Effect of thermal response on physical properties during drilling operations-A case study

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Abstract

The temperature induced or generated during deep hole drilling operations is due to the heat generated between the interface of workpiece surface and the tool surface. Several research study have been conducted to predict the temperature involved while drilling process as a predominant functions of many parameters like feed rate, torque, depth of cut etc. Similarly many experimental procedures have been conducted by several researchers to measure temperature directly by using thermocouples, infrared measurement, pyrometer, and thermisters etc. There is no precise experimental method is available to measure analytical value of energy, power, heat flux etc, while drilling process. The temperature rigima depends on material compositions and physical properties. This paper presents the influence of temperature on physical properties of some study samples during drilling operations.

Keywords: Temperature, Drilling, Heat flux, Thermal response;

1. Introduction

Temperature contact between the drilling hole and the inside surface of rock is of precise interest in a drilling operation. The drilling process with the carbide tools with MQL is under development in the automobile, mining, petroleum industries etc, due to its high available and its environmental benefits [2]. In general approximately 8 percent of the total energy supplied to the drilling is useful (more than 85 percent) goes into losses due to the frictional heat, as a main consequence of this, excessive wearing and fracturing of the drilling tool is observed in the field and laboratory.

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investigations, the main aim for fracturing the rock during drilling operations using drilling tool leads to an excessive
temperature development at the interface of the tool and the workpiece [3]. The workpiece thermal deformation is
significant in dry or wear-dry machining at low speeds or of high torque and a feed rate, such as the deep hole drilling.
The problems developed by work piece thermal expansion are more predominant in MQL drilling of deep holes [4].
Temperature and heat flux measurement is a predominant factor to calculate in drilling operations and it is not an easy
task to observe during drilling zone period and also in machining process. Few methodology like analytical and
experimental based on heat transfer like conduction and convection process has been applied to measure the temperature
during drilling process. Similarly for the tool work thermocouple and embedded thermocouple methods using minimum
quality lubricant condition, gives a good agreement for the zone temperature consideration [5].

2. Temperature measurement

Knowledge of temperature measurement and heat to developed a model between the tool and workpiece (raw
material) and this model works with many parameters like torque, rotational speed constant by disruption of fixed
air flow as a coolant to measure the temperature distribution at regular intervals of times with respect to
thermocouple distance. By considering the upper plate for the heat source and the measuring can be taken care at
lower plate by maintaining 5mm distance. The fit obtained by the model is reliable calculation of the specific energy
for the tool and workpiece [6]. Similarly for the orthopedic drilling, consider drill diameter, feed rate, spindle speed
are used as a input for ANN to predict the temperature as the output [7]. The temperature investigation may be taken
care with deep hole drilling by novel technology by means of thermal drilling, some cases the surface temperature
predominantly effects the rock properties, by we have consider the minerals. The spallation drilling will work with
the rapid heating of the surface by the external source [8]. Especially for the rock properties identification and the
fracture develops due to the continuous drilling and without addition of coolant. But by adding of internally applied
cooling agent reduces the temperature of the solid material and the tool damage reduces with proper maintenance.

3. Methods of thermal response

Many methods have been implemented to measure the surface temperature of the rock while drilling process. In this
regards all this methods give a predominant role to calculate the surface temperature and thermal properties of the rock
samples. Infrared radiation methods and the novel technology like hydrothermal spallation influence of thermal spallation
of the rock, due to high temperature treatment as an external source and this technology reduces the drilling cost for the
geothermal well conditions. Out of all this new methodology, embedded thermocouple method play a vital role to predict
the thermal behavior of the rock during drilling operations. But measurement of temperature of the bottom hole is a
difficult task to carryout HWS and HBS characterization and the physical changes. When we come to numerical methods,
in order to avoid the exact solutions, an approximate analytical integral heat balance method has been proposed to simplify
for the geophysical studies [1][10]. Similarly to predict and asses the results of numerical equation, an artificial neural
network for an optimal solution can also be useful [9].

4. Effect of temperature on physical properties

Deep hole drilling characterized the borehole stability by higher temperature and pressure. Due to the maximum
temperature different for every dept of the drill leads to the deposition of mineral composition and the crack fracture
effects throughout the hole dept of the drill. As the rock fragmentations with novel technology, hydrothermal
drilling, and surface phenomenon play a vital role, because hydrothermal drilling processes are not in contact with
the rock, the wear rate is reduced. But it acts as a surface fragmentation and surface phenomenon.

5. Thermal response by ANOVA analysis

In this paper has been introduced an ANOVA method, which include the thermal response analysis during drilling
process. This method gives a proper identification of the temperature distribution at the point consideration by
thermocouples. Because thermocouples are introduce to measure the temperature at a particular phase and the point,
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