Using Well Log Analysis to Identify Residual Oil Zones at Noble and Kenner West Oil Fields, Illinois

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ABSTRACT

Carbon dioxide enhanced oil recovery (CO2-EOR) has been used to produce oil from thick, naturally occurring intervals of low oil saturation, or residual oil zones (ROZs), in the Permian Basin. Residual oil zones are widespread within the Permian, Big Horn, and Williston Basins that, in addition to CO2-EOR, have potential for significant storage of CO2. Traditionally, open-hole well log analyses focus on higher oil saturations with specific analyses focused on irreducible saturation and movable hydrocarbons. Identifying ROZs in other basins requires methods to find lower oil saturations resulting from the natural waterflooding processes that form ROZs. This study presents a procedure that uses a combination of established well log analyses to identify ROZs. This study uses conventional and shaly-sand well log analyses to identify and characterize the thickness and residual oil saturation of suspected ROZs beneath the main pay zones in the Cypress Sandstone at Noble and Kenner West Oil Fields, Illinois. Archie, ratio, and dual-water methods were used to calculate oil saturation, and a combination of the moveable hydrocarbon index, bulk volume water, and apparent water resistivity were used to aid in picking the top and base of the main pay and ROZs. The oil saturations estimated for four wells at Noble Field were validated with pulsed-neutron logs, and the depths of the ROZ for 20 wells at Kenner West were validated with oil saturations from core analysis reports. The ROZ well log analyses procedure has been effective for both fields. Preliminary results indicate a ROZ approximately 25-30 ft (~8-9 m) thick at Noble and 30-50 ft (~9-15 m) thick at Kenner West. Residual oil saturation at both fields is around 20% - 30%. Core flood studies are planned to estimate actual residual oil saturation to water; additionally, new core will be cut to measure residual oil saturation directly. Planned work includes analyzing wells on the basin scale to identify areas that have a high potential to contain a ROZ and mapping the lateral distribution of ROZs within the Illinois Basin.