

Monitoring of Carbonate Reservoir Development by Changing the Composition and Properties of Produced Crude Oil

Yulia Muratovna Ganeeva^{1,3}, Ludmila Victorovna Fedonina², Tatiana Nicolaevna Yusupova^{1,3}, Gennady Vasilevich Romanov^{1,3}, Vladimir Alekseevich Alfonsov¹

¹*A.E. Arbuzov Institute of Organic and Physical Chemistry, Kazan Scientific Center, Russian Academy of Sciences*

²*Kazan National Research Technological University*

³*Kazan (Volga region) Federal University, Kazan University, KFU. Institute of Geology and Oil & Gas Technologies*

Summary

The article is devoted to studying the influence of long-term injection of chelating acid-containing reagent in injection well on the carbonate reservoir recovery. The analysis of the composition and physico-chemical properties of the produced oil before and during injection of the acid-containing reagent was carried out. The time intervals of relative destabilization and stabilization of the composition and properties of the produced oil during injection of the chelating acid-containing reagent were identified. Changing the composition and properties of the produced oil in the dynamics of development of carbonate reservoir was explained from the point of view of pore space structure of carbonate rocks and features of distribution of reservoir oil in them.

Introduction

Nowadays, stabilization of oil production is possible due to the development of carbonate reservoirs. More than 60% of the world's oil reserves and 40% of gas is concentrated in carbonate sediments [1, 2]. Reserves of carbonate reservoirs for RT fields make up 35-40% of the proven oil reserves. However, the recoverable reserves of these deposits reach only 10-15%. This is due to low reservoir properties and high heterogeneity of carbonate reservoirs by composition and structural-textural features. In addition, in some cases, along with the geological heterogeneity of the carbonate reservoir the development of the deposits and well operation is complicated by high density and viscosity of reservoir oil. The main technology aimed at enhanced oil recovery from carbonate reservoirs is acid treatment of bottom-hole formation zone, which leads to the creation of new filter channels by means of rock dissolution. The aim of this work was to evaluate the impact of a prolonged injection of the acid composition in carbonate reservoir on the composition and properties of the produced oil.

Theory and/or Method

The paper presents the results of a comparative analysis of density, viscosity, and SARA composition of crude oil samples produced from six wells of the carbonate reservoir of Carboniferous deposits of the oil field of the Republic of Tatarstan (Russia) by water flooding before and under injection of the chelating acid-containing reagent in the injection well. The first injection of reagent was produced in August 2012. Prior to injection of the acid-containing reagent the oil samples were chosen periodically during six months, after the injection of acid-containing reagent - once a month for 1 year. To study the effect of the acid-containing reagent directly on the crude oil, 1, 3 and 5% solutions of the reagent in oil were prepared and their SARA composition and properties were examined and compared.

Examples

Prior to injection of chelating acid-containing reagent in carbonate reservoir produced oils were characterized by almost constant density, viscosity, and SARA composition in the dynamics of field development by water flooding. After the injection of the acid-containing reagent in the injection well the density and viscosity of oil samples as well as share of resin-asphaltene components in them increased periodically for the first six months. Then, in the next six months physico-chemical properties of crude oil and its SARA composition returned to initial values. Over one and a half year after injection of the reagent the stabilization of crude oil production was observed, whereas prior to the injection of this reagent the crude production was permanently decreased. No direct impact of an acid-containing reagent on the crude oil has been recorded. Earlier in the investigation of core material it was found that rock samples with higher reservoir properties contained the heavy oil fluid, and rock samples with poorer reservoir properties contained lighter oil fluid. Taking this into account the assumption was made that the used acid-containing reagent acts primarily on zones of reservoir rock with high porosity and permeability and that results in releasing the heavy oil. Next, the zones of reservoir rock with low reservoir properties are involved, from which the lighter oil is extracted.

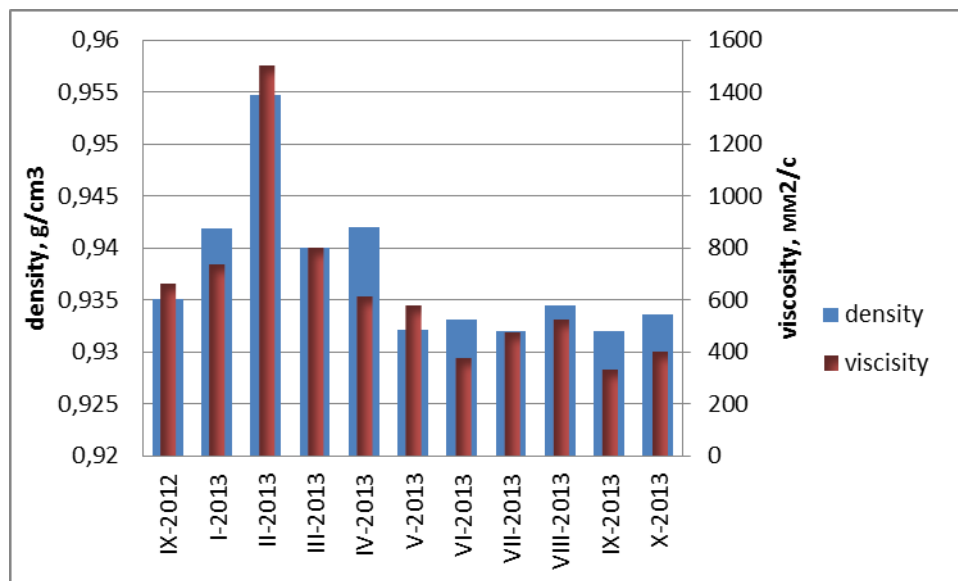


Figure 1. The density and viscosity of the produced oil collected from the same well of carbonate reservoir during one year by water flooding under injection of the chelating acid-containing reagent. The first injection of reagent was produced in August 2012.

Conclusions

The paper shows the possibility of determining the time intervals of exploitation of high-permeability zones (cavities, cracks) or low-permeability layers of carbonate reservoir in the resulting from chelating acid-containing reagent action on the basis of analysis of produced oil samples, taken off in the dynamics of development of carbonate reservoir. Received data may be used to design further elaboration of the carbonate reservoir with using the chelating acid-containing reagent or for carbonate reservoir simulation in total.

Acknowledgements

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

References

1. Mohan, K.; Gupta, R.; Mohanty, R.R. *Energy Fuels*. 2011. 25. 3966-3973.
2. Ravari, R.R.; Strand, S.; Austad, T. *Energy Fuels*. 2011. 25. 2083-2088.