



# ENERGY TECHNOLOGIES FOR HIGH-TEMPERATURE PROCESSES

## CLEAN ENERGY TECHNOLOGIES

## METALLURGICAL FUELS



Canada annually exports about 30 million tonnes of coking coal and uses a further 6 million tonnes domestically. This metallurgical coal is used to manufacture coke, which is subsequently used in blast furnaces to produce iron for steelmaking purposes. At the CANMET Energy Technology Centre-Ottawa, we are increasing the efficiency of the iron and steel making process.

The Energy for High Temperature Processes Group studies and develops technologies to:

- Improve the coking behaviour of coals to produce high quality coke while ensuring safe and efficient industrial operation;
- enhance coal properties for carbonization;
- use coke and alternative fuels in blast furnaces and other metallurgical processes; and
- demonstrate the advantages of Canadian coals to world markets.

### Research Activities

Major areas of research are:

- GHG mitigation in the steel industry
- the unique coking characteristics of western Canadian coals;
- new technologies to enhance coking properties and expand Canada's metallurgical coal resources;
- the coking process in conventional slot-type and energy-recovery ovens;
- the behaviour of coke (degree of stabilization and degradation) in blast furnaces; and
- injection of fossil fuels and alternative fuels including biomass in blast furnaces.

### R&D Facilities

CETC-Ottawa's metallurgical fuel facilities include pilot-scale coal handling facilities, coke ovens and coke testing facilities, and laboratory coal and coke evaluation equipment.

#### Coking Ovens:

- two 460 mm width/325 kg capacity;
- one 310 mm width/250 kg capacity;
- one 150 mm width/15 kg capacity;
- two sole-heated ovens; and
- modelling capability.

#### Pulverized Fossil Fuel and Biomass Injection into a Blast Furnace Environment:

- 12 kg/h injection rate with oxygen enrichment



Discharging of metallurgical coke from CETC-Ottawa moveable-wall pilot oven

and preheated combustion air to 900°C;

- fuel substitution; and
- blast furnace modelling capability.

#### **Coal Preparation:**

- complete pilot plant blending, crushing, pulverization and sampling; and
- briquetting and agglomeration.

#### **Coal Evaluation:**

- petrographic analysis;
- thermal rheological analysis;
- particle size distribution and grindability determination;
- proximate, ultimate and ash analyses;
- standard ASTM, ISO and JIS coal analytical techniques;
- advanced analytical facilities (including coal oxidation), scanning electron microscopy with energy dispersive X-ray spectrometer, surface area and coal porosity determination;
- differential thermal gravimetric and gas analysis; and
- spectroscopic analysis and interpretation.

#### **Coke Evaluation:**

- size distribution determination;
- standard ASTM, ISO and JIS coke strength evaluations;
- coke stabilization determinations;
- hot coke strength (coke strength after reaction-CSR) evaluation;
- coke reactivity determination;
- scanning electron microscopy with energy dispersive X-ray spectrometer;
- coke microscopy (texture) analysis;
- surface area determination;
- porosity and density determination; and
- proximate and sulphur analyses.



*Microscopic Analysis*

CETC-Ottawa's coal evaluation, preparation, agglomeration and carbonization facilities are unique in Canada. They are available to industry on a "fee for service" basis:

- to aid in mine planning, marketing and economic investigations;
- to ensure safety during coking; and
- to evaluate the quality of coke, carbon, coal and other fuels for metallurgical purposes.

## **Technology Development**

CETC-Ottawa works closely with the Canadian Carbonization Research Association (CCRA), the membership of which comprises the following steelmaker coal producers and provincial government:

- Dofasco Inc.;
- Elk Valley Coal Corp.;
- Peace River Coal Inc.;
- Pine Valley Coal Corp.;
- Western Canadian Coal Corp.;
- BC Ministry of Energy, Mines and Petroleum Resources.

Other Clients for CETC-Ottawa's services have included:

- Falconbridge Ltd.
- QIT - fer et Titane Inc.;
- Petro-Canada;
- Algoma Steel Inc.
- Stelco Inc.;
- Iron Ore Company of Canada Inc.;
- SGS Supervision Ltd.;
- Quebec Carter Mining Corp.;
- Gulf Canada Ltd.;
- Ruetgers - VFt Inc. (formerly Carbochem);
- Elkview Coal Ltd.;
- Line Creek Resources Ltd.;
- Smoky River Coal Ltd.;
- ACME Steel Inc.; and
- ISPAT - Inland Steel, USA.

## **Closing Remarks**


Coke and Ironmaking will change over the forthcoming years with the introduction of new technologies to combat climate change. The practice of injecting coal and alternative fuels directly into blast furnaces will increase in order to reduce metallurgical coke requirements. These changes along with the introduction of alternative reduction/smelting technologies could cause fuel requirements for ironmaking to change and affect markets for Canadian coal.

The efficiency with which iron and steel is made can also be increased through the use of new and improved coking technologies. Better technologies such as energy-recovery cokemaking and dry coke quenching are also needed to meet the environmental challenges facing the industry: emissions reduction, waste reduction and the wise use of energy.

A program of technology development addressing the needs of Canadian industry will help to achieve these benefits.



### **Your Invitation to Work with Us**

We are interested in collaborating with you. Please contact the Business Office to discuss your particular needs.

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