

Fuzzy Multi-Criterial Choice of Geological and Technical Measures

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Abstract

The work solves the problem of automating the process planning of assigning geological and technical measures (GTM) at oil fields in conditions of uncertainty. A decision support system is being developed to help an expert make an informed decision about the method of influence of geological and technical measures on an oil reservoir. From the point of view of the imposed restrictions on the choice of geological and technical measures, various types of geological and physical parameters are highlighted. To solve this problem, a fuzzy-production model is proposed for the representation of expert knowledge. A feature of this model is the possibility of different types of parameters use to impose restrictions on the choice of geological and technical measures, using fuzzy restrictions and setting their weights, as well as formalizing the degree of an expert confidence in the reliability of the rule being formed. They provided the possibility of fuzzy modifier use in the conditions of fuzzy production rules for fuzzy constraint correction. To determine the weights of fuzzy constraints in the conditions of the rules, an approach is used based on a multi-criteria assessment of constraints, carried out using the hierarchy analysis method (HAM). The following were used as the criteria for evaluation the weights: the importance of the corresponding geological and physical parameter for an expert, the completeness of the available information on the studied parameter, the relevance of the values, the complexity of obtaining the values. The final choice of geological and technical measures is carried out on the basis of a fuzzy multi-criteria choice according to the following

criteria: satisfaction of the fuzzy production model limitations, high technological efficiency, high economic effect, and the impact on the environment. Based on the knowledge of experts, a knowledge base has been formed that includes fuzzy production rules for choosing 81 different geological and technical measures at production wells using the restrictions on 15 geological and physical parameters. The knowledge base has been tested at the wells of the Feofanovskoye field, Alkeevskaya, Chishminskaya areas. The development of recommendations was carried out in conditions of information incompleteness on a number of parameters of the set. The results generated by the decision support system correspond to the decisions made by the experts.

Keywords- Knowledge Base, Fuzzy Logic, Fuzzy Production Model, Geological And Technical Event, Hierarchy Analysis Method, Decision Support

I. INTRODUCTION

At present, the problem of oil field development efficiency increase [1-3], especially those at the late stage of their development [4], is becoming increasingly important. This stage is characterized by the presence of a large share of hard-to-recover oil reserves, and its extraction rate decrease [5, 6]. To stabilize the rate of oil withdrawal at the late stage, geological and technical measures (GTM) are often carried out [7, 8], the choice of which is carried out by the experts of oil and gas production departments (OGPD).

