Coal Slurries

This project is virtually complete and it would appear that the \$10,000.00

budgeted by the Board a year ago will not be required. Residual oil remaining on coal separated from slurries can affect caking properties slightly but coking properties as measured with the canister method do not appear to be altered significantly. No evidence of sulphur partition between oil and coal was found.

### 9.2 ASTM Round-Robin Coke Tumbler Test Series

This test series is almost complete. An acceptable correlation between Ottawa tumbler results and those from the four participating companies was obtained in all but two cases. One case was explained by a worn drum while the other one is still under study. It has been recommended that 1-inch screen from the same source be used by member companies and the possibility of obtaining an automatic screener should be considered.

### 9.3 Pilot-Scale Oven Correlation Program

An acceptable correlation between the Edmonton and Ottawa 12-inch ovens has been obtained, the Edmonton oven giving coke at 1.6 stability units below the Ottawa oven at stabilities close to 50. Little correlation was found between the Ottawa 12-inch and 30 lb ovens. At a stability of 50, the Ottawa 18-inch oven gives stability values approximately 1.3 units lower than the 12-inch oven. Coke quality is affected by the differences in heating rates between the two ovens, particularly for coals of low fluidity.

### 9.4 By-Product Analysis

Projects are underway to:

1. Characterize preheated coals by analysis of their by-products on carbonization,
2. Investigate the breaking of water-tar emulsions,
3. Study the problem of tar fog.

### 9.5 ISO/TC 27

Mr. J.C. Botham has been appointed Canadian Representative on Working Group XII (Plasticity of Coal and Coke) of ISO/TC 27. The Technical Committee voted to extend its ISO activity to include the business of this Working Group at the international level to complement its interest in Subcommittee 3 (Coal and Coke Testing) of the Canadian Advisory Committee to ISO/TC 27.

## 10.0 POINTS FOR REVIEW BY THE BOARD

The Technical Committee would ask the Board to review the following points:

- (i) Extension of Mr. I.T. Lau's Associateship and financial support for presentation of a paper on formed coke at the Canadian Institute of Chemical Engineers Conference, Toronto, if the paper is accepted.
- (ii) Support be given to CMFRL's case for the establishment of another coke oven in Edmonton.

- (iii) Support in principle be given to the Atlantic Group for Research in Industrial Metallurgy's research proposals for the desulphurization of coke.

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J.T. Collier  
Chairman.

KOPPERS OVEN (CLOVER BAR) TEST RESULTS

(i) PREHEAT PROGRAM FOR A MEMBER COMPANY

	Ambient		Preheat to Approx. 470°F	
Moisture in Charge.....%	*5.9	*3.2	-	-
Coking Time.....Hr:min <sub>3</sub>	8:28	8:39	7:46	7:40
Bulk Density (db)....lb/ft <sup>3</sup>	44.8	50.6	51.4	53.9
Yield.....% <sup>2</sup>	64.3	69.1	69.1	70.7
Max. Pressure.....lb/in <sup>2</sup>	0.74	0.84	0.67	1.06
Mean Coke Size.....in	2.11	2.11	2.04	2.19
Stability.....	49.1	51.2	51.1	48.8
Hardness.....	63.9	67.6	68.5	67.3
Production.....lb/hr	27.2	31.5	34.5	37.5

\*Note H<sub>2</sub>O Content

(ii) PREHEAT (470°F) AND ANTIFISSURANT PROGRAM FOR A MEMBER COMPANY

	100% Blend		95% Blend 5% Coke Fines		93% Blend 7% Coke Fines	
	Ambient	Preheat	Ambient	Preheat	Ambient	Preheat
Moisture in Charge.....%	5.8	-	5.5		5.6	
Coking Time.....Hr:min <sub>3</sub>	8:17	7:29	8:15	7:29	8:09	7:31
Bulk Density (db)....lb/ft <sup>3</sup>	45.1	53.3	44.7	54.4	44.5	55.7
Yield.....% <sup>2</sup>	69.8	71.5	72.1	73.3	73.0	73.4
Max. Pressure.....lb/in <sup>2</sup>	0.43	0.40	0.52	0.40	0.50	0.62
Mean Coke Size.....in	2.05	2.12	2.35	2.38	2.17	2.65
Stability.....	50.7	54.5	51.5	56.8	52.1	56.0
Hardness.....	61.5	66.5	63.1	67.1	61.5	65.7
Production.....lb/hr	28.7	38.0	29.5	40.1	30.0	41.0