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钻井工程

空气钻井条件下钻柱振动特性研究

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摘要：

空气钻井过程中钻柱损坏问题严重，直接影响到了钻井成本并威胁钻井安全，共振是引起钻柱失效的主要原因之一，故需要对其振动特性进行分析和研究。为此，在理论分析的基础上，建立了钻柱振动有限元模型，利用ANSYS软件对空气钻井钻柱振动特性进行了数值模拟。研究结果表明：扭转和纵向振动固有频率数值较大，共振区域窄；横向振动固有频率很小且各阶频率间隔小，共振区域宽；钻柱扭转、纵向振动和横向振动特性受钻柱长度影响很大；空气钻井中钻柱纵向振动和横向振动的固有频率比常规钻井中钻柱振动的固有频率要高很多。谐响应分析结果表明：钻井液的存在使钻柱低频共振响应显著加强，而高频共振减弱；钻井液对钻柱安全有着积极的影响。在进行空气钻井时，需要根据不同的钻柱长度和钻柱组合，动态选择合理的转盘转速。该研究成果对空气钻井转速优选具有一定的指导意义。

关键词： 空气钻井 钻柱 振动 有限元模型 固有频率 转速 优选 川渝气区

Vibrating properties of the drill string during air drilling operations

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Abstract:

During the process of air drilling, drill string failure is so serious as to directly raise the cost and threaten the safety. Resonance is one of the main reasons for drill string failure. So it is necessary to study the vibrating properties of drill string. Based on the theoretical study, a finite element model for drill string vibration was built and a detailed numerical simulation on the properties of the drill string in an air drilling well was done by use of the ANSYS software. The following results are presented herein in this paper. (1) The resonance range is narrow, while the inherent frequency values of torsional and axial vibrations are large. (2) The resonance range becomes wider while the inherent frequency value of lateral vibration is small and the gap between different steps of frequencies is small. (3) The properties of torsional, axial and lateral vibrations of the drill string are largely dependant on the length of the drill string. (4) The inherent frequencies of axial and lateral vibrations of drill string in air drilling are much higher compared with those of the conventional drilling. Moreover, the harmonic response analysis shows that the low frequency resonance becomes stronger and the high frequency resonance becomes weaker when drill string is in the drilling fluid environment, which has a positive impact on the drill string safety. Therefore, a proper rotary speed should be chosen according to different drill string lengths and BHAs.

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