

CANADIAN CARBONIZATION RESEARCH ASSOCIATION



ANNUAL REPORT 2012 / 2013

Chairman's Remarks

Since its inception in 1965, the Canadian Carbonization Research Association (CCRA) has provided a framework for technological cooperation between government and industry, which has been very successful for both parties. The CCRA is a unique organization in being Canada's only technical support for the Canadian metallurgical coal and coking industries. This organization continues to be of real value to its member companies and to the financial health of the associated industries. The value of its research is becoming more recognized on a global basis as demonstrated by the recent increase in membership.

The role played by the CCRA in the past and to be continued in the future is to strive to meet its member's needs. The CCRA technical program continues to evolve as the demands of the coal, cokemaking and ironmaking industry change with the issues facing Canada. With new members, arise more ideas and therefore potential solutions for some of the technical issues facing the coal and steel industries.

It is important to continue sharing our research findings with fellow researchers and industry. The CCRA has again published its work in several international journals and presented papers at both domestic and international conferences. These papers can be found on the CCRA website, www.cancarb.ca.

With the beginning of the Energy Recovery Oven facility construction, a new page has been turned at CCRA and at the CanmetENERGY Laboratory. This facility when commissioned in Q2 2014 will enable CCRA members to initiate research programs utilizing this greener technology. It will provide coal producers and cokemakers a better understanding of energy-recovery cokemaking to the extent achieved in slot oven technology with the movable wall ovens at CanmetENERGY. Energy recovery research will also be performed.

With the current state of flux in the steel industry, our research program reflects changes to greener technologies to support energy savings, environmental improvements and green house gas reductions in the coal and steel industries.

Globally, the Canadian Carbonization Research Association is self-standing in its ability to continue to grow and meet its member's requirements. This remarkable co-operative working relationship between the coal industry, steel industry and government is truly unique and its research program will continue to address its members needs today and in the future.

Ted Todoschuk,
Chairman, Board of Directors

CCRA 2012 – 2013 Review

Two thousand and twelve/thirteen saw CCRA start a major undertaking to add additional facilities to the Bell's Corners carbonization lab. The Association started a process to add an Energy Recovery Coking Facility to supplement the current movable wall coke ovens. A pilot facility is badly needed so the CCRA members can understand this technology and take advantage of its potential, both for coke quality and energy recovery.

An engineering study was contracted to Hatch by CCRA and this work is now completed. The initial design was reviewed and a decision was made to modify the door mechanism which was deemed a potential problem, so additional funds were spent to insure a door system design that would operate without problems. One of the existing movable wall ovens had to be relocated to make room for the new ERC oven. The staff at NRC carbonization lab has played a major part in the project and their assistance is greatly appreciated.

The funding to get the project to its present position has been provided by the CCRA members themselves and a forgivable loan from Natural Resources Canada. It is anticipated that building and commissioning will be complete by the end of Q2 2014.

The 2012-13 fiscal year saw a drop in confidential research carried out, however, this is more timing, rather than an actual reduction. The financial statements show the level of confidential R&D at \$832,221. The Audited Financial Statements show that this fiscal year finished in the black by \$262,424 most of which is monies collected for the ERC project which will go toward the actual construction of the test oven.

This year saw the signing of a new five year CCRA/NRC agreement after lengthy negotiations. The new five year agreement can be renewed for an additional five years term with mutual consent.

In 2015 CCRA will celebrate its 50th anniversary and all those associated with the organization should think about an appropriate celebration for the occasion. If you have any ideas please let either Ted or myself know so we can develop a 50th Anniversary plan for CCRA.

George Chapman

*crawford
smith &
swallow*

**CANADIAN CARBONIZATION RESEARCH
ASSOCIATION**

Financial Statements

March 31, 2013

CANADIAN CARBONIZATION RESEARCH ASSOCIATION

Financial Statements

March 31, 2013

Table of Contents

	Page
Independent Auditors' Report	1 - 2
Statement of Financial Position	3
Statement of Operations and Changes in Members' Net Assets	4
Statement of Cash Flows	5
Notes to Financial Statements	6 - 8
Opening Statement of Financial Position Restated on Adoption of Accounting Standards for Not-for-Profit Organizations	9
Five Year Financial Review	10 - 11

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INDEPENDENT AUDITORS' REPORT

To the Members of the
Canadian Carbonization Research Association

We have audited the accompanying financial statements of the Canadian Carbonization Research Association, which comprise the statement of financial position as at March 31, 2013, and the statements of operations and changes in members' net assets and cash flows for the year then ended and a summary of significant accounting policies and other explanatory information.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditors' Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditors' judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditors consider internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion, the financial statements present fairly, in all material respects, the financial position of the Canadian Carbonization Research Association as at March 31, 2013, and the results of its operations and its cash flows for the year then ended in accordance with Canadian accounting standards for not-for-profit organizations.

Comparative Information

Without modifying our opinion, we draw attention to note 2 to the financial statements, which describes that Canadian Carbonization Research Association adopted Canadian accounting standards for not-for-profit organizations on April 1, 2012 with a transition date of April 1, 2011. These standards were applied retrospectively by management to the comparative information in these financial statements, including the statements of financial position as at March 31, 2012 and April 1, 2011, and the statements of operations, changes in net assets and cash flows for the year ended March 31, 2012 and related disclosures. We were not engaged to report on the restated comparative information, and as such, it is unaudited.



Niagara Falls, Ontario
May 30, 2013

CRAWFORD, SMITH AND SWALLOW
CHARTERED ACCOUNTANTS LLP
LICENSED PUBLIC ACCOUNTANTS

CANADIAN CARBONIZATION RESEARCH ASSOCIATION

STATEMENT OF FINANCIAL POSITION

March 31, 2013

Assets	2013	2012
	\$	\$
Current Assets		
Cash and cash equivalents	1,140,264	1,018,696
Accounts receivable		187,409
Sales tax recoverable	40,268	21,036
	1,180,532	1,227,141
<hr/>		
Liabilities and Members' Net Assets		
Current Liabilities		
Accounts payable and accrued liabilities	7,423	10,272
Due to CANMET	587,817	894,001
	595,240	904,273
Members' Net Assets	585,292	322,868
	1,180,532	1,227,141

Signed on behalf of the Board:

R. L. Stephen Director
J. Woodcock Director

See accompanying notes

CANADIAN CARBONIZATION RESEARCH ASSOCIATION

STATEMENT OF OPERATIONS AND CHANGES IN MEMBERS' NET ASSETS

for the year ended March 31, 2013

	2013	2012
	\$	\$
Revenue		
Confidential research and development	832,221	1,231,511
Research levies	210,000	210,000
Non-recovery oven contributions	363,000	191,151
Consulting funding	7,875	9,000
Membership fees	700	700
Interest income	9,615	5,896
Other income	169	26,532
	<u>1,423,580</u>	<u>1,674,790</u>
Operating Expenses		
Confidential research and development	832,221	1,231,511
CANMET research support	120,000	120,000
Non-recovery oven	180,700	237,000
Consulting	8,679	8,679
Meeting	1,523	3,486
Office	12,138	12,128
Professional fees	5,895	6,020
	<u>1,161,156</u>	<u>1,618,824</u>
Excess of Revenues over Expenses	262,424	55,966
Members' Net Assets, Beginning of Year	322,868	266,902
Members' Net Assets, End of Year	<u>585,292</u>	<u>322,868</u>

See accompanying notes

CANADIAN CARBONIZATION RESEARCH ASSOCIATION

STATEMENT OF CASH FLOWS

for the year ended March 31, 2013

	2013	2012
	\$	\$
Operating Activities		
Excess of revenue over expenses	262,424	55,966
Changes in working capital components - note 3	(140,856)	406,711
Increase in Cash and Cash Equivalents	121,568	462,677
Cash and Cash Equivalents, Beginning of Year	1,018,696	556,019
Cash and Cash Equivalents, End of Year	1,140,264	1,018,696
Cash and Cash Equivalents		
Cash	44,937	7,513
Guaranteed investment certificates	1,095,327	1,011,183
	1,140,264	1,018,696

See accompanying notes

CANADIAN CARBONIZATION RESEARCH ASSOCIATION

NOTES TO FINANCIAL STATEMENTS

for the year ended March 31, 2013

Organization

Canadian Carbonization Research Association (the "Association") is a national organization which initiates, coordinates and provides funding towards research and development having particular importance to the coal and carbonization industries of Canada. The organization is incorporated under the Canada Corporations Act as a not-for-profit association.

1. Significant Accounting Policies

The financial statements of the Association are the representations of management prepared in accordance with Canadian accounting standards for not-for-profit organizations, consistently applied. Because a precise determination of many assets and liabilities is dependent upon future events, the preparation of periodic financial statements necessarily involves the use of estimates and approximations. These have been made using careful judgement in the light of available information. The financial statements have, in management's opinion, been properly prepared within reasonable limits of materiality and within the framework of the accounting policies summarized below:

Financial reporting framework

The Association, being a not-for-profit organization, chose to establish their financial statements in accordance with Canadian accounting standards for not-for-profit organizations, issued by the Canadian Institute of Chartered Accountants.

Revenue recognition

Membership fees, research levies, consulting funding and other income are recognized in the fiscal year for which they have been assessed. Confidential research and development revenues are recognized when the related services are provided. Non-recovery contributions are voluntary in nature and recognized in the year of receipt.

Cash and cash equivalents

Cash equivalents include guaranteed investment certificates that are readily convertible to cash and are subject to insignificant risk of change in value.

Financial instruments

The Association's financial instruments consist of cash and cash equivalents, accounts receivable, accounts payable and accrued liabilities and due to CANMET. Financial instruments are initially measured at fair value on acquisition and are subsequently measured at amortized cost. Transaction costs and financial fees associated with financial instruments carried at amortized cost are recorded as adjustments to the initial fair value recognized, and amortized over the life of the financial instrument.

CANADIAN CARBONIZATION RESEARCH ASSOCIATION

NOTES TO FINANCIAL STATEMENTS

for the year ended March 31, 2013

2. Adoption of the New Canadian Accounting Standards for Not-for-Profit Organizations

Effective April 1, 2012, the Association adopted requirements of the Canadian Institute of Chartered Accountants (CICA) Handbook - Accounting, electing to adopt the new accounting framework: Canadian accounting standards for not-for-profit organizations. These are the Association's first financial statements prepared in accordance with these accounting standards and the transitional provisions of Section 1501, First-time Adoption by Not-for-Profit Organizations have been applied. Section 1501 requires retrospective application of the accounting standards with certain elective exemptions and limited retrospective exceptions. The accounting policies set out in note 1, significant accounting policies, have been applied in preparing the financial statements for the year ended March 31, 2013, the comparative information presented in these financial statements for the year ended March 31, 2012 and in the preparation of an opening statement of financial position at April 1, 2011 (the Association's date of transition), see Schedule 1.

The Association issued financial statements for the year ended March 31, 2012 using generally accepted accounting principles prescribed by CICA Handbook - Part V, Pre-changeover Accounting Standards. The adoption of accounting standards for not-for-profit organizations had no impact on the previously reported assets, liabilities and net assets of the Association and, accordingly, no adjustments have been recorded in the comparative statement of financial position, or the statements of operations, changes in net assets and cash flows. Certain of the Association's disclosures included in these financial statements reflect the new disclosure requirements of the accounting standards for not-for-profit organizations.

3. Statement of Cash Flows

Changes in working capital components include:

	2013	2012
	\$	\$
Accounts receivable	187,409	(177,408)
Sales tax recoverable	(19,232)	(19,545)
Accounts payable and accrued liabilities	(2,849)	1,352
Due to CANMET	(306,184)	604,112
Deferred income		(1,800)
	(140,856)	406,711

CANADIAN CARBONIZATION RESEARCH ASSOCIATION

NOTES TO FINANCIAL STATEMENTS

for the year ended March 31, 2013

4. Statement of Members' Net Assets for the Years Ended March 31

	2013	2012
	\$	\$
Balance, beginning of year as previously stated	322,868	266,902
Adoption of the new accounting standards - note 2		
Balance, beginning of year as restated	322,868	266,902
Excess of revenues over expenses for the year	262,424	55,966
Balance, end of year	585,292	322,868

5. Financial Instruments

Cash Flow Risk

The Association is exposed to the risk that the interest earned on its cash balances will fluctuate due to changes in market interest rates. The Association manages its cash balances based on its cash flow needs and with a view to maximizing its interest income. Interest received in the year amounted to \$ 7,414 (2012 - \$ 3,485)

Credit Risk

Credit risk is the risk that a party to a financial instrument fails to discharge an obligation and causes financial loss to another party. The Association is exposed to credit risk on its cash and accounts receivable balances. The total credit risk exposure as at March 31, 2013 was \$ 1,180,532 (2012 - \$ 1,227,141). The Association's cash balances comprise of deposits with a single Canadian chartered bank. The accounts receivable substantially represent outstanding balances from the members for confidential research and development. The Association grants credit to its members in the normal course of operations and monitors their financial condition and reviews the credit history of new members. The Association has not established an allowance for doubtful accounts as all accounts receivable were collected subsequent to the year end.

Credit Facilities

The Association has not obtained any external credit facilities and relies solely on annual revenues plus accumulated working capital to finance its annual cost of operations.

6. Related Party Transactions

Fees amounting to \$ 6,887 (2012 - \$ 9,180) were charged by Burlington Management Services Inc. ("BMSI") to the Association for the year. BMSI is owned by the Treasurer of the Association. In addition, accounts payable includes a balance of \$ 791 (2012 - \$ Nil) owed to BMSI.

7. Taxation Status

The Association is exempt from income taxes as it has complied with the necessary provisions of the Federal and Provincial Tax Acts. Consequently, no provision for income taxes is reflected in the accounts.

CANADIAN CARBONIZATION RESEARCH ASSOCIATION

Schedule 1

**OPENING STATEMENT OF FINANCIAL POSITION RESTATED ON
ADOPTION OF ACCOUNTING STANDARDS FOR NOT-FOR-PROFIT
ORGANIZATIONS**

April 1, 2011

Assets	As Reported \$	Effect of Transition \$	As Restated \$
Current Assets			
Cash and cash equivalents	556,019		556,019
Accounts receivable	11,492	(1,491)	10,001
Sales tax recoverable		1,491	1,491
	567,511		567,511
Liabilities and Members' Net Assets			
Current Liabilities			
Accounts payable and accrued liabilities	8,920		8,920
Due to CANMET	289,889		289,889
Deferred income	1,800		1,800
	300,609		300,609
Members' Net Assets	266,902		266,902
	567,511		567,511

See accompanying notes

CANADIAN CARBONIZATION RESEARCH ASSOCIATION

Schedule 2

FIVE YEAR FINANCIAL REVIEW

STATEMENT OF OPERATIONS AND MEMBERS' NET ASSETS

for the year ended March 31, 2013

	2013	2012	2011	2010	2009
	\$	\$	\$	\$	\$
Revenues					
Confidential research and development	832,221	1,231,511	365,705	1,118,668	718,330
Research levies	210,000	210,000	104,000	110,000	111,000
Non-recovery oven contributions	363,000	191,151	8,850		
Consulting funding	7,875	9,000			
Membership fees	700	700	400	500	600
Interest income	9,615	5,896	4,120	4,230	10,773
Other income	169	26,532	1,000	1,291	2,447
	1,423,580	1,674,790	484,075	1,234,689	843,150
Operating Expenses					
Confidential research and development	832,221	1,231,511	365,705	1,118,668	718,330
CANMET research support	120,000	120,000	100,000	110,000	111,000
Non-recovery oven	180,700	237,000			
Consulting	8,679	8,679			
Meeting	1,523	3,486	2,126	2,364	2,772
Office	12,138	12,128	7,633	8,136	7,984
Professional fees	5,895	6,020	5,860	5,805	3,523
ISO Vancouver sponsorship				2,500	
	1,161,156	1,618,824	481,324	1,247,473	843,609
Excess (Deficiency) of Revenues over Expenses	262,424	55,966	2,751	(12,784)	(459)
Members' Net Assets, Beginning of Year	322,868	266,902	264,151	276,935	277,394
Members' Net Assets, End of Year	585,292	322,868	266,902	264,151	276,935

See accompanying notes

CANADIAN CARBONIZATION RESEARCH ASSOCIATION

Schedule 2 - continued

FIVE YEAR FINANCIAL REVIEW**STATEMENT OF FINANCIAL POSITION**

as at March 31, 2013

	2013	2012	2011	2010	2009
	\$	\$	\$	\$	\$
Assets					
Current Assets					
Cash and cash equivalents	1,140,264	1,018,696	556,019	768,816	645,460
Accounts receivable	40,268	208,445	11,492	189,445	375
	1,180,532	1,227,141	567,511	958,261	645,835
Liabilities and Members' Net Assets					
Current Liabilities					
Accounts payable and accrued liabilities	7,423	10,272	8,920	8,765	5,673
Due to CANMET	587,817	894,001	289,889	685,345	363,227
Deferred income			1,800		
	595,240	904,273	300,609	694,110	368,900
Members' Net Assets	585,292	322,868	266,902	264,151	276,935
	1,180,532	1,227,141	567,511	958,261	645,835

See accompanying notes

TECHNICAL COMMITTEE REPORT

2012 - 2013

EXECUTIVE SUMMARY

The CCRA Technical Committee held four meetings during Fiscal Year 2012-13: one in Hamilton (AM Dofasco) in June 2012, two in Ottawa (CanmetENERGY) in September and November 2012 and one in Fernie (Teck) in March 2013.

The 2012-13 Research Program consisted of four main research areas:

1. Energy and CO₂ Reduction in the Coal and Steel Industry
2. Energy and Environment
3. Fundamental Aspects of Coal and Coke Utilization
4. Database, Standards and Procedures

In total, 17 projects were part of the Research Program although several projects were not progressed.

Major accomplishments/highlights:

1. During FY 2012-13, the CCRA had one paper published, '*Small scale determination of metallurgical coke CSR*' in Fuel (available on-line, 12 September, 2012),
2. The CCRA also presented two papers at AISTech 2012 Conference, Atlanta, May 2012; '*Wood Pellets for Ironmaking from a Life Cycle Analysis Perspective*' and '*Incorporation of Charcoal in Coking Coal Blend—A Study of the Effects on Carbonization Conditions and Coke Quality*'.
3. On coke fissuration (CCRA 84), preliminary work was presented on using a high-temperature dilatometer acquired by CanmetENERGY in 2011 to investigate contraction rates of Canadian and foreign coals after resolidification. To date, limited success has been achieved in preventing sticking/jamming of the coal sample/piston assembly upon examining effects of high-temperature lubricants, onion paper and sample length.
4. On Blast Furnace energy reduction initiatives (CCRA 91), bulk of effort was on construction of PCI simulator rig at CanmetENERGY with purchasing of furnaces, other equipment/components and conducting CFD modeling of PCI simulations on different VM coals. Timely construction and successful operation of this rig is very important to Arcelormittal as a whole and to USS Canada. Furthermore, preliminary results were presented on characterizing BF dusts as per their different carbon types (coal, char, coke and soot) via TGA. Main objective of this work is to achieve quantitative analysis of the various C types to monitor the effectiveness of auxiliary BF fuel injection.
5. On the use of renewable energy for the steel industry (CCRA 70 & 85), the CCRA held two meetings/workshops in June and September 2012 to assemble some of the main players in bioenergy/bio-carbon making from the private, public and university sectors. Main focus was on challenge and requirement to achieve conversion of raw biomass to a usable 'mineral-matter free' char or bio-carbon. The main driver for this work is the possibility of a C tax imposed on industry by governments. Also, information was presented on designing and constructing a small apparatus (5 kg capacity) for demineralization of bio-char at CanmetENERGY, with subsequent work to be done in 2013-14.
6. On Energy Recovery Coke Oven (CCRA 77), main accomplishment was the successful relocation, reconstruction and recommissioning of the Carbolite pilot oven – cost covered by the CCRA. Updates were also provided on the progress in construction of the new

ERCO with projected timeline and budget. Again this year discussions were held around logistics of funding for this project.

7. On influence of organic liquids on coking properties (CCRA 90), work was undertaken on examining a high-inert Western Canadian coal with modest rheology treated and untreated with various liquids and effect of ageing on coke quality. This work, motivated by an ACARP (Australia) report, has so far indicated a significant decrease in CSR for the treated coal relative to the untreated one. This work will be continued in 2013-14.
8. On mineral matter and coke reactivity (CCRA 81), further work was presented confirming the complexity of mineral changes during coal to coke. Evidence showed that the XRD-RIR technique was adequate and accurate for identifying minerals. An interesting finding was that minerals in MWO and SHO cokes were essentially identical supporting the similar CRI and CSR for cokes produced by the different carbonization routes. Future work is planned for elucidating mechanism of mineral transformation.
9. On performance of Canadian coals in high-inert blends (CCRA 86), for examining effect of inert level, bulk density and quench method on coke quality, Phase 2, consisting of 14 tests in Carbolite oven on 3 blends with R_o 1.28 was completed and reported along with regression analysis relating dependent to independent variables. Phase 3 work on blends of lower R_o ~1.1 remains a possibility and would involve a further 14 Carbolite oven tests.
10. On factors affecting coke bed permeability (CCRA 82), a successful method/apparatus and procedures was developed to characterize both the size and shape of coke and thus estimating the pressure drop in a coke bed. Permeability data was presented for industrial cokes from AM Dofasco and USS Canada. Further work could involve (1) effect of iron ore penetration on coke bed permeability (2) effect of coal origin on coke size and shape characteristic (3) measurement of coke size and shape from 18" and Carbolite MWO.
11. On Standards (CCRA 54), presentation on Canada's organisation of an Inter Laboratory Study on coal dilatation to promote the better understanding and acceptance of the SD2.5 approach developed at CanmetENERGY and currently used by the majority of Canadian laboratories.
12. On database analysis (CCRA 76), mineralogy of Western Canadian coals is very different from that of foreign coals and CRI related well to estimated ankerite content $(Ca(Fe,Mg,Mn)(CO_3)_2)$ but only for WC coals. Also, examination of the CanmetENERGY database revealed that repeatability in CRI and CSR are different and inferior to ASTM values and that repeatability depend on range considered, e.g., for CSR they are smaller the higher the CSR value.
13. On Technical Merits of Western Canadian Coals (CCRA 87), Phase 2 and 3 of a program aimed at redefining a MOF diagram for Canadian coals/blends was completed (12 Carbolite oven tests) and showed that blends of Canadian coals of R_o 1.25 (Ph 2) and 1.12 (Ph 3) and Maximum Fluidity of only ~50 dd/min can make good quality coke – not 200 dd/min as per MOF (Miyazu) paper published in 1974. This is a very important result showing that coking blends of western Canadian coals need be evaluated using the proper criteria. The plan is to pursue further work in this project by blending US Appalachian with Western Canadian coals.
14. On CSR comparison between movable wall ovens and sole-heated ovens (CCRA 88), a paper was accepted for publication in Fuel. Further work was also proposed in conducting I_{600} tumblers on a series of pairs of cokes from pilot test ovens and sole-heated oven for examining relations between I_{600} and CSR and CSR and fitted CSR using CRI and I_{600} .

Oven Utilization:

CanmetENERGY oven utilization statistics for 2012-13 showed the following in comparison with 2011-12:

Sole-Heated Ovens

1. CCRA – 42 vs 22 trials
2. Coal Companies – 189 vs 146 trials (54% in Stelco oven)
3. Steel Companies – 79 vs 64 (70% in Canmet oven)

In total, usage of sole-heated ovens in 2012-13 was 310 trials were appreciably higher than 232 trials in 2011-12 (34% higher).

Sole-Heated Oven Coke Reheats - CSR

1. CCRA – 25 vs 14
2. Coal Companies – 119 vs 65
3. Steel Companies – 26 vs 21

In total, 171 reheats of sole-heated oven cokes for CSR determination – vs 100 in 2011-12.

CSR Determination

1. CCRA – 40 vs 29
2. Coal Companies – 235 vs 207
3. Steel Companies – 46 vs 70

In total, 321 CSR evaluations were performed – vs 306 in 2011-12.

30 lb Oven

No tests performed during 2012-13 vs 6 trials done in 2011-12.

Coke Stabilization

No such work was done in 2012-13 vs 26 coke stabilization trials (Measure of coke size distribution, ASTM S/H, Extended IRSID) in 2011-12.

Movable Wall Ovens

1. CCRA – 30 vs 24 trials (All in Carbolite oven)
2. Coal Companies – 99 vs 116 trials (All in Carbolite oven)
3. Steel Companies – 37 vs 34 trials (All in 18 inch oven)

In total, usage of movable wall ovens in 2012-13 was 166 trials compared to 174 trials in 2011-12 (~5% lower).

TECHNICAL COMMITTEE MEETINGS

Four Technical Committee Meetings were held during 2012-13 fiscal year:

<u>Meeting No.</u>	<u>Location</u>	<u>Date</u>
219	Hamilton, ON	June 19-20, 2012
220	Ottawa, ON	September 25-26, 2012
221	Ottawa, ON	November 27-28, 2012
222	Fernie, BC	March 19-20, 2013

Utilization of CanmetENERGY Facilities

Oven Tests				
April 1, 2012 - March 31, 2013				
Facility	CCRA	Coal Companies	Steel Companies	Totals
SHO				
Stelco	24	102	6	132
Canmet	14	64	55	133
New SHO(#3)	4	23	18	45
Total	42	189	79	310
SHO Coke Reheats	25	119	26	171
CSR	40	235	46	321
Coke Stabilization				
Movable Wall Oven				
18 inch	0	0	37	37
Carbolite	30	99	0	129
Totals	30	99	37	166

CCRA Technical Committee Planning Table for 2012-2013

Program	Program Objectives	Projects	Industrial Monitor	Project Objectives and Deliverables	Specific Project Activity	Status of Current Work, Next Steps or Final Product	Outstanding Issues
1. Energy and CO₂ Reduction in the Coal and Steel Industry	To develop the technical understanding to improve energy efficiency and coke quality for higher productivity and lower coke rate blast furnace operation	CCRA 84 Coke Fissuration	T. Todoshuk AM Dofasco L. Giroux CanmetENERGY	<ol style="list-style-type: none"> To establish and understand coke fissuration mechanisms. To determine how coke fissuration affect coke quality including size, shape, strength and stabilization. 	<ol style="list-style-type: none"> Review existing literature on the topic. Investigate rate of contraction phenomena. 	<ol style="list-style-type: none"> Literature review - BCRA, COMA Year-Book, CPM papers/reports, BHP and others. Netzsch horizontal High-Temperature Dilatometer (Germany) purchased by CPM, France has been evaluated. CanmetENERGY is commissioning HTD from Automazione (Italy). Main issue is to resolve sticking/jamming of piston inside retort tube. CanmetENERGY has completed TGA trials to attempt detecting loss of VM at resolidification (primary gases) and beyond – derivative profiles. A NSC (Japan) paper on use of a High-Temperature Dilatometer for examining effect of coke contraction on mean coke size has been reviewed. 	<ol style="list-style-type: none"> Summary of coke fissuration papers highlighting rate of contraction of semi-coke, 1st and 2nd peaks, coefficient of contraction, dictating coke contraction behaviour. Once new HT Dilatometer is commissioned, develop project to investigate contraction profiles of Canadian and foreign coals at 500-1000°C - preliminary project plan tabled at December 2011 meeting.
		CCRA 61 High Temperature Properties of Coke	T. Todoshuk AM Dofasco S. Ray CanmetENERGY	<ol style="list-style-type: none"> To characterize coke degradation after 1100°C using the high temperature softening meltdown test. 	<ol style="list-style-type: none"> Investigate if cokes with different initial CSRs show significant changes after primary slag attack/smelling of iron ore. Quantify the changes in coke properties associated with higher temperature degradation after primary slag attack/smelling of iron ore. 	<ol style="list-style-type: none"> Multivariate analysis was used to examine results of CCRA study "Strength of Coke after Different Degree of Reaction". A mathematical procedure for estimating the change in SAR with time using measured CSR and CRI was proposed. 	<ol style="list-style-type: none"> Conduct trials on iron ore pellets to meltdown (1600°C) and in presence of cokes with CSRs in 50-70 range. Coke strength determination is required. This project will be replaced by a new one, Blast Furnace Energy Reduction Initiatives (CCRA 91), beginning in 2013-14.
		CCRA 70 Renewable Energy for the Steel Industry	T. Todoshuk AM Dofasco J. Quanci SunCoke Energy T. MacPhee CanmetENERGY	<ol style="list-style-type: none"> To investigate the short-term solutions for utilizing bio carbon in ironmaking. 	<ol style="list-style-type: none"> Charcoal addition to existing blends for bio-cokemaking and application for PCI. Explore potential of biomass from algae as a C source for bio-cokemaking and PCI. 	<ol style="list-style-type: none"> Charcoal in a coal blend affects both coke hot and cold strengths. Stability and hardness can be maintained by manipulating the size of charcoal added to the coal blend. Bench-scale laboratory work focused on the effect of different parameters for extracting minerals from charcoal for it to become suitable for bio-cokemaking. A review of charcoal-making technologies currently available and a new bio-char briquette preparation technology develop in Japan was presented. CCRA presented update of its R&D work to the Ontario Ministry of the Environment, March 2012. In June and September 2012, CCRA held meetings with major stakeholders from the various levels of government, the private sector and universities to present its research program and to become familiar with other bio-based carbon research currently taking place in Canada. Papers presented at Melec-InSteelCon, Germany, June 2011 and AISTech, Atlanta, May 2012. <p><i>Bio-fuel Injection</i></p> <ol style="list-style-type: none"> A flowsheet on coal washing from UCC Energy (White Mining Ltd and CSIRO, 2011) using Acid/alkali leaching to dissolve mineral matter was presented at November 2012 meeting. Based on this flowsheet, charcoal demineralization process was proposed. Paper on "Selection of Biofuel for Direct Injection in Blast Furnace Ironmaking presented at Scanmet IV conference, Sweden, June 2012. 	<ol style="list-style-type: none"> Set-up of washing facility at CanmetENERGY to produce sufficient clean charcoal to pursue Sole-Heated Oven work. Conduct Sole-Heated Oven work on washed & unwashed charcoal to determine its upper limit of addition to coal. Consider use of charcoal briquettes. Preliminary project plan tabled at December 2011 meeting. Organise 3rd meeting/workshop on Bio-Carbon for iron and steelmaking to develop a methodology for producing reasonable amounts of bio-carbon possessing suitable characteristics for iron and steelmaking applications. Explore the use of biomass from algae from US Steel Canada pilot-scale project (Carbon Strategy Drivers).

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		<p>CCRA 85 Radical Renewable Energy Solutions for the Steel Industry & Alternative Primary Processes with CO₂ Capture and Storage</p>	<p>T. Todoshuk AM Dolasco J. Quanci SunCoke Energy K.W. Ng CannetENERGY</p>	<ol style="list-style-type: none"> Establish a long-term bio-carbon plan involving the transformation of raw biomass into a suitable bio material for ironmaking reduction applications, e.g., BF, EAF and DRI. Reconfiguration of primary end to achieve CO₂-free ironmaking. 	<ol style="list-style-type: none"> Perform Life-Cycle Analysis of charcoal. Investigate methods that are required to "clean" bio based material for suitable use in ironmaking reduction. Determine process methods to produce a 100% bio-carbon material for suitable use in the BF, EAF and DRI facilities. Identify reduction processes capable of handling 100% bio-carbon which may be different than current BF, EAF or DRI. Mandate of long-term radical solutions for biocarbon use in ironmaking and steelmaking is to examine technical solutions and not economics. 	<ol style="list-style-type: none"> Presentation of a review of world efforts on developing breakthrough technologies for radical reduction in GHG emission in the steel industry and a LCA study on the use of wood pellets for ironmaking. Determine biomaterials to be considered (local supply) - chemical compositions, etc. Explore enrichment of bio carbon (C content) through leaching, temperature and briquetting) to make suitable char. Papers presented at Metec-InSteelCon 2011, AISTech 2011 & 2012 conferences. A 2nd meeting/workshop on Bio-Carbon for iron and steelmaking was held with key partners in late September 2012. Objective of meeting was to continue discussion on the need to develop a methodology for producing bio-carbon possessing suitable characteristics for iron and steelmaking applications. Next steps were identified. No new work is planned for this project in 2012-13. 	<ol style="list-style-type: none"> Preparation of a position paper clearly outlining CGRA's long-term R&D needs in applying biomass in iron and steel making. Explore partnerships with Bio Networks in Canada LCA of Biomass applications in BF ironmaking – for sustainability of biomass use. Perform cost analysis on washing of biomass and on determining optimal capacity of charcoal making plant to meet the demand of the steel industry.
<p>2. Energy and Environment</p>	<p><i>To determine options for alternative cokemaking in Canada</i></p>	<p>CCRA 77 Coke and Power - Energy Recovery Cokemaking</p>	<p>R. Stephens Teck J. Quanci SunCoke Energy K. Witich CannetENERGY</p>	<ol style="list-style-type: none"> Evaluation of energy savings and coke quality improvements (size, strength and CSR) achievable with this technology for Canadian coals. Determine the impact of Canadian coals in international coal blends using this technology. Investigate potential of ERCO for producing a suitable biocarbon material for iron and steel making. 	<ol style="list-style-type: none"> Determination of funding source(s) available for this large-scale project - approximately \$2M will be needed over 5 years. Engineering design contract to Hatch. Site preparation engineering design and materials purchasing. 	<ol style="list-style-type: none"> Hatch completed engineering design of pilot-scale Energy Recovery Coke Oven in October 2012. CannetENERGY secured funding through federal ecoEI program towards purchase and design for new oven and for long-term R&D program, 2012-2016. Research program has been developed. Emphasis has been placed on coke quality, heat/energy recovery and the environment. CGRA members have been asked to contribute financially towards the building of the new oven. 	<ol style="list-style-type: none"> Construction of new oven to begin at CannetENERGY during Q4 of 2012-13. Step 1 in this process will involve moving the Carbolite MWO to make space for construction of the new oven. Financial support from various sources is required for building a pilot ERO facility at CannetENERGY. In the longer-term, proceed on using the pilot-scale Energy Recovery Oven to perform bio-carbon development work in view of its potential to accommodate the use of more biomass and for studies on densification of weak coking coals and wood (briquettes).
<p>3. Fundamental Aspects of Coal and Coke Utilization</p>	<p><i>To understand the fundamental science of coal and coke utilization in order to improve energy efficiency</i></p>	<p>CCRA 80 Plant Coal Quality Upgrading</p> <p>CCRA 90 Influence of Organic Liquids on Coking Properties</p>	<p>T. Slier Peace River Coal L. Giroux CannetENERGY</p> <p>M. Holuszko Teck L. Giroux CannetENERGY</p>	<ol style="list-style-type: none"> To characterize the metallurgical properties of mine circuits to better understand how to improve coke quality and hence energy efficiency for both the coal and steel industries. To determine which "oxidation/aging" parameters best reflect the caking/coking ability of each circuit and coal. 	<ol style="list-style-type: none"> A plan to characterize the metallurgical properties of coarse, medium, fine and tailing circuits for the new coal members has been accepted. 	<ol style="list-style-type: none"> A work plan for project "Quality Characteristics of Wash Plant" was presented whose objective is to determine ways to improve the quality of washed coal and the resultant coke. Characterize heavy, medium and fine circuit products at Peace River Coal Trend mine - conduct rheological and oxidation tests to determine which ones are suitable for such coals. 	<ol style="list-style-type: none"> Anglo American/Peace River Coal expressed interest in this project and will prepare a draft work plan with tentative schedule & cost in Q4 of 2012-13.

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		CCRA 81 Mineral Matter and Coke Reactivity	T. Todoshuk AM Dofasco R. Stephens Teck K.W. Ng CanmetENERGY	<ol style="list-style-type: none"> To study the effects of coal (coke) mineral matter on CRI and CSR. To determine if high strength after reaction can be achieved with highly reactive coke. 	<ol style="list-style-type: none"> A plan to characterize mineral matter and its influence on reactivity has been tabled and accepted. Mineral characterization will be done on coal, semi coke and post CSR coke from sole-heated oven to understand the changes in the chemistry of minerals during coal to coke transformation. A suite of activities were proposed in 2012 to progress this work. 	<ol style="list-style-type: none"> Work conducted has shown that major Fe- and Ca-containing minerals in coals are pyrite, FeS₂, and calcite, CaCO₃. As coal is transformed into coke, pyrite decomposes into pyrrhotite, Fe₉S₈ as suggested in the literature but calcite is not expected but rather to dolomite, CaMg(CO₃)₂. A summary of the work accomplished thus far on this project and plan for progressing further was presented in September 2012 – 5 activities were put forward. Presentation made on Activity 1 – Validation of Reference Intensity Ratio X-Ray Diffraction Analysis at November 2012 meeting. 	<ol style="list-style-type: none"> Develop a reliable and accurate mineral matter characterisation technique as results to date from two quantitative XRD techniques (RIR and Rietveld) have been significantly different. Explore relation between mineral index (ratio of minerals decreasing and improving CRI) and CRI.
		CCRA 86 Performance of Canadian Coals in High-Inert Blends	M. Conejeros Teck L. Giroux CanmetENERGY	<ol style="list-style-type: none"> To understand how western Canadian coals behave/work in high-inert blends. 	<ol style="list-style-type: none"> Evaluate the performance of high-inert Canadian blends under different pilot oven charge densities and with wet/dry quenching of coke. 	<ol style="list-style-type: none"> Phase 1, consisting of a total of 21 tests in Carbolite oven (7 Lots and 14 trials on 3 blends with R₉₀ 1.18) for examining effect of inert level, bulk density and quench method on coke quality was completed and reported in 2011-12. Data showed quantitative relationships between CSR and inerts and P-O₂ for the 7 Lots and importance of dry quenching on coke quality, namely hot and cold strengths and mean coke size. Phase 2 on higher rank blends, R₉₀ ~ 1.25 was completed in 2012-13. Regression analysis on some of the primary variables (stability, hardness, I40, I10 and mean coke size, CSR and CRI) versus coke quality parameters, inert levels, BD and quench method has been done. 	<ol style="list-style-type: none"> More in-depth data analysis remains on Phase 1 & 2 findings. An attempt will be made to identify a good set of western Canadian coals for doing Phase 3 at lower R₉₀, 1.10-1.12 at a later date.
		CCRA 89 Utilization of Briquetting technology	T. Todoshuk AM Dofasco L. Giroux CanmetENERGY	<ol style="list-style-type: none"> To investigate different parameters (binder, compression strength, size, shape) for briquette making. To determine lowest rank coal possible for briquetting while maintaining coke strength/quality. 	<ol style="list-style-type: none"> Review past CCRAM/CanmetENERGY briquetting work. 	<ol style="list-style-type: none"> This project focuses on briquetting USA low-rank coals (for maximizing amount of these coals) within AM Dofasco standard industrial blend. Six (6) tests including WVO, SHO & other analyses completed in 01 2011. Coke quality data from these trials showed that CSR are improved by briquetting although those in the set studied are lower than expected. One of the conclusions of this work was that it is not wise to only briquette the high-vol coals as this leads to poor mixing of the blend components. 	<ol style="list-style-type: none"> Possibility of conducting briquetting work using a marginal coking coal with R₉₀~0.5 within a standard steelmaker blend. Continue to enquire at NSC, Japan on techno-economical benefits of coal briquetting technology & rank of briquetting coal used in Japan. This project will not be pursued in 2013-14.
		CCRA 82 Factors affecting Coke Bed Permeability	R. Stephens Teck K.W. Ng CanmetENERGY	<ol style="list-style-type: none"> To determine how bed permeability changes with size and shape consist. 	<ol style="list-style-type: none"> Literature review is required to develop testing program. 	<ol style="list-style-type: none"> Work was presented on (i) methods to characterize coke size using sieve analysis and image analysis (ii) dependence of bed permeability on coke size and shape - bed permeability decreases rapidly with decreasing coke size (iii) effect of iron ore pellet layer on coke bed permeability – leading to a decrease in bed permeability (iv) new approach for 3D characterization of coke size and shape by image analysis - calculated Ergun slope found to be consistently higher than experimentally measured one suggesting the need of a correction factor to account for imperfection in size and shape measurements. Abstract on 'Coke Size and Shape Characterisation for Bed Permeability Estimation' was submitted for AIS Tech 2013 conference, Pittsburgh. Summary of work accomplished thus far, and ideas for further work was presented in September 2012. Bed resistant index data for industrial wharf and BF coals was presented at November 2012 meeting. 	<ol style="list-style-type: none"> If further work is to be done including the effect of coal properties on coke size and penetration of iron ore into the coke bed, it should be done as part of a new project. Coke samples from AM Dofasco, US Steel Canada and Sun Coke are being tested for bed resistant index to broaden the coke size and shape range to that produced in industrial coke plants.

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		CCRA 83 Characterization of Gething Coals	T. Siler Peace River Coal L. Giroux CanmetENERGY	1. To characterize hard coking coal from the Gething Formation	1. A project plan to characterize hard coking coal from the Gething Formation has been tabled. Gething Formation coals are highly variable with respect to rank and hence coking potential changes from seam to seam. 2. To participate in ASTM and ISO meetings. 3. To participate in the development of ASTM and ISO standards for ensuring that Canadian coals and interests are not undermined by new or modified standards.	1. Report presented on 'Analyses of Gething Formation Coal Seams' involving coking data of 8 coal seams and 3 blends carbonised in CanmetENERGY's sole heated ovens. 2. Summary report presented on 'Market Potential of Gething Formation Coal Seams' and could act as a final report to this project.	1. Project is complete.
4. Database Standard and Procedures	To develop standards or procedures to enhance the knowledge and utilization of Canadian coal and coke	CCRA 54 Standards	T. Todoshuk AM Doliasco L. Giroux CanmetENERGY	1. The CanmetENERGY business plan includes the development of standards and procedures pertaining to Canadian Coal and Steel industries.	1. To participate in ASTM and ISO meetings. 2. To participate in the development of ASTM and ISO standards for ensuring that Canadian coals and interests are not undermined by new or modified standards.	1. CanmetENERGY data presented on ruggedness of Dilatation, SD2.5, and FSI testing. 2. A new ISO project in SCI, Coal Preparation, links well with a new CCRA project on effects of organic liquids on coal rheology and resultant coking properties. 3. CanmetENERGY initiated participation in SGS-LOSI Proficiency Testing Programme on CSR and ASTM Coke Tumbler. CanmetENERGY performed well in a CSR round robin organised by SGS-LOSI. 4. Proposal tabled at November 2012 meeting on organising an International laboratory Study on ISO coal dilatation for demonstrating the improved precision of reporting dilatation to a normalised weight basis of 2.5 g dry coal.	1. Conduct an International Laboratory Study on Coal Dilatation as part of ISO TC27. 2. Coke sampling standard (ASTM D346) is being rewritten to reflect industrial practice. Work also required on coke texture standard (D5061). 3. Review of ISO/TC27/SC4/WG10 13909 standards on mechanical sampling of coal and coke. 4. Explore potential of using Sapozhnikov platometer apparatus – ISO. 5. Initiate study on oxidation detection methods for coal with CCRA members.
	To generate Industrial Intelligence from historical data.	CCRA 76 Database Analysis	R. Stephens Teck K.W. Ng CanmetENERGY	1. To develop relationships for coal and coke properties from existing CanmetENERGY data.	1. To develop a coke strength prediction model based on coal properties.	1. Coke strength prediction (stability, I ₁₀ and CSR) on AM Doliasco movable wall oven database was undertaken using PLS modelling – collaboration with Doliasco Process Automation. 2. Teck coal database under examination and link made with AM Doliasco to harmonize the statistical approach. 3. The multivariate technique for analyzing a large data set and establishing correlations was demonstrated. Using this technique on CanmetENERGY data for developing a coke quality model, coal ash chemistry was found to have the most significant effect on CSR and CRI followed by rheological properties. 4. Abstract on 'Relationship between CSR and Coal Properties' was accepted for paper and presentation at AISTech 2013 conference, Pittsburgh.	1. Preliminary project plan on mining CanmetENERGY database for modelling coke properties using PLS tabled at December 2011 meeting. 2. Application of multivariate analysis technique to the CanmetENERGY database for prediction of coke quality, CSR and wall and gas pressures.
	To develop fundamental studies that show the technical merits of Western Canadian coals	CCRA 87 Technical Merits of Western Canadian Coals	M. Conejeros Teck L. Giroux CanmetENERGY	1. To package existing technical information/data and gather new analysis data for highlighting the fact that Canadian coals prove to make good quality cokes for modifying perception of marketing representatives.	1. To collect key information and generate new data to illustrate the technical merits of Western Canadian coals.	1. Phase 1 - coking 6 coal blends from CCRA 86 high-inert was completed in FY 2011-12. It showed that blends of Canadian coals of Ro-1.17 and MF of only 40-50 ddt/min can make good quality coke. 2. Phase 2 on blends of Canadian coals of Ro-1.25 was completed in FY 2012-13. It found coke quality not deteriorating until MF fall below 40 ddt/min. 3. Abstract on 'Predictive Model for Blending Coking Coals - Part 1: Western Canadian Coals' was accepted for paper and presentation at AISTech 2013 conference, Pittsburgh.	1. Coal blends for Phase 3 at lower Ro, 1.13 were carbonised at CanmetENERGY in November 2012. 2. Data analysis on Phase 1, 2 & 3 is required.
	To perform co-operative research with International Research Leaders in the field	CCRA 75 International Research Collaboration	T. Todoshuk AM Doliasco L. Giroux CanmetENERGY	1. To establish technical exchanges or co-operative research studies with International Research groups.	1. To collaborate with foreign R&D institutions involved in similar work as the CCRA.	1. Collaboration with foreign organisations on common projects. 2. At the National level, meetings with Canadian institutions to undertake joint research project on biomass conversion for enhancing suitability for iron and steel.	1. Pursue discussions/collaboration with Canadian universities and institutions involved in Bio Carbon research. 2. Pursue common projects/goals with foreign research groups. 3. Need to develop contacts at ACARP, Australia.
	To compare CSR values from CanmetENERGY 18 In. and Carbolite Movable Wall Ovens – Sole-Heated Oven Database	CCRA 88 CSR 18 in. and Carbolite Movable Wall Ovens – Sole-Heated Oven Database	T. Todoshuk AM Doliasco T. MacPhee CanmetENERGY	1. To establish relationship/correlation of CSRs measured in CanmetENERGY's 18 in. and Carbolite Movable Wall and Sole-Heated Ovens.	1. To determine CSR of selected components and blends in CanmetENERGY's 18 in. Research and Carbolite ovens and Sole-Heated Ovens. 2. Examine textures of cokes from pilot movable wall and sole-heated ovens.	1. A total of 45 pairs from CanmetENERGY's pilot IMWO and sole heated ovens were presented showing CSR and CRI obtained by either method have the same statistical validity (homogeneous data set). 2. Papers presented at Metec-InSteelCon 2011, ICCS&T 2011 and published in Fuel Journal.	1. Perform CSR comparison in both types of ovens on selected Western Canadian coals. 2. Develop project plan to assess the ambient strength of coke utilising small quantity of coal.

**CANADIAN CARBONIZATION RESEARCH ASSOCIATION
(2012-13)
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The History of Canadian Carbonization Research Association

During a visit to the Booth Street lab of Energy Mines & Resources , F.J. Pearce , who worked for The Steel Company of Canada , Limited was discussing the coke and coal situation with Dr. J. Walsh and J. Chisholm and it was apparent that Industry and EMR should develop a formal Research/Technical relationship. With the approval of senior government and Stelco management F.J. Pearce was asked to contact all of the Canadian coal and steel companies in order to form the bases for the relationship. From this Canadian Carbonization Research Association was started from the responses to F.J. Pearce's contacts. Dr. Walsh and J. Chisholm sought the approval of senior government management and A. Ignatieff of EMR was in complete support of the idea, and this cleared the way.

Canadian Carbonization Research Association (CCRA) was formed on September 2,1965 with the adoption of a Constitution by the Canadian Steel and Coal industries, as a mechanism to promote and establish carbonization research in Canada. The Associations original members were C.W. Drake of Algoma Steel Corporation, W.J. Riva of Canmore Mines Limited, J. John of Crows Nest Industries, J.E. Ludberg of Dominion Foundries and Steel Limited, T.G. Cassidy of Dominion Tar & Chemicals Ltd, R.P. Nicholson of Dosco Steel Ltd, F.J. Pearce of The Steel Company of Canada Limited and J. H Walsh of The Mines Branch of Energy, Mines and Resources . Others at this founding meeting were H.N. Paulencu of Stelco, A Ignatieff, J. C Botham, D.S. Montgomery and J.H Hudson of CANMET. They were representatives of the major cokemaking steel producers, independent coke producer, major metallurgical coal miners, major coal tar users of the day and the federal Government area involved with these Industries. The first Chairman of the Board of Directors was C.W. Drake, with J. Ludberg as Treasurer and J. Walsh as Secretary. The Technical Committee Chairman was F. Pearce with R. Zavitz, R Nicholson and J. Botham of EMR as Secretary.

CCRA is a unique co-operative research and development effort between Industry and Government which became a model for all other industry/government R&D joint efforts. CCRA and CANMET have had different opinions on what R&D the Joint Program should take on, however, these differences have always been over come to the satisfaction of both parties. The winner in this whole matter has been R&D in Canada and we look forward to the continuation of this joint effort for years to come.

The Early Years

The original members of CCRA and the senior officials of EMR were successful in convincing the Minister of EMR to establish a coal carbonization laboratory in Canada. The first Laboratory was located at The Mines Branch on Booth Street in Ottawa and centered around a 12inch Wide Pilot Coke Oven, a newly designed Sole heated Oven and the BM/AGA Coke Oven. J. Walsh managed this new facility and the other EMR staff helped with the operation including J.C. Botham who later became the Technical manager. At first the operation of the equipment was often done by the CCRA member companies personnel and later CCRA employed personnel for this purpose.

In 1968 a new facilities location was chosen at Bell's Corners where a laboratory was to be built. CCRA played a significant role in getting this new Laboratory. EMR

provided the building facilities and CCRA members supplying much of the carbonization equipment for the new lab. The new lab was to center around a new 18 inch silica brick movable wall oven. A 30 pound coke oven was also part of the new facilities and the BM/AGA Oven was redesigned and rebuilt. In December 1968 the group at the Mines Branch concerned with coal and ironmaking were also relocated to Bells Corners.

Expanding Activities in the 1970's

In 1970 J. Ludberg of Dofasco became Chairman of the Board. W. Gardner joined the research staff at CANMET and was charged with getting the new 18 inch oven operational, relocating the 12 inch oven to Bells Corners and redesigning the BM/AGA oven. The coal preparation plant from Booth Street was moved to Clover bar in Western Canada. Research work was managed by J.C. Botham under the direction of the Technical Committee and centered on coal pipelining, additives to coking charges, hot briquetting, form coking and petrographic methods for all coal.

Arrangements were made to establish a coking facility at Clover Bar to accommodate the western Canadian Coal producers. Algoma arranged to donate their Koppers pilot coke oven with alumina refractory. A mini fluidized bed was constructed for heating coal for hot briquetting as part of the form coke project. By 1974 this facility was operational. EMR hired Dr. J. Gransden and Dr. J. Price and they have gone on to be the backbone of the Technical program and have gained international recognition as carbonization scientists.

In the early 1970's a major concern of the CCRA research was reliability of petrography to predict the coking quality of Western Canadian coal and considerable work was done to address the issue of reactive semi-fusinite in coal. When the "energy crisis" developed in 1973/74 concern about energy self-sufficiency came to the forefront. A considerable amount of research was done to determine if Western Canadian coal blends could make satisfactory coke for Blast Furnace operations. This crisis also resulted in a number of oil companies getting involved in the coal mining business and Shell Canada, Esso Resources, BP Canada and Gulf Canada becoming CCRA members.

The organization underwent a substantial change in 1975 when the movable wall coke oven crew, which had grown to six, switched from being CCRA employees and became EMR term employees, to conform with Government policy. CCRA established a new Treasurer system to handle the organization's financial affairs and research funding. This change resulted in the Treasurers position becoming an appointed officer with full financial authority for the Association. G.A. Chapman was appointed Treasurer and has held that Office ever since.

Incorporation of CCRA & Facility Changes – the 1980's

The next change was a major one with the Incorporation of CCRA under The Canadian Corporations Act on July 16, 1981, as a non-for-profit research association. Letters patent set out the organizational structure with each member company putting forward a representative for election to the Board of Directors, and Active members appointing a Technical Committee member. The administration of CCRA has always been the responsibility of the Board of Directors to whom the Officers and other appointed positions report.

The objectives of CCRA are set out in the Letters patent, “ (1) To conduct Research and Development of importance to the coal and carbonization industries in Canada, (2) To co-ordinate and support Canadian carbonization Research in and related to steel, foundry, smelting and coal industries, (3) To affiliate with national and international organizations or associations having similar objects,” for the benefit of Canada.

In the early 1980's new research studies centered around the correlation of coke and processing conditions from pilot ovens with that from industrial ovens. Gas and wall pressure measurements in pilot and industrial coke ovens were emphasized. This area of study included a unique study which took place at Algoma Steels battery number 6 which was scheduled to be torn down. The study used the battery to carbonize very high pressure coking blends to determine what the high coking wall pressures, would do to an oven and if it could even cause wall failure.

One of the Technical highlights of CCRA has to be the CCRA/NKK Technical Exchanges that took place, in Canada and Japan. Four Technical Exchanges took place where both sides presented papers on their research work. The delegations generally involved 12 to 15 representatives from each country and were highly successful. The fourth exchange took place, in Tokyo Japan in 1983 with about 20 CCRA representatives participating in the technical meetings and the tours of the Japanese steel mills that followed.

By the latter part of the 1980's the international energy crisis had subsided, coal and steel prices were dropping, and both industries were entering a period of highly competitive markets. Coal injection into the blast furnace was introduced in Europe and Japan. Many new projects were initiated by the Technical Committee in this period, one of which was the upgrading of coking quality of Canadian coals through wash plant control, while others included CSR and carbon texture, vertical temperature distribution in a coke oven, effect of partial oxidation of a component coal on coke quality to mention a few.

A project to study coal injection into a blast furnace was approved and a special facility was built at Bell's Corners. CCRA and Canadian Steel Industries Research Association co-sponsored a study "Strategic Ironmaking Study " with CANMET to review where ironmaking technology might go over the following 20 years. This study was completed in 1990 and became the road map for the steel industry for many years.

Difficult Times in the Coal and Steel Industries – the 1990's

Canadian coal exports had doubled over the past decade but global warming was becoming a concern because of the effect on the environment. Research was aimed at reducing the cost of coke and energy for Canadian steel makers and finding a niche for Canadian coal. PCI work became very important to both the coal and steel companies. The PCI facilities at Bell's Corners was proving its value in the injection program. A CCRA sponsored project at the University of British Columbia on coke oven modeling was completed and the model now resides at CANMET for all to use.

In 1995 CCRA celebrated its 30th Anniversary of its founding. Because of the economic conditions in the coal and steel industries membership had declined to

eight and EMR was undergoing a review and CCRA was asked to prepare an Impact statement for the review.

1997 saw the CCRA/CANMET fee structure undergo a significant change with the old confidential oven test increasing substantially. The Board also set the wheels in motion to approve By-law Number 2 to create a new category of Member the "Connected Member". This was a category for members who were not eligible to join as full member but wished to be part of CCRA .

Consolidation of the Coal Industry -2000

The year 2000 saw the another down turn in steel and coal industries with two of the three Canadian steel and a coal producers having to drop their CCRA memberships because of financial considerations. This made CCRA financial situation difficult as well as the Association had to dip into reserves to maintain its commitments to CANMET. The consolidation of the metallurgical coal producers at the end of 2002, further complicated the financial situation for CCRA as there was now only one coal and steel member. The Association and CANMET co-operated to keep CCRA as a viable entity and it is hoped that new members can be obtained as the economy in these industries improves. R. Leeder remained as Chairman of the Board of Directors and T. Todoschuk as Chairman of the Technical Committee

The Association

Membership is dependent s on the number of Companies eligible for membership as well as the business climate. The number of Metallurgical coal producers was substantially reduced in 2002 with the formation of Elk Valley Coal which incorporated most of the producers under one organization. The cokemaking industry is down to three steel producers, and because of economic conditions only one is currently a CCRA member. CANMET has a special category membership in CCRA "Associate Member" which carries full representation and voting privileges without CCRA fees. Other membership categories are Connected, Affiliated, and Inactive.

The CCRA /CANMET relationship has seen the need for change over the years and this was formally put into a "Understanding" document starting in 1984 and this document was later modified by a subsequent the latest of which is 2000.

Over the years CCRA and CANMET have carried out many research and development programs to improve the metallurgical coal and cokemaking operations of the members. Many of these have had far reaching effects which have been documented in studies carried out by consultants for the government showing the economic effects of the joint R&D program. The benefits to Canadian industry have been substantial, however, it could not have taken place without the joint efforts of CANMET and CCRA. A laboratory to conduct carbonization research is beyond the feasibility of any one company so the single Canadian lab makes the only sensible way to carry out R&D in this field in Canada.

The fields of R&D covered by the joint CCRA/CANMET program include energy and fuel conservation, stabilization of supply, GHG reduction, mining, processing, transportation, production of iron, environment, and safety. At any specific time the R&D program places priority on the most pressing problems while not ignoring the long term work necessary for the future.

The CCRA/CANMET R&D program has provided Technical Information to the Canadian metallurgical coal industry that is accepted by their international customers as reliable accurate and unbiased. This has allowed Canadian metallurgical coal to compete on the International market and retain jobs in Canada. The export of Canadian Coal generates a significant amount of foreign exchange and assists with Canada's balance of payments. Canada is one of the major exporters of metallurgical coal as well it will supply a growing proportion of the coking coal used in Eastern Canada during the next few years.

As CCRA celebrated its 40th Anniversary in 2005, the future looked more promising than it has for several years, despite the economic ups and downs of the industries that CCRA represents, it has survived and Canada has benefited as a country, the industries gained as a result of the R&D and along with ERL both have had international recognition for the work CCRA and CANMET have carried out. As we enter the new century many problems face the coal and steel industries and with the support of Natural Resources Canada's, Bell's Corners, Energy for High Temperature Processes Lab, we all can look forward to the next 40 years of the Canadian Carbonization Research Association.

At the end of 2006 Dr. Ross Leeder, the longest serving member of the Board retired. Ross had joined the Technical Committee in 1971 when he was a member of the CANMET staff at Bell's Corners. He chaired the Technical Committee before moving to the Board of Directors. Ross became Chairman of the BOD in 1989-90 and again in 1999 to 2006. During the 35 years Ross was associated with CCRA he presented numerous papers on the industry.

2007 saw two new coal companies join as Connected Members, Peace River Coal and Western Canadian Coal Corp and Dr. Barry Ryan joined as an Individual Connected Member representing the B.C. Government.

2008 was the 30th anniversary of George Chapman assuming the duties of Treasurer of the Association. Peace River Coal became a full member of the Association in 2008 and Essar Steel Algoma Inc. joined as a Connected Member.

In the spring of 2009 the Algoma representative Bob Lamour retired after being on the Technical Committee and a Board member. Bob was replaced by Eilal Kaukolin. Barry Ryan retired from the B.C. Government Ministry of Energy, Mines and Petroleum Resources and there has not been a replacement named for Barry so the B.C. Government no longer is a CCRA member.

Dr. John Price and Dr. John Gransden, both retired from Natural Resources Canada during the last year. These two gentlemen have been at Bells corners for many years and their departure has left a large hole which cannot be filled. CCRA wishes to thank both of these gentlemen for their contributions to Carbonization in Canada and wish them all the best in their retirement.

2008-9 has been a tough economic climate for the steel and coal industries as the overall economic downturn has caused a dramatic reduction in steel demand which results in a drop in metallurgical requirements.

Green House Gas has become a major thrust of the joint R&D program in the last couple of years and the research program reflects this issue. During this year the Technical Committee and the Board of Directors have spent a significant amount of

time putting together information on the development and financing of a Non-Recovery Pilot coke oven so the joint CCRA/CanmetENERGY program can look at this new cokemaking technology. Because the cost of such a facility is critical to have Government participation at both the Federal and Provincial levels and include other parties such as Ontario Hydro Generation as partners. Planning studies are under way and it is hoped to have a complete plan ready for presentation next year.

The 45th anniversary of CCRA's inception was celebrated in 2010. This year saw the push for a Non-recovery pilot coke oven continuing with a meeting with the Minister of NRC in December. Shortly after the meeting the Minister of NRC was changed and the letter that was promised was never received. Work, however, continued and an engineering study to develop a proposal and cost for the pilot facility has been started. The year also saw CCRA having to get a new Auditor when the CA Association refused to reissue a license because the Auditor "did not have enough billable hours".

In 2010-2011 the Association started on a very ambitious project to carry out engineering, design, construction and commissioning of a Non-Recovery Pilot Coke Oven (NRO) for Bell's Corners. The NRO technology is one of the latest approached to coke ovens and pilot facilities are nearly non-existing, so little R&D can be carried out. CCRA is hoping to put Canada at the leading edge of this technology by having a facility where our members can determine how coal behave in this type of the oven and what is needed to allow the Canadian steel industry to determine the value of this technology to control emissions and product quality. The projected budget for the NRO facility is nearly \$1 million. It is hoped that this funding will come from a variety of sources industry, federal and provincial governments and power generation as a feature of this technology is co-generation.

The 2011 –2012 fiscal year seen US Steel Canada . SunCoke Energy, Inc., join CCRA and Grande Cashe Coal Corp. rejoin after an absence of some years. CCRA signed a contract with Hatch Inc to carry out the preliminary design of a pilot scale Non-Recovery Oven with the final report due in the summer of 2012. Funds for this work were raised by some of the CCRA members contributing to a fund for this specific purpose. CCRA has also signed a Non Repayable Contribution Agreement with Natural Resources Canada to assist with the costs. The Canadian Steel Producers Association has also contributed to the project. It is hoped to have the funding in place to construct the facility during the next fiscal year. The new NRO will be located at Bell's Corners CanmetENERGY facility with the other coking facilities.

A major project to add a Energy Recovery Pilot Coke Oven (ERO) started in 2012 – 13 with Hatch being contracted to develop a preliminary design for a facility which will put Canada on the leading edge of a new coke oven technology. The engineering design study was financed by contributions from CCRA member companies and a forgivable loan from Natural Resources Canada. With the design complete, planning on the location and support facilities got under way with one of the existing movable wall ovens being relocated to facilitate the ERO. Planning is under way to obtain financial support to construct the actual oven .

CCRA has joined with CanmetENERGY to provide a web site for Canadian Carbonization. The web site can be accessed at www.cancarb.ca and it contains timely information on the activities of CCRA/CanmetENERGY research and development programs and other information on the Canadian Coal and Coke industry.

Chairman of the Board of Directors CCRA

1965 – 1966	C.W. Draker	Algoma Steel Limited
1967 – 1968	F.J. Pearce	The Steel Company of Canada Limited
1969 – 1970	J.E. Ludberg	Dominion Foundries and Steel Limited
1971 – 1972	J.S. Anslow	The Steel Company of Canada Limited
1973 – 1974	J.O. Thomas	DEVCO
1975 – 1976	A.M. Cameron	Algoma Steel Limited
1977 – 1977	J.T. Collier	DEVCO-SYSCO
1978 – 1979	W.A. Riva	Kaiser Resources Limited
1980 – 1980	J.E. Ludberg	Dofasco Limited
1981 – 1982	A. Johnson	Gulf Resources Limited
1983 – 1984	A.W. Kay	Stelco Inc.
1985 – 1986	R. Sagi	Denison Mines Limited
1987 – 1988	W. Becken	Dofasco Inc.
1989 – 1990	W.R. Leeder	Denison Mines Limited
1991 – 1992	K. Carnes	Fording Coal Limited
1993 – 1994	H. Stelmach	Line Creek Resources Limited
1995 – 1996	T. Benner	Dofasco Inc.
1997 – 1998	W. Jonasson	Algoma Inc.
1999 – 2000	W.R. Leeder	Teck Corporation
2001 – 2002	W.R. Leeder	TeckCominco Corp.
2003 – 2006	W.R. Leeder	Elk Valley Coal Limited
2007 –	T. Todoschuk	ArcelorMittel Dofasco Inc.

2012– 2013 Board of Directors

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