PROJECT FACT SHEET

CONTRACT TITLE: An Experimental and Theoretical Study to Relate Uncommon Rock/Fluid Properties to Oil Recovery - A Geologic/Engineering Approach.

DATE REVIEWED: 01/12/93 **DATE REVISED:** 01/05/93

OBJECTIVE: To improve the efficiency of oil production by measuring and correlating the interrelationship of various rock/fluid properties to recovery efficiency. These properties will be related to two oil recovery values: 1) The recovery at water breakthrough in a secondary recovery mode, and 2) The recovery at flood-out.

ID NUMBER: DE-AC22-89BC14477

B & R CODE: AC0530000

CONTRACT PERFORMANCE PERIOD:
09/21/89 to 10/16/93
PROGRAM:
RESEARCH AREA: Geoscience

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University Park, PA
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SCHEDULED MILESTONES:

Phase 1 - Purchase of capital equipment.
Phase 2 - Experimental core floods.
Phase 3 - Rock fluid property measurements.
Phase 4 - Development of simulator.
Phase 5 - Data processing. 06/90
Phase 6 - Correlate simulator to processed lab data. 09/90
Phase 7 - Extend concepts to systems such as polymer floods, caustic floods, and-or carbon dioxide floods. 10/91
Phase 8 - Data Compilation & Final Report. 10/93

FUNDING (1000'S)	DOE	OTHER	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	261	0	0	**261**
FISCAL YR 1993	0	0	0	**0**
FUTURE FUNDS	0	0	0	**0**
TOTAL EST'D FUNDS	**261**	**0**	**0**	**261**

PROJECT DESCRIPTION: Parameters to be investigated include pore size distribution, surface area, tortuosity, pore geometry, wettability alteration, pore microtexture, permeability, porosity, residual oil saturation and interfacial tension. It is proposed to measure and relate these properties to two oil recovery values; recovery at water breakthrough in a secondary recovery mode and recovery at flood-out. Reservoir rocks of varying permeability will be evaluated and a stochastic model will be developed to match these observations. By using a multi-disciplinary approach combining geologic data with reservoir engineering, it is the purpose of this project to more thoroughly understand porous media. Through this understanding it is expected that improvements in the efficiency of hydrocarbon recovery process can be made.

PRESENT STATUS: No cost extension was signed into place extending report to 10/16/93.

ACCOMPLISHMENTS: Summary of what was learned in the analysis of data collected:
1) The means and medians of variables considered in the waterflood experiments were approximately equal. Consequently, the frequency distributions of these variables are close to a normal distribution.
2) The wettability of the Berea sandstone ranged from +0.45 to 1.00. This variability was attributed to the amount of shale present in the individual cores and in the amount of hydrophobic and hydrophilic surface area present.
3) Wettability was found to control fluid distribution.
4) Average wettability indices were directly proportional to average irreducible water saturation and inversely proportional to average residual oil saturation.
5) Oil recovery at breakthrough and oil recovery at flood-out were higher for the strongly water-wet systems, and directly proportional to wettability.
6) Regression analysis indicated that oil recovery at breakthrough and oil recovery at flood-out were related to rock surface area.
7) Tortuosity expressed in terms of the wetting phase retention time was found to be inversely proportional to the median pore-throat size of the Berea sandstone.

BACKGROUND: Standard rock/fluid properties such as porosity, permeability, residual oil saturation, capillary pressure, and interfacial tension have been measured by researchers for years and related to hydrocarbon recovery efficiency. To date, recovery efficiencies are still rather low depending upon the specific geologic environment from which the field is producing. This research effort will look at specific methods to better understand how rock/fluid properties relate to water flood results.

Rock properties such as pore size distribution, rock surface area, tortuosity, pore geometry, surface wetting and pore microtexture analysis will be evaluated and related to oil recovery efficiency from both experimental and theoretical directions.

Empirical models will be developed to match the experimental results. The models may be used as predictive tools for similar geological reservoir systems.