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Modelling the load transfer and tool surface for friction reduction drilling by vibrating drill-string

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Abstract: A unified mathematical model, considering the two mechanisms of static-dynamic friction conversion and friction decomposition, is developed to analysis the effect of different vibration manners and parameters on axial load transfer and tool face of positive displacement motor and evaluate the vibration level and dynamic security of the drill-string. A second-order finite difference method is used to solve this model. The change of weight on bit, rate of penetration and tool face of positive displacement motor under three different slide drilling manners are obtained. Simulation results show that the vibrations applied on drill-string mitigate the stick-slip and adhesion phenomenon and make the load transfer and movement of the drill-string smoother. The increment of weight on bit is the combined effect of the change of axial friction acting on drill-string and the exciting force. Among the three vibration manners, the axial vibration applied at bottom hole has the best friction reduction and tool face stabilization effects and the lowest vibration intensity. The torsional vibration applied at wellhead mainly affects the upper drill-string and has an optimal torsion angle subject to the torsional depth. The axial vibration applied at wellhead has a strong effect on the drill-string of vertical section. Results provide guidance and advice to the research and applications of friction reduction by vibrating drill-string.

Key words: Friction reduction; Vibration drilling; Load transfer; Tool face; Drill-string dynamic safety

1 Introduction

Drilling a complex structural well to exploit the unconventional oil and gas resources can ensure

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