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Measurement of heat generation in drill bits under simulated drilling conditions and estimation of temperatures in drill bits during drilling

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Abstract: In high-temperature formation drilling, the life of drill bits becomes shorter due to thermal damage to the O-ring seal set in the bearing part. An increase in the formation temperature has been regarded as a major reason for the temperature of drill bits increasing. However, mechanical factors such as WOB(Weight on Bit)and rotation have not been fully taken into consideration. In this study, an experimental device that can simulate situations for drill bits during drilling was fabricated. The test piece was designed to simulate a cone of a 8-1/2 "tri-cone bit. Two types of bearings were prepared for the test pieces; journal bearing and roller bearing types. Experiments using the device were performed under various mechanical loaded conditions to investigate heat generation in tri-cone bits with cooling affected by circulation fluid. In these experiments, the range of the weight on a cone was 2.5–5.1 t(corresponding to 7.5–15.3 t of WOB), and the range of the cone rotation speed was 60–120 rpm(corresponding to 40–80 rpm of drill pipe rotation speed). In these experimental conditions, the heat generation in the cone in tri-cone bits was 100–160 kJ/min for journal bearings and 30–60 kJ/min for roller bearings. It was also found that the surface temperature of tri-cone bits was almost the same as the temperature of the circulating fluid at the bottom of the hole, under flow rate conditions at a rig site. Further, based on the experimental results, we suggested two estimation methods for determinations of the temperature in drill bits during drilling wells, especially near the radial loaded bearing part in which temperature is important for thermal damage of the O-ring. Using these methods, in the case where a bottom-hole temperature is given, the temperature of drill bits can be estimated. The method will be useful to assist in deciding drilling conditions that will not cause thermal damage to the O-ring seal in a bearing.

Key words: [heat generation in tri-cone bits](#), [cooling effect by circulation fluid](#), [temperature in drill bits](#)

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