Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 120 (2017) 67–74

Procedia Computer Science

www.elsevier.com/locate/procedia

9th International Conference on Theory and Application of Soft Computing, Computing with Words and Perception, ICSCCW 2017, 24-25 August 2017, Budapest, Hungary

Selection of the best combination of bit types and technological parameters during drilling, taking into account uncertainty

Galib M. Efendiyev[a]* , Parviz Z. Mammadov[b], Igor A. Piriverdiyev[a], Mansuk D. Sarbopeyeva[c]

[a] *Oil and Gas Institute ANAS, 9 F.Amirov str., Baku, Azerbaijan*
[b] *Azerbaijan State Oil and Industry University, 16/21 Azadlıq ave., Baku, Azerbaijan*
[c] *Engineering named after Sh. Yessenov, 32 micro district, Aktau city 130003, Mangystau region, Kazakhstan*

Abstract

The article is devoted to the estimation of the required mud density during well drilling in fields with abnormally high reservoir pressures. The possibility of density calculation is shown on the basis of data on gradients of pore pressures and fracture pressures, as well as changes in rate of penetration with depth. Identification of the expression for estimating the mud density was applied to some deposits, distribution of pore pressures, fracture pressures and drilling mud density was constructed using the example of one of the deposits.

Peer-review under responsibility of the scientific committee of the 9th International Conference on Theory and application of Soft Computing, Computing with Words and Perception.

Keywords: rate of penetration; mud weight; membership function; decision-making; uncertainty; fuzzy sets.

1. Introduction

When drilling wells in the conditions of the abnormally high, first of all, special attention should be given to the parameters of drilling fluids, as well as the design of the wells, in the selection of which an important role is played by a correct assessment of geological conditions. Ignorance of the exact values of reservoir (pore) pressures often

* Corresponding author. Tel.: +994125393471.
E-mail address: galib_2000@yahoo.com

1877-0509
Peer-review under responsibility of the scientific committee of the 9th International Conference on Theory and application of Soft Computing, Computing with Words and Perception.
10.1016/j.procs.2017.11.211

leads to complications such as manifestations during drilling, emissions, which in turn can lead to loss of the well, which is associated with large material damage. Therefore, a timely assessment of the pore pressure allows you to reasonably choose the required mud density.

The problem of optimal management of drilling process is one of the most important problems in recent years. The complexity of this task lies in the heterogeneity of the rocks being drilled and the limited information about both its properties and their impact on the drilling performance. Drilling management requires a deep analysis of various factors, justification of the criteria, structure and methods of constructing of models and making an optimal decision, assessing the risks of making erroneous decisions. The fact that many geological and technological parameters, as well as the formulation of goals and constraints in decision making are fuzzy makes optimal decision-making difficult. In the construction of drilling management systems, a problem associated with the development of new models arises. As information accumulates, these models are able to adapt to the situation of uncertainty. The model can be effectively implemented with the use of various mathematical methods, including the theory of fuzzy sets. Proceeding from the noted, the problem of solving the problem of increasing the efficiency of the drilling process through the optimal management of technical and technological parameters is actual.

2. A brief overview of the methodological approaches to the optimal choice of bits and regime parameters.

The development of information retrieval systems and means allows solving the problem of optimal control of technical and technological parameters of drilling wells at a higher level. To date, a large number of studies devoted to the interaction of the bit with the rock have accumulated, methods for studying the physical and mechanical properties of rocks, the mechanism of their destruction, the influence of various factors on the efficiency indicators of the drilling process have been proposed. Known methods (Osipov) for finding optimal parameters of the drilling regime can be divided into three groups: expert methods based on physical modeling, analytical and field. Usually, in practice, it is sufficient to analyze the experience of drilling in a given area (or similar in geological conditions of drilling areas) or a field (if information is available), or the method of experimentation with selected new bits, drilling methods, etc. is used. The methods of the first group require a large amount of information. The methods of the second group are based on modeling a single act of impact of the armament element of the bit on the rock and require a large volume of core material, which is practically impossible to provide. Methods relating to the third group require expensive and time-consuming field experiments. According to the results of field experiments, as well as the results of accumulated studies, there are no uniform laws describing the drilling process. Modern bits, as a rule, are capable of passing several heterogeneous in terms of drillability layers in one drill, which limits the possibilities of these methods.

To successfully use them, an appropriate model based on the current monitoring of the drilling process is needed. A new direction - geological and technological research in the drilling process has been developing and improving in recent years. A correct and justified assessment of conformance of the type of bit to the characteristics of the drillable rock and the regime parameters directly in the drilling process allowed the most possible use of the potential capabilities of the drill bits. From this perspective, the energy intensity of the fracture process, the reliability and durability of the bits, the work on drilling optimization, the use of the results of geological and technological research in the process of drilling wells were studied. The authors of (Gulatarov, Kurepin, 1992) propose their own approach to the study of the energy intensity of fracture of rocks by various bits using electric drills, carried out on the basis of an analysis of energy indicators.

The novelty of the approach is also to compare the values of the energy parameters determined for the atmospheric conditions of drilling rock blocks with anomalous indicators obtained in the downhole drilling conditions. The optimum rotary RPM of a cone bit, according to the authors, should be chosen taking into account the rock permeability factor. When drilling cone bits in clayey rocks, the regime of increased axial load on the bit and rotary RPM is effective. The work (Purvinsky et al. 1992) is devoted to the use of the energy intensity of destruction for the purpose of identification of rocks. The work (Purvinsky et al. 1992) is devoted to the use of the coefficient of energy intensity of destruction for the purpose of identification of rocks. The regularity of the change in the energy intensity factor depending on the category of rocks by drillability is established. As in the previous work, the author comes to the conclusion that the energy intensity coefficient directly depends on the rate of penetration at the same rotary RPM and the load on the downhole, which is explained by the significant dependence