

Bituminous Coal Research, Inc.
Sponsored Research Program

GAS GENERATOR RESEARCH AND DEVELOPMENT

Phase I Summary Report

SECTION 1. SUMMARY AND RECOMMENDATIONS

Bituminous Coal Research, Inc., under contract to the Office of Coal Research, has made a survey of coal gasification processes, both conceptual and actual, available in the United States and abroad. In the survey, attention was given to those processes which held promise for potential development as economical systems for the production of fuel gas and/or synthesis gas capable of conversion, by water-gas shift and methanation, into a high Btu gas by means of processes developed by others. The data and information obtained in the survey have been consolidated in this report, together with opportunities and recommendations for further research and process equipment development under Phase II.

Evaluation of the data on processes for synthesis gas production indicates that certain coal gasification systems using oxygen at high pressure upon further development bear promise of becoming economical and competitive with other fuels.

1. The amount of methane produced in the initial gasification of the coal is one of the most critical factors affecting the economic potential of processes for the production of high Btu pipeline gas from coal. The amount formed is a function of not only the operating conditions, but also the quality and composition of the starting coal feed and the activity of the resultant char from devolatilization of the coal. The two-stage super-pressure gasification processes evaluated in the present study are designed to realize the maximum potential from these factors. By two-stage entrained gasification at 1000 psi or higher, using criteria established for this study of 15 cents per MM Btu coal cost and annual fixed charges at 15 percent, high Btu pipeline gas would cost 54 cents per M scf. Using capital cost of 12.1 percent (including local taxes) and coal cost of 11 cents per MM Btu attainable at some mines, high Btu pipeline gas by this same process would cost 41 cents per M scf.

2. By a new conceptual process, catalytic steam methanation, the cost of high Btu pipeline gas using the same criteria would cost 46 cents per M scf and 38 cents per M scf, respectively.

3. Economic manufacture of fuel gas appears possible in a well developed system producing a hot clean gas from caking bituminous coals. Such an improved system would extend the field of application of producer gas from coal to processes requiring clean gas and continuous operation without periodic cleaning of the gas mains. Such a hot clean gas should be competitive with natural gas in many areas.

4. By two-stage fluidized super-pressure gasification of char using air, the production appears possible of a producer gas suitable for use in the steam-iron generation of hydrogen needed in the hydrogasification of coal to produce high Btu pipeline gas.

In regard to the "three" coal gas generating systems which are considered best suited for the detailed experimental study under Phase II, the following recommendations are made:

1. Continued research and development of process equipment are recommended to establish the full potential of multi-stage super-pressure gasification of coal. This includes further research and process equipment development as required to obtain the necessary data and information needed for the design, construction, and operation of a laboratory unit producing (a) synthesis gas from coal employing entrained gasification in the second stage, and (b) high pressure, high temperature steam-iron reduction gas from char employing an airblown two-stage fluidized super-pressure gas producer.

2. Continued research and development of equipment are recommended to establish the feasibility and the full potential of the catalytic steam methanation process for the production of high Btu pipeline gas from coal.

3. Development work for the design and later construction and operation of a gas producer is recommended that will combine the low cost and ability to handle caking coals of the Wellman-Galusha producer with the greater economy of obtaining clean gas by the two-stage International Furnace Equipment producer.

In addition, the following recommendations are made concerning research for conduct in overall support of the Phase II activities recommended above:

1. Continuation of laboratory bench-scale studies is recommended to obtain needed information on the effects of coal quality and composition and to establish the benefits which can be expected from the beneficiation of coal with respect to further possible reductions in cost.

2. The cost of feeding coal into systems operating at pressures in the range of 1000 - 1500 psi represents a significant portion of the overall cost of the product gas. A new conceptual coal feeder offers promise for minimizing these coal feeding costs. To establish the full potential of the new conceptual high pressure coal feeding device, a development program consisting of theoretical aerodynamic studies and model experiments followed by the design, building, and testing of a prototype coal feeding unit is recommended.

3. Finally, to fully establish the costs of producing high Btu pipeline gas by two-stage super-pressure entrained gasification, and to delineate additional areas requiring further research and development, a detailed engineering evaluation of the process including cost estimates is recommended.