Optimizing Solids Control and Cuttings Dewatering for Water-Powered Percussive Drilling in Mineral Exploration

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Abstract : The Deep Exploration Technologies Cooperative Research Centre (DET CRC) is researching and developing a new coiled tubing based greenfields mineral exploration drilling system utilising down-hole water-powered percussive drill tooling. This new drilling system is aimed at significantly reducing the costs associated with identifying mineral resource deposits beneath deep, barren cover. This system has shown superior rates of penetration in water-rich, hard rock formations at depths exceeding 500 metres. With fluid flow rates of up to 120 litres per minute at 200 bar operating pressure to energise the bottom hole tooling, excessive quantities of high quality drilling fluid (water) would be required for a prolonged drilling campaign. As a result, drilling fluid recovery and recycling has been identified as a necessary option to minimise costs and logistical effort. While the majority of the cuttings report as coarse particles, a significant fines fraction will typically also be present. To maximise tool life longevity, the percussive bottom hole assembly requires high quality fluid with minimal solids loading and any recycled fluid needs to have a solids cut point below 40 microns and a concentration less than 400 ppm before it can be used to reenergise the system. This paper presents experimental results obtained from the research program during laboratory and field testing of the prototype drilling system. A study of the morphological aspects of the cuttings generated during the percussive drilling process shows a strong power law relationship for particle size distributions. This data is critical in optimising solids control strategies and cuttings dewatering techniques. Optimisation of deployable solids control equipment is discussed and how the required centrate clarity was achieved in the presence of pyrite-rich metasediment cuttings. Key results were the successful pre-aggregation of fines through the selection and use of high molecular weight anionic polyacrylamide flocculants and the techniques developed for optimal dosing prior to scroll decanter centrifugation, thus keeping sub 40 micron solids loading within prescribed limits. Experiments on maximising fines capture in the presence of thixotropic drilling fluid additives (e.g. Xanthan gum and other biopolymers) are also discussed. As no core is produced during the drilling process, it is intended that the particle laden returned drilling fluid is used for top-of-hole geochemical and mineralogical assessment. A discussion is therefore presented on the biasing and latency of cuttings representivity by dewatering techniques, as well as the resulting detrimental effects on depth fidelity and accuracy. Data pertaining to the sample biasing with respect to geochemical signatures due to particle size distributions is presented and shows that, depending on the solids control and dewatering techniques used, it can have unwanted influence on top-of-hole analysis. Strategies are proposed to overcome these effects, improving sample quality. Successful solids control and cuttings dewatering for water-powered percussive drilling is presented, contributing towards the successful advancement of coiled tubing based greenfields mineral exploration.

Keywords : cuttings, dewatering, flocculation, percussive drilling, solids control
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