

INTERACTION OF NITROGEN/CO₂ MIXTURES WITH CRUDE OIL

Lead Organization: The Pennsylvania State University
Key Contact: Robert W. Watson
(814) 865-0531, rww1@psu.edu
SWC Co-funding: \$ 70,034

A nitrogen huff and puff process has been utilized to stimulate oil production in the Big Andy field located in eastern Kentucky. This nitrogen stimulation project has been ongoing for over 6 years, in which a four fold increase in oil production has been achieved. Nitrogen is generated on site, utilizing membrane separation technology, at an approximate unit cost \$1 per MCF. It requires 2.5 MCF of nitrogen per barrel of oil produced. The nitrogen obtained through membrane separation technology contains up to 5 percent oxygen by volume. Also, given the fact that a significant increase in oil production has been realized, the question becomes what is the long term effect of nitrogen injection on the crude oil.

The objective of an existing funded stripper well project has been to develop an understanding of the phase behavior of N₂/O₂ gases in the presence of hydrocarbons. In order to meet this objective, a PVT system was fabricated in order to measure the impact on the physical properties of the crude oil. System validation tests have been completed with propane, methane/propane and propane/ethane mixtures at different temperatures. Pressure versus specific volume data has been generated and compares well with published charts in the literature. A phase behavior computer package has been developed and is being tuned using data obtained from the field and laboratory.

Field experience has indicated that periodic injection of CO₂ mixed with nitrogen has improved the volumetric flow rate of the wells. It is postulated that the CO₂ tends to remove skin damage in the near well bore area. Also, it is understood that CO₂ is miscible in oil.

The objective of this proposal is to evaluate the behavior of N₂/CO₂ injection and its impact on the recovery process. Moreover, it is likely that future legislation will mandate a reduction in CO₂ levels that are generated through hydrocarbon combustion. A means of sequestering this CO₂ is to inject it into oil and gas horizons. It is likely that the injection of CO₂ can result in improved recovery from these horizons.

The Crude oil to be evaluated will be obtained from the Big Andy Field in Kentucky and the Chipmunk sandstone in Cattaraugus County, New York. It is anticipated that the results of these studies will be used as the underpinnings to subsequent field tests.