A New Correlations Approach for Prediction of PVT Properties of Oil Reservoir

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Abstract

Reservoir oils PVT properties are of primary importance for determination of nearly all the aspects of petroleum engineering computations such as well testing, material balance, volumetric reserve estimates and numerical reservoir simulation. PVT data are essential in reservoir engineering calculations. It is important to obtain reservoir fluid samples to determine PVT properties. To determinate such quantities in laboratory is expensive and time consuming and also results are dependent on the validity of the reservoir fluid sample In case no fluid samples are taken or experimental PVT data is not available, For saving time and money, correlation methods can be used to estimate PVT data. This study presents a novel model of correlation for the prediction of the pressure, volume, and temperature (PVT) properties of crude oil samples. It illustrates a methodology with which to obtain higher prediction precision of parameters by applying this newly developed model of correlation to a set of crude oil samples from different wells of oil reservoirs. The correlations based on a large PVT database and was considered nitrogen content, viscosity of oil and methane content of crude oil, in order to evaluate more accurate correlation.

The new model developed in this paper would suit a large number of reservoirs from different geographical location in worldwide with different properties. In addition, in contrast to most existing correlations which have several parameters in mathematical equations, the new model developed in this paper has only one parameter which can easily be applied to any oil sample. Reservoir oil properties are usually measured at reservoir temperature and are estimated at other temperature using empirical correlations. Fluid properties correlations cannot be used globally because of different characteristics of fluids in each area. Here, based on Iranian oil PVT data, new correlations have been developed to predict saturation pressure and oil formation volume factor at bubble point pressure. The calculation of reserves in an oil reservoir or the determination of its performance and economics require good knowledge of the fluids physical properties. Bubble point pressure, GOR, and OFVF are of primary importance in material balance calculation. These data can be obtained either by conducting a laboratory study on reservoir fluid samples or estimated by using empirically derived PVT correlations. Although laboratory results give better accuracy where controlled conditions are imposed, the results are heavily dependent on the validity of the reservoir fluid samples, especially when the reservoir has depleted below the bubble point pressure. In situations where the experimental data are not available, empirically derived correlations are used to estimate the physical reservoir fluid properties. Fundamentally, there are two different types of correlations in the literature. The first group of correlations is developed with randomly selected data sets; we will refer to such correlations as "generic" correlations.

The second group of correlations is developed using a known geographical area or a certain class/type of oil. Correlations using randomly selected data sets may not be suitable for certain types of oils or for some geographical areas. Even though the authors of the generic correlations attempt to cover a wide range of data, such correlations still work better for certain types of oils. Specialized correlations represent the properties of a certain type of oil or geographical area (for which they have been developed) better than the generic correlations. and output data as compared to linear and nonlinear regression techniques Reservoir fluid properties such as bubble point pressure, oil formation volume factor and viscosity are very important in reservoir and petroleum production engineering computations such as outflow–inflow well performance, material balance calculations, well test analysis, reserve estimates, and numerical reservoir simulations. Ideally, these properties should be obtained from actual measurements. Quite often, however, these measurements are either not available or very costly to obtain.

In such cases, empirically derived correlations are used to predict the needed properties using the known properties such as temperature, specific gravity of oil and gas, and gas–oil ratio. Therefore, all computations depend on the accuracy of the correlations used for predicting the fluid properties. Almost all of these previous correlations were developed with linear or nonlinear multiple regression or graphical techniques. Artificial neural networks, once successfully trained, offer an alternative way to obtain reliable and more accurate results for the determination of crude oil PVT properties, because it can capture highly nonlinear behavior and relationship between the input. The new correlations were developed using genetic programming approach. The new models were developed and

tested using linear genetic programming (GP) technique. The models efficiency was compared to existing correlations. Average absolute relative deviation, coefficient of correlation, and cross plots were used to evaluate the proposed models, and their outputs indicate the accuracy of the GP technique and the superiority of the developed models in comparison with the commonly utilized models tested. PVT (pressure-volume-temperature) properties of reservoir fluids in the oil and gas industry constitute an integral part of the required data for a thorough study of the reservoir, optimally compilation of oil production and operation schemes. In the absence of PVT data that measured in laboratory conditions, empirical correlation is used to evaluate these properties. These correlations cannot be applied universally due to the differences of crude oil composition, the working condition of geographical and oil environment. In the article widespread correlations and models was investigated in the field of prediction of PVT properties of reservoir oil from different regions. Their accuracy and productivity was thoroughly analyzed too.