FLUID VELOCITIES IN OIL CORES DURING WATER INJECTION

M. A. Robinson (1), W. A. Edelstein (2)

(1) Chemical Engineering Department, University of Houston, Houston, Texas 77004 and University of Wyoming, Laramie, Wyoming 82071.
(2) General Electric Corporate Research & Development, Schenectady, New York 12301.

INTRODUCTION

In most coreflood experiments, a fluid is injected in one end of the core and produced and measured at the other end. Such an experiment gives little information about the nature of the pore structure. Instead, it can only yield averaged properties for the entire core.

With the advent of non-invasive imaging techniques (X-ray CT Scanning and Magnetic Resonance Imaging), it has become possible to observe the 3-dimensional structure of the core during corefloods (see Majors, *et al*, for example). Properties such as local porosities, saturations, and velocities can be determined inside the core, potentially yielding much useful information on the nature of the fluid displacement.

In the past, X-ray CT Scanners have been used in flow imaging experiments on oil cores. However, such experiments required displacement of the resident fluid with a fluid of different X-ray absorptivity, and local velocity could only be calculated indirectly at the front. With MRI it is possible to measure fluid velocities at any point within the core with only a single flowing phase: no displacement front is required. The measurements are done in the steady-state mode, so no local pressure and saturation transients are produced.

Using MRI to measure fluid velocities inside oil cores is extremely difficult. Because of high mineral content and high surface-to-volume ratios inside oil cores, the T_2 relaxation constant is quite short. In order to measure velocities accurately, pulse sequences with very short spin-echo times are required. In addition, the signal-to-noise ratio for core imaging experiments is only on the order of 10:1. Unless the flow rate is quite high inside the core, the effect of low signal-to-noise ratio on the velocity measurement can be catastrophic. Because of these conditions, long experiments are required in order to get adequate signal-to-noise. A modified 3DFT pulse sequence is used in order to obtain the shortest echo times possible, and yet have a sufficiently long flow encode time in order to measure the slow velocities observed in core flood experiments.

The use of a 3DFT pulse sequence yields a complete dataset for the core, so that the velocity images can be viewed in all three coordinate directions at various positions within the core.