Toward Automation of a Nanotagging Technology for Improved Cuttings Depth Correlation

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Abstract

Real-time evaluation of drill cuttings in the field can provide direct petrophysical characterization of the formation while drilling. When integrated into advanced mud logging workflows, it can effectively support logging and measuring while drilling (LWD and MWD) and geosteering. This technique has the potential to optimize well placement, improve efficiency and safety of drilling and completion operations, and ultimately to maximize recovery cost-effectively.

We have demonstrated that the NanoTagging technology, which manually injected nanoparticle tags to label cuttings and determined the downward lag time using the stable internal volume of the drill pipes and mud hydraulics, can reduce depth uncertainties that arise from variations in annular volume. Our technology reduces the variation of cuttings' depth assignment to +/- 1-2 ft. In this work we report our design and demonstration of an automatic injection of barcoded tags and automatic processing of cuttings to extract tags from recovered cuttings in field. These automation steps bring the NanoTagging technology a step closer to real-time field-application.

We have designed and constructed a new air-powered rapid-multiplexing tag injection apparatus that consists of high-pressure fluid tanks for tag colloids, feeding air lines for pressurizing the tank, needle valves for flow rate control, one-way check valves, and a LabView based automation software to operate the apparatus via a laptop computer. This apparatus delivers sharp pulse injections of each tag to the mud pumps' intake line through a small valve on a flange where the tags mix with the drilling mud. The injection time and flow rate for each tag are programmed based on the flow rate of the mud. We have also customized an automatic platform to carry out field cuttings preparation for 48 batches of cuttings within 24 hours; the workflow includes the weighing of cuttings, solvent addition, filtering the cuttings, and vacuum drying the solvent extract to recover the tags from cuttings before analysis using pyrolysis-GCMS. This automation platform significantly increases the efficiency of cuttings handling and preparation for characterization.

We are conducting a field test to demonstrate the two automation processes using three NanoTags injected into water-based mud in a gas well located in a carbonate formation in Saudi Arabia. The automated processes of our NanoTagging technology will improve logging while drilling accuracy efficiently and cost-effectively, as well as create new opportunities for logging in conditions where traditional mudlogging is not available.