

ERL 92-49(OP)

- last page says  
where presented

**TITLE:** Evaluation of the Suitability of Coals for  
Blast Furnace Injection Based on a Computer Model

**AUTHORS:** Wieslaw P. Hutny and John T. Price

**AFFILIATION:** Energy Research Laboratories  
Canada Centre for Mineral and Energy Technology  
555 Booth Street  
Ottawa, Ontario  
K1A 0G1

**ABSTRACT:** Until coal injection was developed on a commercial scale, non-coking coals could not be used as fuels in blast furnaces. Now, poor coals or those that are non-coking are commonly used for this application, largely because the injection of coal directly to the hearth of the furnace decreases coke consumption and improves the furnace performance.

Although only a few blast furnaces used coal injection before 1980, the practice has increased significantly world-wide. Currently, 60 blast furnaces in 14 countries use coal injection. The average injection rate is approximately 40 kg/t HM and is soon expected to rise to 200 kg/t HM. In Japan, coal injection is used on 25 of 35 existing blast furnaces. Since 1985, the average injection rate there has risen from 13.2 to 70 kg/t HM, and is predicted to rise even higher.

Since coal injection technology will affect the traditional coal markets, decreasing the demand for metallurgical coal and increasing the demand for cheaper coals, the coal market will become more competitive. This means that Alberta and other Canadian coals need to be assessed for their suitability in blast furnace injection to keep pace with the marketplace.

Although blast furnaces appear to tolerate a range of coal characteristics at low injection rates, some desired coal characteristics affect operating results significantly at high injection rates. Generally, the suitability of coals for blast furnace injection is influenced by the combustibility, cooling and coke-replacement properties. Knowledge of these characteristics is

ERL 92-049 (OP)

01-0004719

essential for blast furnace operators as it allows them to select the most beneficial coal for a particular blast furnace. This is especially important for high injection rates and should help achieve maximum profits through improved furnace productivity, as well as reduced coke consumption and overall costs.

The combustibility of coal can be assessed experimentally. It depends on factors such as volatile matter content, soot formation, inert macerals, mineral matter content and composition, and the microstructure of char. Cooling and coke-replacement properties can be determined by mathematical modelling and simulation that takes into account the cooling effects of using non-coking coals.

Thus, the technical objectives of a study undertaken by CANMET are:

- to determine the theoretical cooling and coke-replacement characteristics of Alberta/Canadian coals;
- to simulate blast furnace response to specific Alberta/Canadian coals;
- to identify potential customers who are using coal injection; and
- to identify suitable Alberta/Canadian coals or blends of coals for future work.

All results will be compared with corresponding data for foreign coals.

A computer model of the blast furnace process has been developed by the Metallurgical Fuels Section of the Energy Research Laboratories. It is being used in this study. It is based on principles of mass and energy conservation for the steady-state continuous process. The model includes mass balance equations that account for carbon, oxygen and iron, as well as enthalpy balance equations which account for the bottom zone of the furnace and the combustion zone. The input variables that are considered are: properties of charged materials (carbon content in the coke, type of iron ore, flux in charged materials), the dimensions of the furnace, hot metal composition, blast characteristics (quantity, temperature, oxygen content, moisture content), injection data (rate of injection, injection composition) and slag characteristics. The model is programmed in Fortran 77 for use on a PC.

Wes Hutney

**ALBERTA  
OFFICE OF  
COAL  
RESEARCH &  
TECHNOLOGY**

**1992 Coal Research  
Contractors' Conference  
and  
Power Plant Ash  
Utilization Symposium**

October 14 and 15, 1992

*Abstracts of Presentations*

Sheraton Cavalier Hotel  
Calgary, Alberta

**Alberta**

ENERGY  
Research and Technology Branch