Determination of Reservoir Fluid Properties from Contaminated Samples

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This laboratory has targeted its efforts over the past two decades towards the measurement and modelling of properties and behaviour of reservoir fluids mainly in support of improved hydrocarbon recovery schemes. Novel experimental techniques are used to generate reliable composition, volume, density, interfacial tension (IFT) and viscosity in support of developing compositional models to predict the above properties for reservoir studies.

Collection of representative reservoir fluid samples is the most essential element in fluid property studies. Contamination of reservoir fluids with oil based mud filtrate has extensively been investigated by this laboratory since 1996, with very encouraging results. Initially several methodologies were developed to retrieve the composition and to reliably predict the phase and volumetric behaviour of the original fluids from given contaminated samples when the reservoir fluid is completely miscible with oil based mud filtrate. Gas condensate, however, is often not completely miscible with mud filtrate. In this case, due to mass exchange between gas condensate and mud filtrate, the captured gas condensate sample does not fully represent the reservoir fluid because of losing/gaining components to/from mud filtrate. A tracer technique, which requires the vapour-liquid equilibrium ratio data (K-value) of the tracers at reservoir conditions, has been developed for applying to the above case. Experimental data on K-values of tracers in a number of hydrocarbon systems including paraffins, naphthenes and aromatics, have been generated to determine the binary interaction parameters (BIP's) of tracers with hydrocarbons for application in equation of state modelling. Additional methods, particularly useful for heavy tracers, have also been developed. The adsorption loss of tracers has been examined in a real HTHP drilling mud, containing surface-active solids, by performing a modified filtration test, where no loss due to adsorption was observed. A compositional reservoir simulator has been used to model continuous (multiple) contact between the formation fluid and the oil-based mud filtrate around the wellbore. The effects of fluid type (richness of gas condensate), rock characteristics (vertical/horizontal permeability and high permeability streaks) and probe/formation geometry (location of sampling probe with respect to non-permeable boundaries of formation) on clean up time have been investigated. It is shown that using the developed decontamination method the clean up time could be reduced by 70%.

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