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Reservoir Characterization for an Alkaline-Surfactant-Polymer Flood of Pennsylvanian and Cypress Sandstone Reservoirs in Lawrence Field Illinois

Preliminary results for a Department of Energy-sponsored alkaline-surfactant-polymer pilot flood in Lawrence Field, Illinois will be described. To date, Lawrence Field has produced more than 400 million barrels of oil, primarily from shallow Lower Pennsylvanian and Middle Mississippian Cypress sandstone reservoirs. Detailed reservoir characterization of the Pennsylvanian Bridgeport A, B, and D sandstones in the pilot area shows that rapid facies changes are responsible for compartmentalization of Pennsylvanian reservoirs. Facies interpretations based on core from six new wells in the pilot area show that these reservoirs are thin, fluvial-deltaic and shallow marine deposits. Evidence from detailed core descriptions and mapping and modeling of facies architecture show that the porosity, permeability and reservoir quality are closely associated with the distribution of discrete sedimentary facies. Effective recovery strategies need to address these areally limited, facies-related differences in reservoir quality.

Cypress Sandstone reservoir architecture at Lawrence Field, as well as at many other Illinois oil fields, is characterized by multiple 10 to 40-foot thick, vertically stacked or shingled sandstones. These sandstones occur as linear ridges, oriented northeast-southwest and are commonly isolated and compartmentalized. The linear sandstone ridges are analogous to those formed in modern-day tidal shoals.

Petrographic analysis of reservoir rocks and chemical analysis of reservoir oils show there are major mineralogic, diagenetic and chemical differences between the reservoir rocks and oils in the Bridgeport and Cypress reservoirs. Special attention to reservoir compartment geometry and proper chemical formulation of floods are required for optimal recovery from these reservoirs.