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Baden Arena Kongress 1 – Tiefe Geothermie

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Baden Arena Congress 1 – Deep Geothermal Energy

A comprehensive study on drilling performance of first prototype from ORCHYD: Design, fabrication and experimental tests

Eine umfassende Studie zur Bohrleistung des ersten Prototyps von ORCHYD: Entwurf, Herstellung und experimentelle Tests

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Geothermal energy is a leading candidate to meet the Net Zero Emission strategy by 2050 by providing clean, sustainable, and non-intermittent renewable source of energy. However, high drilling costs serves as a bottleneck for its scalability and adaptability across the globe. The primary reason for its elevated costs come from drilling deep, hard crystalline rocks such as granites that are found at depths more than 4 km. Drilling deeper rocks come at a higher expense of energy required to break rocks under high confining stresses. The ORCHYD (Novel Drilling Technology Combining Hydro-jet and Percussion for ROP Improvement in Deep Geothermal Drilling) project was set up under Horizon 2020 program, funded by the European Commission, to study a different technique to increase the drilling performance in deep geothermal wells.

In ORCHYD technology, high-pressure water jetting (HPWJ) and percussion drilling techniques are combined to efficiently break the rock. A peripheral groove created using the high-pressure water jet isolates the rock surface from the surrounding stress regimes and eases the rock breakage when a mud hammer is utilized. Initial tests on a laboratory scale rig under realistic downhole conditions have already shown a 2X increase in the rate of penetration as compared to when the hammer is used on its own. In this study, experimental results of the first prototype that combines HPWJ, and percussion drilling will be highlighted using which a 4X increase in the ROP was achieved as compared to the conventional drilling technologies. Such promising results were achieved due to the combined effect of stress release effect because of peripheral slotting (1-2 cm deep) by high pressure water jet and reflection of the percussive pressure wave against the free surface in the periphery.

This study also highlights the several parameters with a degree of freedom to optimize the drilling process. This includes, shape and size of the drill bit inserts, their distribution on the drill bit surface, profile of the drill bit; position, shape and size of the high-pressure nozzle to optimize the stress release effect; and other operating conditions such as the nozzle jet pressure, mud flow rate for hammer operation.

A comprehensive study of the design and fabrication of the first prototype of this hybrid drilling technology will be presented and its applicability for deep drilling conditions will be established using the experimental results obtained from testing the prototype at a controlled laboratory facility in Pau, France.