421b Wettability Alteration for Gas Condensate Reservoirs by Surfactant Treatment

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In gas condensate reservoirs the gas productivity is found to decline when the well pressure falls below the dew point. This is because of the liquid dropout and accumulation around the wellbore. Wettability plays an important role in condensate accumulation around the wellbore, through capillary pressure. Most gas condensate systems are water-wet in nature. This leads to condensate accumulation around the wellbore, reducing the productivity. By injecting surface-active chemicals the rock wettability can be altered to intermediate gas wetting state. We have conducted laboratory studies to evaluate wettability alteration and its effects on gas mobility in gas condensate systems. Different surfactants were studied to achieve wettability alteration from initial water wet state to final gas-wet/intermediate wet state. The chemicals were screened by studying the contact angle behavior on calcite and silica surfaces. Successful chemicals were then used for studying the changes in gas and oil relative permeability and mobility on a core scale. This was done by conducting core flood experiments before and after treatment with chemicals. Spontaneous and forced imbibition studies were also conducted to characterize the core wettability. From contact angle studies, chemicals were identified which changed the wettability from initial water wet state to intermediate and preferentially gas wet state. It was observed that Fluorosilane, and a novelty chemical Z-27, changed the contact angle to intermediate and preferentially gas wet regime. It was also observed that by increasing the Fluorocarbon chain length in these chemicals, the wettability alteration was more pronounced, but they were more and more incompatible with the ethanol, which was used as solvent. The novelty chemical A changed the wettability to intermediate gas wetting at very low concentrations of 0.05 wt %. Z-27, and Fluorosilane D were then used for core flood experiments. Amott-Harvey test on treated cores showed that the wettability was altered from water-wet state to water repelling state in these cores. The core flood experiments showed a significant increase in the liquid-phase relative permeability. And due to lower liquid saturation and high mobility, the gas mobility also increased for fixed pressure drop.