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Equation of state of crude oil samples

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Technological advancement in exploration, refinement and enhanced recovery of hydrocarbon fluids heavily depend upon the thermo-physical properties of these fluids under different temperature and pressure conditions. A direct measurement at in-situ conditions is quite difficult; therefore we have utilized thermodynamic equations to extrapolate these thermo-physical properties at ambient conditions. The basic ingredients are density, ultrasound velocity and the specific heat which we have measured in the laboratory as a function of temperature for light and heavy crude oils procured from different wells of Oman. The densities of the samples were measured as a function of temperature using a precision density meter. We have also measured the sound velocity using an ultrasound interferometer and the specific heat at constant pressure using a differential scanning calorimeter. These data, in turn, were used to develop the equation of state

$$P = P_r + \int_{T_r}^{T} \left(\frac{\beta(T)}{\kappa_T} \right) dT$$

where (Tr, Pr) refer to the temperature and pressure of reference state. The coefficient of volume expansion, β is determined from the measured density data, and the isentropic compressibility, κ_s are evaluated from the ultrasound velocity and density. κ_s is further utilized to obtain the isothermal compressibility $\kappa_T = \gamma \kappa_s$. The ratio of specific heats (γ=CP/CV) of the crude oils are determined from the thermodynamic relation

$$\gamma = 1 + \frac{TV\beta^2}{C_P \kappa_S}$$

Our computed equation of state conforms reasonably well to the *in-situ* reservoir conditions

Biography

Abraham K. George did his Ph.D. from MS University of Baroda, India in 1980 and later did postdoctoral research at Chelsea College, University of London. Currently he is a Professor of Physics at Sultan Qaboos University, Muscat, Oman. His research interests are in Liquid Crystals, Petrophysics and Geophysics. He has published over 75 papers in reputed journals.

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