

# Quantitative Viscosity Prediction Method for a Complex Fault-Block Heavy Oil Reservoir in Offshore Bohai Bay Basin

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## Abstract

Half of the proven reserves in offshore Bohai Bay Basin are heavy oil, which is an important oil and gas resource in offshore Bohai Bay Basin. Viscosity of heavy oil has important research significance for exploration evaluation and development plan design. The existing technical methods must rely on physical analysis and laboratory data in order to predict the viscosity, and can not be used for pre-drilling analysis and prediction in areas without physical data. In this paper, the correlation between the measured viscosity data of crude oil and the biodegradable strength index is established, and the viscosities of heavy oil in undrilled areas can be calculated according to the fitting formula. This method can not only quantitatively predict the viscosities of heavy oil, but also predict the pre-drilling viscosities of non-drilled areas, which provides an important basis for real-time decision-making of exploration evaluation and development plan design. The shallow heavy oil in the sea area is mainly formed by biodegradation. Biodegradation of crude oil is mainly a process of hydrocarbon oxidation. A large number of bacteria and fungi metabolize by consuming saturated hydrocarbons and aromatic hydrocarbons. Because most bacteria are aerobic bacteria, it is necessary for aerobic bacteria to supplement molecular oxygen by surface water supply. The larger the surface water supply, the stronger the biodegradation and the higher the viscosity of heavy oil. Therefore, the correlation between biodegradation strength and crude oil viscosity can be established, and then the viscosities of heavy oil can be predicted. Surface water recharge in complex fault-block reservoirs is proportional to fault activity and inversely proportional to the distance

from the reservoir to the ground. According to the statistics of fault activity and the distance from reservoir to surface, and then using the data of fault activity and the distance from reservoir to surface to do multivariate correlation analysis with the measured viscosity of crude oil, ultimately the biodegradation intensity index of crude oil can be obtained. Finally, the correlation between crude oil viscosity data and biodegradable strength index is established, and the viscosities of heavy oil in undrilled areas can be calculated according to the fitting formula. This study is very effective for predicting the viscosity of complex fault block heavy oil reservoirs with fault-controlled high points, and does not depend on empirical formulas. According to this method, it has good application in LD21-2 oilfield, BZ29-6 oilfield and Bozhong 36-1 oilfield. Viscosity prediction results are basically consistent with the latest measured results of drilling crude oil viscosity, which proves the reliability of the viscosity prediction method.