Multi-Sensor Acoustic Parameter Analysis System for Monitoring and Evaluation of Deep Drilling, Jetting, and Stimulation Operations

Shahin Jamali, Volker Wittig, and Rolf Bracke
Fraunhofer - IEG, Monitoring and Artificial Intelligence, Bochum, Germany (shahin.jamali@ieg.fraunhofer.de)

Acoustic Emission (AE) based systems have been under development and used in this research at Fraunhofer – IEG to monitor, evaluate, and control conventional and novel drilling processes and their pertinent equipment used in geothermal applications. Moreover, new stimulation and high pressure (radial) jetting and drilling operations in deep geothermal reservoirs do heavily rely on such new technologies in order to be able to control them properly and thus, to generate an optimal connection between the main wellbore and the reservoir. As Service intervals and lifetime of machines have long been predicted and monitored via Acoustic Emission (AE) systems, and it is becoming a standard in numerous other industrial operations, AE is known as being a promising technique to be used for such monitoring purposes. AE monitoring is based on the detection and conversion of elastic waves into electrical signals, which are typically associated with a rapid release of localized stress-energy propagating within a given material. Thus, it is passive testing, logging, and analysis method to evaluate changes in the properties and behavior of machines and also mineral type materials such as rocks during operations. Such changes may be induced by drilling, jetting, or other drilling methods and being recorded, located, and evaluated via an AE system. This is the core of Fraunhofer – IEG’s new development, the AE based, so-called Multi-Sensor acoustic parameter analysis (MoUSE) as the primary control and monitoring mechanism during rock breaking, drilling, jetting, and stimulation. AE signals generated during jetting or bit-rock interaction are being monitored and analyzed extensively using novel numerical methods, based on sound analysis and engineering applications. The objective of this paper is to present an alternative approach for QA and QC during drilling, jetting, and stimulation operations based on AE waveforms generated during such continuous processes, including jetting and thermal drilling processes. Initial results of rock breaking tests, including mechanical, and non-contact drilling or jetting, will be presented.