

New Saturated Oil Viscosity, Bubble Point Oil Viscosity and Bubble Point Pressure Correlations for Saturated Omani Crude Oil

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Abstract

Estimating oil viscosity is vital for oil field development strategies such as enhanced oil recovery. Direct measurement of oil field viscosity is costly and requires representative oil fields sampling that are often unavailable. Therefore, empirical correlations have been developed and used for several decades. However, those correlations were too simple or too complex to use and they were commonly developed for special regions of the world that limit their applications.

The main objective of this study is to develop an empirical correlation which predicts the saturated oil viscosity for Omani crude oil. For this purpose, 79 PVT reports with 721 data points were used for the development and validation of the correlation. About 48 PVT (pressure-volume-temperature) reports with 409 data points were used to develop the correlation, while the remaining data were used to assess the validity of the correlation. This study covered Omani crude oils from light to heavy within specific gravity ranging from 17.6 to 48.3 oAPI.

The Omani crude oil database was compared with the existing saturated oil viscosity correlations. Then, a genetic algorithm optimization technique was applied to develop a new correlation for saturated viscosity. Statistical and graphical analysis was conducted to validate the accuracy of the new correlation. The results revealed that the new correlation was able to better predict the viscosity data by 50% in comparison with the best published correlation. The average absolute relative error for saturated oil viscosity using training data set was 10.4% while 7.4% for the validation data.

An attempt was also made to predict the bubble point viscosity and bubble point pressure for Omani crude to facilitate their prediction of saturated oil viscosity when these data are unavailable. The proposed correlations for bubble point oil viscosity and bubble point pressure improved the performance of the proposed and the published correlation of saturated oil viscosity with an average absolute relative error of about 19.4% and 13.1%, respectively. It was also found that the calculated bubble point pressure attend similar performance to that of published correlations when used in the saturated oil viscosity.