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Extended Abstract

Using a laboratory simulator for drilling operations to study factors affecting cleaning and fluid pressure drop in the well drilling

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Abstract

Cuttings transfer means improving well cleaning in the drilling process, increasing the bit penetration rate, preventing pipe jams, and reducing torque and drag problems. If the well is cleaned optimally, the drilling speed will increase, and the final cost will decrease. This study aims to investigate the effect of drilling stabilizers on cleaning and fluid pressure drop. The output of the experimental design for the laboratory simulator was used to examine the behavior of the cuttings. By increasing the distance of the stabilizer from the laboratory head, the pressure drop decreases. In the laboratory environment, the pressure drop will be lower with more rotation of the drill string. With increasing cutting density, the pressure drop slightly increased, and the height of the cutting bed also increased.

1. Introduction

The primary means of transporting cuttings during drilling operations is the circulating fluid, or drilling fluid. Carrying and suspending cuttings is one of the most important properties when selecting a drilling fluid[1]. The pressure drop in the ground surface, pipes, and the wellbore is caused by friction between the walls and the fluid and is known as frictional pressure drop, while the pressure drop in the drill is caused by increased fluid acceleration[2]. A complete study of stabilizers and drilling string can be an important and effective matter in drilling hydraulics and well cleaning, which requires having a correct knowledge of the characteristics of the well and the drilling fluid. Based on the shape of the blade, the stabilizer has two types: spiral blade and straight blade[3]. The higher the rotation rate of the drill pipe, the more fluid it moves upward. In deviating wells, this layer of drilling fluid removes the bed of cuttings that have formed around the pipe and accumulated in the lower part of the well[4].

2. Methodology

The purpose of the experiments was to observe the movement of the cuttings around the drilling stabilizer and to investigate the effect of the presence of the drilling stabilizer at different points of the drilling string on the cleaning of the annular space simulator from cuttings. The device's temperature was constant in the experiments, and all the air was removed from the system using air release valves. In these experiments, water was used as the drilling fluid. By changing the angle of the simulator, the effect of the well deviation angle in the presence of the drilling stabilizer was investigated. The location of the drilling stabilizer along the drilling string was investigated. Because the cuttings injected into the device rose to a height above the annular space, the initial location of the drilling stabilizer was selected to simulate conditions near the drill

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at a distance of 25 cm from the drill head. Subsequent stabilizer locations were chosen at 75, 125, and 175 cm distances. The angles used in these experiments are 0 (to simulate the vertical part of the well), 45 (to simulate the directional part of the well), and 90 degrees (to simulate the horizontal part of the well). The fluid flow rate in the experiments is 27.30 gallons. Also, nozzles of 4, 6, and 8 mm in size and sand and silica logs were selected to perform these experiments, and 500 grams of these logs that passed through a 30-40 mesh were used.

Then, using the experimental design software and the D-optimal method, we determined the number of 12 experiments, which we acted accordingly.

3. Results and Conclusions

Here, we analyze one of the graphs from the experimental studies conducted in the faculty laboratory .The graph in Figure 1 is related to the effect of drill string rotation on pressure drop.

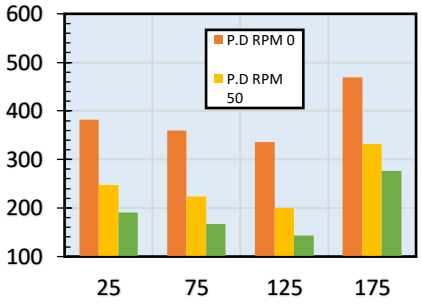

Fig. 1. Pressure drop diagram based on drill string rotation with stabilizer location displacement

Figure 1 shows that in a laboratory environment, the pressure drop decreases significantly as the drill string rotation increases. The rotation of the drill string can contribute to the pressure drop in the annulus space. This occurs for several reasons: 1. Creation of turbulent flow 2. Reduction of fluid viscosity 3. Increased heat transfer

The pressure drop decreased with increasing the distance of the stabilizer from the bit and with greater rotation of the drill string. With the increase in density of the cuttings, the pressure drop increased slightly, and the height of the cuttings bed also increased.

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5. References

[1] Van dyke, K., Rotary Drilling, The Bit Unit 1 Lesson 2. International Assocciation f Drilling Contractors, 1951.

[2]ع. م . م نبئی مهندسی حفاری, کنکاش ۱۳۸۴.

[3] Chen, Z. M., & Xiong, J. Y. (2010). Numerical Calculation for Carrying-cutting Lifting of Spiral Centralizer in Conventional Drilling. Natural Gas Technology, 4(5), 44-46.

[4] X. Sun, K. Wang, and T. Yan, “Effect of drillpipe rotation on cuttings transport using computational fluid dynamics (CFD) in complex structure wells,” pp. 255–261, 2014. DOI 10.1007/s13202-014-0118-x