

Development of Insulating Compositions for Watered Oil Wells to Improve the Environmental State of Oil Producing Regions

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Article Info

Page Number: 7766-7769

Publication Issue:

Vol. 71 No. 4 (2022)

Article History

Article Received: 25 March 2022

Revised: 30 April 2022

Accepted: 15 June 2022

Abstract

Background: The article discusses the current state of the oil industry in terms of environmental impact. The results of analyzes of the impact on the elements of the natural environment at various stages of the development of oil and gas facilities are presented.

The issues of formation waters produced with oil, their impact on the ecosystem as a whole are raised. The ecological aspects of selective isolation in oil wells are widely considered. Data on modern insulating reagents, their effectiveness, as well as ongoing research in our Republic on the creation of water-insulating compositions are given.

Keywords: waters oil, the ecosystem isolation reagents, water-insulating compositions

1. Introduction

It is known that the extraction of hydrocarbon raw materials is accompanied by enormous damage to the biosphere, although the negative processes accompanying this type of activity are not inevitable. The growth of hydrocarbon production is carried out through the development of new deposits, which significantly increases the environmental hazard of this production. According to estimates in the CIS countries, enterprises of the fuel and energy complex, including oil production and processing, despite the decline in production, remain the largest source of environmental pollutants in industry. They account for about 48% of emissions of harmful substances into the atmosphere, 27% of polluted wastewater discharges, over 30% of solid waste and up to 70% of total greenhouse gases. But, the most common and difficult to restore object, which is negatively affected by oil production, is the soil.

As we know, the process of environmental impact from the oil and gas sector begins at the stage of exploration, exploratory drilling. According to scientists, at present, approximately 4-5% of unallocated wells may turn out to be dangerous, and their number is constantly growing. Wells, even mothballed and liquidated in accordance with all the rules and regulations, pose a potential hazard to the environment.

Currently, due to imperfection or violation of production technology, oil, oil products and associated formation waters are priority environmental pollutants.

Formation waters produced with oil and forming a dispersed system with it contain, as a rule, a significant amount of soluble mineral salts. The peculiar salt and microelement composition of reservoir mineralized waters dramatically changes the state of ecosystems, leads to the degradation of biocenoses, and the rate of transformation of the soil complex is much higher

than during oil spills, and self-purification is slower. A noticeable loss of productivity of contaminated lands, and the rapid degradation of the landscape determine the need to study the processes that cause their transformation. Loss of soil fertility due to its salinization and schistosity, that is, saturation of the soil absorbing complex with exchangeable sodium, is the main cause of plant death due to such pollution [1].

Selective isolation of formation waters will make it possible to solve two problems at once - development problems, i.e. flooding of production wells and, accordingly, the problem of the release of formation waters produced together with hydrocarbons to the environment.

Currently, in Uzbekistan, at oil and gas producing wells, the technology of installing a cement bridge during well workover is used as the main method for eliminating formation water inflow into production horizons.

This technology has a number of disadvantages, for example, the cement slurry is practically not filtered into the bottomhole formation zone, and the cement hardening time is quite long, when interacting with formation water, the cement stone is of poor quality.

Having studied foreign methods and technologies, the authors set the task of creating composite compositions for the selective isolation of formation waters based on local raw materials, but at the same time not inferior to foreign analogues in terms of technological indicators.

L In connection with the foregoing, the authors carried out experimental work related to the search for formulations of such cementing materials that would have as little pressure as possible when they are forced into the bottomhole formation zone.

The following chemical reagents available in Uzbekistan were subjected to laboratory studies, which gave the expected results in other oil regions of Russia and abroad: oil-cement solutions, hydrochloric acid, oil, PSK polymer complex, clay powder, Navbakhor bentonite and Shorsu hydromicaceous clay, liquid glass, soda ash, sodium and calcium alkalis.

As a result of the experimental work, a special composite composition was developed for isolating water inflows in oil and gas wells - UzIZOL. This composition is prepared on the basis of local material - Navbakhor bentonite clay using polymeric structure formers, the composition of which is presented in table 1.

Polymer complexes PSK-1 and PSK-2 were prepared on the basis of carboxymethyl cellulose (CMC) with the addition of the hydrochloric acid polymer salt of dimethylaminoethyl methacrylate (PSDM) and the polymer salt of dimethylaminoethyl methacrylate with allyl ester of chloroacetic acid as the second polymer part [2, 3]. The ratio of CMC and polymer salt is in the range of 10:1.

Table 1

The main ingredients of the insulating solution

№	Component name	Component content, in %	
		lower limit	upper limit
1	soda ash	0,1	0,5
2	Polymer complex PSK-1	-	3,0
3	Polymer complex PSK-2	0,5	-
4	Oil density not more than	45	55

NAs a result of preliminary laboratory studies, the optimal composition of the insulating solution UzIZOL with the use of PSK, which was subjected to reaction with mineralized formation water and oil, was revealed. The test results are shown in table 2.

Table 2

Physico-chemical and technical characteristics of the insulating solution.

№	Name of the substance subjected to the reaction	Test results
1	Density, kg/m ³	1,10-1,16
2	Conditional viscosity, s	90-100
3	Water loss, cm ³ /30 min	2-3
4	pH	8-9
5	Color	brown
Interaction with reservoir fluids:		
1	Oil	n/a
2	Water	gel
3	Gas	n/a

Note: n/v. - does not interact with reservoir fluid; gel - gelation occurs.

2. Results

Based on the tests carried out, the UzIZOL solution, obtained on the basis of local raw materials using the PSK polymer complex, can be recommended for the selective isolation of formation waters in oil and gas wells.

It should be noted that for the developed new composition, the start time of the reaction with formation water is 20 minutes, this time is sufficient for injection of the insulating composition into the reservoir in full. At the same time, it is possible, depending on the geological parameters of the reservoir, as well as the technological parameters of the well, where water-proofing works are provided, it is possible to control the reaction time with formation water due to the concentration of the PSK polymer complex.

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