



Laboratorial studies on the effect of rock microfabric parameters on drill rig vibration

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Abstract

Drilling is a crucial operation in mining and construction, and optimizing it can significantly impact costs and operation time. Therefore, it is necessary to determine the parameters affecting the drilling and the correct understanding of these relationships can help to optimize the drilling operation. In the meantime, the relationships between the parameters of the drilling machine and the rock can be considered as a decisive operational condition. One of the effective parameters in drilling is the rock texture, which is measured based on the image analysis of thin sections. Additionally, the vibration caused by drilling can assist in determining the type of rock and its characteristics, guiding further operations. In this study, we utilized a laboratory-scale drilling machine to measure the vibration it caused during drilling and examined its relationship with the microfabric parameters of 10 different rocks. Statistical analysis indicated the highest and lowest correlation coefficient between vibration with aspect ratio and the equivalent diameter, respectively. These relationships can provide a good view of the impact of rock texture parameters on the vibration of the drilling rig on a laboratory scale. Also, by using the 3D surface plot and considering the combination of rock microfabric parameters, the drilling vibration can be predicted with much higher accuracy. This result shows that the drilling vibration is affected by a combination of rock microfabric parameters.

Keywords Drilling · Microfabric parameters · Vibration · Statistical analysis

Introduction

The initial unit production process of mining is drilling. Drilling is one of the extraction operations that can reduce mining costs by optimizing (Thuro 1997). Monitoring helps to better understand the drilling operation. This understanding makes the next drilling operations more effective. The

measurement of effective parameters during drilling is called measurement while drilling (MWD), which indicates the effects of rock mechanics on drilling operations. By using MWD, it is possible to measure the parameters that depend on the device and its origin such as specific energy, drillability, vibration, and ROP (Rate of Penetration) (Ghosh et al. 2018; Kamel et al. 2018; Park and Kim, 2019; van Eldert et al. 2019; Park and Kim 2020; Shen et al. 2022; Zhao et al. 2023). Rock properties can be obtained directly or indirectly and can provide valuable insight into rock durability in drilling. By monitoring these parameters in real-time, it is possible to adjust drilling parameters and select appropriate drilling tools to optimize the drilling process and minimize costs associated with tool replacement and downtime (Zhao et al. 2023).

The microfabric parameters are one of the most basic parameters which is determined by microscopic studies. Textural parameters determine the appearance of rock characteristics. Many researchers have presented the relationships between textural characteristics and rock engineering parameters. This measure has been shown to have practical

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