MASTER

THE MEASUREMENT OF THE FLOW PROPERTIES
OF COALS FOR IN-SITU GASIFICATION

Progress Report for the Period
July 1978 - September 1978

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Date Published: October 1978

PREPARED FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Under Contract No. ET 78-S-02-4639

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ABSTRACT

The effective and relative permeabilities of Hanna, Wyoming sub-bituminous coals and Texas lignites to nitrogen and carbon dioxide were measured as functions of water saturation and structural orientation at simulated overburden pressures of 200 psig and 400 psig.

Porosity values derived from water saturation and shrinkage values were also obtained for the six Hanna and three lignite samples which were tested.

The results of permeability tests on five Texas lignites reported previously were coupled with the three new runs to obtain average relative permeability curves for the lignites.

The present report does not attempt to analyze the results of the various tests. Rather, the present work merely adds to the statistical population of the contract as a whole and complete analysis will be a partial function of the Final Report of the contract.

REPORT FORMAT

The reader will note that the present report is less formal than those issued under previous contracts. The present format follows the guidelines of the ERDA Guide of March, 1976.

COMPLIANCE WITH CONTRACT REQUIREMENTS

Progress to date has been in compliance with the objectives and scope of work which are detailed in the contract. This is particularly true now due to our recent acquisition of cores from Gulf Oil Corporation's steeply-dipping beds from Rawlins, Wyoming.

The principal investigator, the co-investigator and the research associate have expended the time requirements as specified in the contract budget.

PUBLICATIONS AND PRESENTATIONS

The results of our work to July 1978 were published in the Proceedings of the Fourth Annual UCC Symposium held at Steamboat Springs, Colorado on July 17-20, 1978.

Several abstracts of our work were published in Abstracts and Research Accomplishments in the Proceedings of the Fifth Annual DOE/Fossil Energy Conference on University Coal Research, Lexington, Kentucky, June 15, 1978.

In addition, we have provided advice and copies of our work to numerous industrial concerns, principally Gulf, Mobil, and Conoco.

RESULTS OF LABORATORY MEASUREMENTS

Nine new samples have been tested during the period of this Progress Report. These consist of six Hanna surface samples half of which were flowed parallel to their face cleats and the other three flowed parallel to their butt cleats. All were flowed parallel to their bedding planes. Three samples of Texas lignite were also tested. These were flowed parallel to their bedding plane; other structural orientations being either non-existent or not discernible.

Table 1 lists the various sample properties (point values). Figures 1 to 18 show the various effective and relative permeability curves for the samples tested.

Figures 19, 20, and 21 depict the average relative permeability curves for the Texas lignites which include results from the five samples run previously coupled with the results of the three new runs.

Figures 3-6 and 9-12 for four of the Hanna coals are of particular interest inasmuch as they clearly show the effect of increased overburden pressure on the effective permeability values.

FUTURE WORK

We are currently in the first stages of running permeability tests on the steeply-dipping (65°), sub-bituminous coal of the G-seam of Gulf Oil Corporation's in-situ cores from Rawlins, Wyoming. Cores from two wells have been provided to us. We have successfully cored five samples parallel to their bedding plane, to date. Overburden between the two wells varies from 72 feet to about 545 feet. We have given the steeply-dipping beds our top priority.

We have also received from the Laramie Center additional core from the Hanna IV site. We hope to be able to test these also during the coming period.

We may possibly be able to also run two more Texas lignites which will exhaust our supply of this fuel.

RELEVANT REFERENCES

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9. Reznik, A. A., Fulton, P. F., and Lien, C. L., DOE Contract No. ET-78-S-02-4639, July 1978, available from NTIS.

LEGEND AND NOTES ON SYMBOLS AND FIGURES

Suffix B indicates flow ll to face cleats

Suffix F indicates flow ll to butt cleats

The absence of either suffix indicates that flow was ll to the bedding plane and that cleat orientation was not discernible.

S_w = water saturation as fraction of pore volume

B.V. = bulk volume

P_{ov} = simulated overburden pressure in psig $\approx$ twice the Hassler-type sleeve pressure of the core holder

k_g = the effective permeability to gas in md

k_{rg} = the relative permeability to gas = $k_g/k_g @ S_w = 0$

All runs were performed over a decreasing water-saturation cycle.

Prefix WH indicates Hanna, Wyoming sub-bituminous coal

Prefix TL indicates Texas lignite

TABLE 1. SAMPLE PROPERTIES

Sample No.*	Porosity By Water Saturation (% B.V.)	Shrinkage (% Original B.V.)	Absolute Permeability (md) @ $P_{ov} = 200$ psig	Absolute Permeability (md) @ $P_{ov} = 400$ psig
WHB-10	15.9	7.1	245 (N_2)	
WHB-11	13.6	6.2	185 (CO_2)	30 (CO_2)
WHB-12	13.9	6.9	175 (CO_2)	75 (CO_2)
WHF-14	13.3	6.5	350 (N_2)	
WHF-18	13.6	6.3	155 (CO_2)	35 (CO_2)
WHF-19	12.9	4.7	120 (CO_2)	70 (CO_2)
TL-1	38.6	24.6	2800 (N_2)	
TL-2	40.2	27.3	4700 (N_2)	
TL-3	42.2	22.4	13000 (N_2)	
TL-4	40.9	23.9	7900 (CO_2)	
TL-5	43.5	24.7	4700 (CO_2)	
TL-6	45.3	19.2		3100 (CO_2)
TL-7	46.7	26.2		3700 (CO_2)
TL-8	41.8	28.4	1900 (N_2)	

* Samples TL-1,2,3,4 and 5 were run prior to the current period and are included here because they are averaged with the three current lignite runs in the present report.

FIGURE 1: WHB-10

FIGURE 2: WHB-10

FIGURE 3: WHB-11

FIGURE 4: WHB-11

FIGURE 5: WHB-12

FIGURE 6: WHB-12

FIGURE 7: WHF-14

FIGURE 8: WHF-14

FIGURE 9: WHF-18

FIGURE 10: WHF-18

FIGURE 11: WHF-19

FIGURE 12: WHF-19

FIGURE 13: TL-6

FIGURE 14: TL-6

FIGURE 15: TL-7

FIGURE 16: TL-7

FIGURE 17: TL-8

FIGURE 18: TL-8

FIGURE 19: AVERAGE OF TL-1,2,3,8

FIGURE 20: AVERAGE OF TL-4&5

FIGURE 21: AVERAGE OF TL-6 & 7