

Using NMR to Detect Oil Desaturation in Miscible Gas Flood

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Abstract

This work focuses on determining the feasibility of applying Nuclear Magnetic Resonance (NMR) as a monitoring technique in the Miscible Gas Flood process. This process utilizes oil desaturation, which provides a quantitative indicator of the miscible gas ratio in the reservoir oil. The study is based on laboratory measurements for oil and miscible gas samples of a specific reservoir under simulated conditions to measure oil desaturation caused by miscible gas flooding processes. For each sample, NMR results were used to obtain the distribution of transverse relaxation time (T₂), map of longitudinal relaxation time T₁ versus T₂ (T₁T₂ map), and map of diffusion effect (D) versus transverse relaxation time (DT₂ map). The results of NMR parameters from all samples were utilized to generate correlation values that can be used to estimate the miscible gas ratio. Analysis from the results shows that the diffusion NMR test is more sensitive to changes in dissolved gas ratio than other parameters of T₁ and T₂. Statistical analysis shows that diffusion NMR can distinguish desaturated oil from live oil with significance at 82% confidence level after adding 8.5 mol% miscible gas. The study shows that NMR can be used in a surveillance program of a Miscible Gas Flood and it can easily differentiate between pure oil and pure gas in this particular reservoir.