Direct Prediction of Cricondentherm and Cricondenbar Coordinates of Natural Gas Mixture using the Cubic Equation of State

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Proper analysis of many petroleum problems requires knowledge about at least a portion of the phase envelope. For a petroleum fluid, the shape of its phase envelope depends on its composition and the nature of the components making up the system. The phase envelope has numerous applications in petroleum production and process design, ranging including reservoir simulation, pumping liquids, transportation of natural gas, ethane plus recovery, refrigeration processes, and operation near the critical point or in the super critical region.

For gas condensate reservoirs, there are two important points on the phase envelope from production, transportation, and processing view points. These two points are the cricondenbar and cricondentherm, the maximum pressure point and temperature point at which a fluid may exist in two phase regions, respectively.

A new algorithm is presented for accurate and direct numerical calculation of the cricondenbar and cricondentherm coordinates of multicomponent mixtures of known composition. In this algorithm, the property of the distance from the free energy surface to a tangent plane, in equilibrium condition, is added to the saturation calculation as an additional criterion.

The basis of calculations in these algorithms is an equation of state (EoS), and it is used to calculate all required properties such as compressibility factors, fugacities, and equilibrium ratios. The algorithm was tested with SRK, PR, and MNM equations of state. For each EoS, the binary interactions parameter (kij) impact was studied. The impact of initial guesses for temperature and pressure was also studied. The results of the algorithm were compared with results of simulation programs such as Hysys, Aspen Plus, and EzThermo, as well as experimental measurements.