

A Review of Formation Effect on PDC Drill Bits Performance, Design Criteria Considerations to Improve Rock Drillability, Bit Stability and Drilling Cost Reduction

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Abstract

The drill bit is a critical component of the drilling string, and the proper selection and application are crucial to the success of drilling operations. Incorrect selection and application of the drill bit can lead to non-productive time (NPT), which can cause high drilling costs. NPT can arise from a low Rate of Penetration (ROP), stuck pipes, hole rugosity, vibration, and hole loss. Despite attempts to address these issues, PDC bit wear related to mineral composition and textural aspects of the formation remains a challenge. This paper aims to comprehensively review the effects of various factors on PDC drill bit performance, design criteria, rock drillability, and stability. The study focuses on the impact of lithology, geomechanics, texture, and chemical composition of rocks on drill bit selection and application. The research analyzes and discusses different design criteria, highlighting their advantages and disadvantages. The study found that the reactivity of young shale causes the bit to ball up while the mineralogical composition, size, and degree of grain sphericity increase bit wear. Formation drillability is influenced by factors such as formation strength, bit selection, and drilling application, while bit stability is a function of the bit's aggressivity on the formation. Considering these factors and selecting the appropriate drill bit can yield substantial cost savings for the oil and gas industry. The paper concludes by emphasizing the importance of carefully selecting and applying the drill bit, considering the formation's lithology, geomechanics, and geochemical properties. This approach ensures efficient and cost-effective drilling operations and reduces the risk of NPT.