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Integrated Treatment Of Formation Waters Of Oil Deposits Of The Republic Of Bashkortostan

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Abstract: The objective of this paper is selection rationale in such trend of development of the regional economy as extraction of some components from formation waters of oil deposits such as (I, Br, Sr, etc.) and selection of the most appropriate extraction methods. In separate regions and Russia in general integrated utilization of subsurface waters with the specific mineral composition may play an important role in the successful development of economy [1]. Subsurface waters are produced during the process of development of hydrocarbon reservoirs together with oil being very valuable material resources given there is the specific procedure of treatment of these products. On the territory of the Republic of Bashkortostan development of oil deposits that have entered the final and late stage of exploitation is performed. Nearly the entire infrastructure of these facilities is designed for utilization of formation oil waters for extraction of valuable micro-components. To increase the oil recovery rate at the oil deposits water flood has been used for a long time as the result of which the fluid produced is heavily watered and concurrently with oil significant formation waters volumes are produced. Besides, at the deposits there are plenty of idle wells that can also be used for production of mineral waters with further production of valuable products.

Key words: formation waters, micro-elements, chemical analysis, treatment.

1. INTRODUCTION

Oil and formation waters are an integral part of the natural system. By oil production the formation waters at deposits are used for formation-pressure maintenance in the systems or for production of agents and muds for the secondary oil recovery effect [2].

In separate regions and Russia in general integrated utilization of subsurface waters with the specific mineral composition may play an important role in the successful development of economy. Subsurface waters are produced during the process of development of hydrocarbon reservoirs together with oil being very valuable material resources given there is the specific procedure of treatment of these products. On the territory of the Republic of Bashkortostan development of oil deposits that have entered the final and late stage of exploitation is performed. Nearly the entire infrastructure of these facilities is designed for utilization of formation oil waters for extraction of valuable micro-components. To increase the oil recovery rate at the oil deposits water flood has been used for a long time as the result of which the fluid produced is heavily watered and

concurrently with oil significant formation waters volumes are produced. Besides, at the deposits there are plenty of idle wells that can also be used for production of mineral waters with further production of valuable products.

On the oil deposits subsurface waters contain concentrations of bromine, iodine, lithium, magnesium and boron. In these elements huge potential resources are contained – the annual volume of formation waters that are produced concurrently with oil in Russia makes 800 billion m^3, small amount of ore reserves, short supply of these elements and nearly inexhaustible content in formation waters make works on development of engineering solutions and design of technical means for treatment of the hydro mineral raw material especially topical. The subsurface industrial waters may serve as the new source of the mineral raw material. Thus, in a number of cases they are able to substitute traditional kinds of raw materials [3].

2. CONTENT OF MICRO-ELEMENTS AT DEPOSITS

According to the water sampling performed by ЦНИПР we conducted analysis of formation waters in terms of content of valuable micro-elements at the Ardatov deposit.

In many wells heavy water inflows in the form of absorption of flushing water have been observed. According to the chemical analysis of water of the medium-mineralized Serpukhovian (142-148 g/l) of calcium-chloride kind, the water density makes 1,130-1,144 g/cm3. Withdrawal of water from the water-bearing deposits of the Serpukhovian is performed for water injection in the aquifer of productive oil-beating strata.

At the Tournai stage of culm measure the water composition was analyzed by 14 samples. The average mineralization values made 174 g/l with density of 1,132 g/cm^3. In water bromine is found in concentrations that exceed the standard value as well as lithium, strontium, rubidium and boron in weak concentrations. Time correlation of water quality parameters of waters produced from the Devonian shale has been performed, the effect of salinity on binding of Cd, Cr, Cu and Zn to dissolved organic matter has been investigated, according to the literature data [4-6].

The salt concentration is very high and reaches 403 g/l, bromine content reaches up to 790 mg/l. The content of lithium - 11,0-12,0 mg/l, strontium 106-109 mg/l exceeds the standard value. Iodine content in some wells reaches 102 mg/l. Formation water production rate makes 18 m^3/day [7].

Table 1- Micro-elements content in the Ardatov deposit

Deposits age, number of wells / number of assays	Rare elements, mg/l					
	Barium Ba	Boron B (250)*	Lithium, Li (10)*	Iodine J	Rubidiumй Rb	Strontium Sr
The Famennian, 1/1	492,7	790	12	102	0,15	109

Figures of micro-elements content in other deposits are presented in the Tables 2 and 3

Table 2 - Micro-elements content in the Elizovetinsky deposit

Deposits age, number of wells / number of assays	Commercial components, mg/dm^3			
	Bromine Br (200)*	Iodine J (10)*	Boron trioxide B_2O_3 (250)*	NH4
Serpukhovian, 1/1	895,1	1,52	167,14	79,2
Tournai stage, ¾	492,7	6,73	156,69	176,4
The Famennian Stage Zavolzhsky superhorizon, 1/1	1030,9	5,71	118,39	126

Mid-Famennian sub-stage, 1/1	378,3	-	83,6	115,2
The Frasnian Kynovian horizon 2/3	717,4	2,26	42,76	100,81

Table 3 – Rare elements content in the Elizovetinsky deposit

Deposits age, number of wells / number of assays	Rare elements, mg/dm3					
	Barium Ba	Boron B(250)*	Lithium Li (10)*	Cesium Cs (0,5)*	Rubidium Rb (3,0)*	Strontium Sr(300)*
Tournai stage, 2/2	492,7	6,73	6,85	0,30	0,15	236,50
The Frasnian Kynovian horizon 2/3	717,4	2,26	7,70	0,30	0,19	331,50

Table 4 - Commercial micro-elements of the Petropavlovsk oil deposit

Deposits age, number of wells / number of assays	Commercial components, mg/dm^3			
	Bromine Br	Iodine J	Boron B	Total salt content
Serpukhovian	272	4,00	313	201
Podolskian	-	4,00	-	86,0

The inflows rates make 103-360 m^3/day.

What shall be noted is the list of extracted components for formation water treatment by development, the sequence of extraction and selection of the extraction method, i.e. it is needed to design an integrated flow chart of treatment of formation waters of oil deposits. The simplicity and reliability of stages is a necessary criterion of practical implementation of the integrated flow chart; economic efficiency; raw materials availability; use of standard equipment; output of high-quality commercial products [7].

3. MICRO-ELEMENT ESTIMATES BY VOLUMES OF FORMATION WATER PRODUCTION:

The inflow of formation water at the Ardatov deposit makes 18 m^3/day.

1) 102×18000:1000000=1.836 × 80%= 1.468 kg of iodine can be produced daily, within a year 547.5 of iodine, 2600 kg of barium, 4152 kg of boron, 573 kg of strontium, 78 of lithium, 1 of rubidium can be produced.

The rate of production of formation water in the Petropavlovsk deposit makes 103-360 m^3/day, thus, within a year 7942 kg of bromine, 146 kg of iodine and 9139 kg of boron can be produced.

4. FORMATION WATERS TREATMENT METHODS

In the oil and gas industry the most widely used method is the simplest and cheapest one - — tank bottom settling. Other treatment methods are also used: mechanical, physico-chemical and biological. By the example of the oil-and-gas deposits of the Carpathian region. Significant iodine content in the formation waters of the Carpathian Through (over 50 mg/l) speaks of the necessity of recovery of formation waters from these deposits by means of improvement of the collection and treatment systems. One of the methods of improvement of such systems is use of plants for iodine recovery from water. Thus, formation waters represent highly-mineralized brines with mineralization 840–900 mg-eq/100 g [8, 9].

5. CONCLUSIONS

On the basis of the data above the conclusion may be drawn that high concentrations of these elements in formation waters allow referring these deposits to the hydro mineral raw materials and demonstrate the possibility of integrated recovery of these elements from formation waters.

This trend is promising for Bashkiria and the output products will be demanded.

6. SUMMARY

A new branch of industry can be created due to component deposit in waters and the use of the already existing infrastructure of the oil production industry allows solving this issue quite quickly and with relatively small capital expenditures.

CONFLICT OF INTERESTS

The author confirms that the data provided does not contain the conflict of interests.

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