Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 102 (2016) 163 – 167

Procedia Computer Science

12th International Conference on Application of Fuzzy Systems and Soft Computing, ICAFS 2016, 29-30 August 2016, Vienna, Austria

Analysis of the impact of operating conditions of pumps on their efficiency indicators using fuzzy clustering algorithm

M.K.Karazhanova[a*], I.A.Piriverdiyev[b]

[a] *Department of Oil and Gas Business and Geology, Caspian State University of Technologies and Engineering named after Sh. Yessenov, 32 micro district, Aktau city 130003, Mangystau region, Kazakhstan*

[b] *Institute of Geology and Geophysics of Azerbaijan National Academy of Sciences, H.Javid Av., 119, Baku AZ1143, Azerbaijan*

Abstract

The report is devoted to the results of analysis of information and the establishment of the relationship between the factors influencing the efficiency of exploitation and performance indicators (turnaround time, coefficient of pump flow) using fuzzy clustering algorithm. The relationship between input and output variables was obtained, which can be expressed by fuzzy rules.

Peer-review under responsibility of the Organizing Committee of ICAFS 2016

Keywords: water cutting; liquid flow rate; turnaround time; membership function; fuzzy cluster-analysis

1. Introduction

One of the main objectives of oilfield practice is to assess the influence of various factors on the efficiency of field operation and making the right technology decisions. The reliability of assessments and decisions is determined by how reliably input and output variables and their values were selected. Often, there are situations when having the same data we receive fundamentally different results. To find concrete expression of these relationships and the parameters characterizing them, we use, in particular, methods of statistical data processing. Finally, real experimental data or the results of the field observations are replaced by obtained laws and some integral. In accordance with the technology, the law, which is found in the form of coupling equations between the influencing factors and performance indicators, will further be transferred to the object under study. This way is often a source of erroneous conclusions, since in most cases the formulation of objectives and constraints during decision-making

* * Corresponding author, Tel.: + 7 (7292) 42-57-57

E-mail address: mikado_70@inbox.ru, igorbaku@yandex.ru

Peer-review under responsibility of the Organizing Committee of ICAFS 2016

doi:10.1016/j.procs.2016.09.384

for increasing the efficiency of pumps and fields exploitation, occurs in the presence of vagueness, fuzziness and multiple factors which require an adequate approach.

When drilling wells we have to face with a variety of parameters inherent in the oil reservoir as a complex system. One of the difficult problems in this case is classification and clustering of this volume of information, as well as highlighting the most important ones. The theory of fuzzy sets is successfully applied to solve these problems in the analysis of field exploitation and decision-making. In[1] fuzzy information about hydrocarbon deposits is seen as a situation which arose due to the physical and linguistic uncertainty. Physical one arises from the impossibility of determining the necessary physical and chemical, mechanical, geological and technological parameters at each point of the complex mining systems. As the author notes, information on geological and technical system is dotted and does not cover fully the whole system. In addition, the measurements inaccuracy and their subsequent interpretation contribute to the physical uncertainty of quantitative assessments. Linguistic uncertainty of quality parameters is caused by the multiplicity and ambiguity of meanings and relationships of specialists' and experts' languages[1]. In the marked work it is believed that quantitative and qualitative characteristics of the complex geological and technical system are fuzzy. In this framework, the author examines the ways of the virtual field exploitation.

Works dedicated to decision-making in fuzzy terms in oilfield practice are shown in[2,5-9]. The advantages of applying the fuzzy set theory at control problems solving and monitoring processes of gas fields exploitation and objects of gas extraction system under conditions of uncertainty are shown in[2]. Calculation algorithms have been given, the results obtained when working with fuzzy values are shown in real or hypothetical data. Fuzzy logic and by its potential application in solving petroleum engineering related problems are shown in[5-7]. The most successful applications of intelligent systems, especially when solving engineering problems, have been achieved by using different intelligent tools in concert and as a hybrid system. As is shown in[8], expert systems are artificial intelligence tools that store and implement experts' opinions, methods and rules to achieve accurate system results. As a preparation of an expert system, exploiting experts knowledge, analyzing oil wells data and reordering memberships of petroleum oilfields, and Fuzzy Petroleum Prediction (FPP) as an expert system has been designed.

In general, the analysis of accumulated studies has shown the ability to solve a number of problems in oilfield practice, in particular, problems of modeling, decision making, classification of objects, etc. using fuzzy set theory.

2. Formulation of the problem

To assess changes in the pump parameters it is invited to use the coefficient of flow and turnaround time according to the literature.

The coefficient of flow and turnaround time depends on many factors. In order to establish the impact of these factors, the analysis of information about the geological and technological characteristics of the operating conditions was performed, which showed the impossibility of building the statistical relationships because of its failure in this case. In recent years, methods of decision-making, taking into account uncertainty in the environment, found widespread. One of such kind of methods is fuzzy classification[3,4].

In[3] a description of fuzzy clustering algorithm has been given, its meaning, role and importance of fuzzification factor, which plays an important role, because it directly affects the shape of produced fuzzy clusters, have also been shown.

3. Results of the analysis.

As it known, the main problem with the wells in the complicated conditions is a deterioration in reliability indexes, that in turn affects the technical and economic indicators as a whole. Pumps work is influenced by numerous factors, such as geological, and also technical and technological.

Geological factors (gas, water, salt and wax deposits, mechanical impurities, etc.), first of all, characterize the reservoir conditions.

Another group of factors are factors associated with the design of the well or the pump (production casing diameters, hole curvature, pump components and spare parts, etc.). Naturally, all the factors can be separated into factors with a positive or negative effect on the pump performance. To date, a large number of studies on the deep-well pumps in complicated conditions have been accumulated. As practice shows, waterless period of well operation occupies a small part of the total period, and therefore the influence of water on the pump starts almost from the