UNDERGROUND GASIFICATION PROJECT, GORGAS, ALA.

Field-scale experiments have been conducted in cooperation with the Alabama Power Co. on underground gasification of coal. The product may be used for the synthesis of fluid fuels or for generating electricity. Such underground gasification might permit utilization of thin or high-ash-content coal beds.

In June 1954 the Bureau of Mines, the Alabama Power Co., the Stanolind Oil & Gas Co., and the Halliburton Oil Well Cementing Co. entered into cooperative agreements to try hydraulic fracturing of a coal bed to prepare a passage within the bed suitable for gasification. This procedure, as applied at Gorgas to bituminous coal in the America coal bed in October 1954, was described in the 1954 report.

Evaluation of Hydraulic Fracturing

The permeability of the coal bed around the injection well was measured before and after fracturing. Before treatment the formation accepted 6 std. cu. ft. per min. of air at an applied pressure of 65 p.s.i.g. Following treatment the formation accepted 520 to 600 std. cu. ft. per min. of air at 65 p.s.i.g., approximately an 85- to 100-fold increase in permeability.

At the site of the injection well the America coal bed lies under 155 feet of overburden. Ten wells were drilled around the injection well, at distances of 150 to 650 feet. In every instance air introduced under pressure at the injection well resulted in air flow from the test well. This permeability to air was found only at the horizon of the America coal bed. Flow was noted also at outcrops 830 feet southwest and 790 feet northwest of the injection well in an old mine in the America bed with the nearest working face approximately 620 feet northwest of the well and in old gasification workings 370 feet northeast of the well.

These data indicated that a large area of the coal bed was affected by the hydraulic fracturing process. The boundary between the fracture and the normal coal bed could not be defined, but an area with a radius of 200 to 300 feet around the injection well appears to have been affected by the treatment.

Following the test drilling program, air-flow tests were made to find possible flow paths for gasification. From the test hole 200 feet southwest of the injection well, 338 std. cu. ft. per min. of air at 60 p.s.i.g. could be pumped underground with a recovery of 36 percent at the injection well. Similarly, from a test drilling 200 feet southeast of the injection well, 187 std. cu. ft. per min. of air could be pumped underground at 59 p.s.i.g. and 41 percent recovered at the injection well. Both paths were promising from the standpoint of gasification, and the former was chosen for a first test.

Ignition

A 7-5/8-inch-diameter hole was drilled 190 feet southwest of the injection well adjacent to the 200-foot test hole. This well was cased to the top of the coal bed, and a gas burner was installed, in February 1955. Propane was burned at the horizon of the coal bed while air was admitted at both the new hole and the adjacent test hole; in approximately 1 hour the coal bed was successfully ignited.

Gasification Operation

The initial air-injection rate was approximately 50 std. cu. ft. per min. at 55-70 p.s.i.g.; later this rate was increased to 400-500 std. cu. ft. per min. at 55-60 p.s.i.g. Currently, the air injection rate is being held constant at 215 std. cu. ft. per min. at 45-55 p.s.i.g. The gas volume ranged initially from 4 to 10 std. cu. ft. per min., and through subsequent operations has increased until now (after 4 months) it varies between 40 and 80 std. cu. ft. per min. A typical analysis of the gas was:

	Percent
Nitrogen	62.3
Carbon dioxide	11.8
Carbon monoxide	11.2
Hydrogen	8.3
Methane	5.9
Oxygen	.3
Illuminants	.2
Heating value B.t.u. per cu. ft., 60° F., 30 inches Hg, dry	127
Specific gravity	.94

Various changes have been made in flow direction and operating procedures to obtain better control and to improve the capacity of the system. The permeability tests had indicated and operation confirmed a tendency toward leakage, because of the extensive fracturing and increased permeability. Also, a zone of high resistance to flow develops just beyond the carbonization zone within the coal bed, which makes it difficult, as yet, to obtain good system capacity. This work is continuing, and various methods and modifications of operating procedures are under test.

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