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Studying the problems of preventing pollution of oil-field waters located on the Absheron Peninsula

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Abstract
The paper is devoted to the study of the problems of preventing oil-field water pollution located on the Absheron Peninsula. The wastewater of the Absheron oil field mainly consists of formation water, which is a multicomponent chemically complex, polydisperse and unstable, high oil-containing and mechanical mixed system. The choice of one or another method of wastewater treatment is determined by the requirements for the content of purified water in a particular field.

Keywords: oily water, pollution, purification

Introduction

In the oil fields of Azerbaijan, mainly sea water is used as technical water, which belongs to the type of hard water, which is characterized by a high content of sulfates.
The amount of oil products in oil field wastewater is in the range of 0.5-20 g/l, and the amount of suspended solids varies widely. The composition of mechanical mixtures consists of various minerals, quartz sand, clay, particles of metal oxides, and etc. It is known that the spread of pollutants in water has a great influence on the choice of methods for treating oily waters and on the efficiency of treatment facilities. This physical state mainly depends on the method of exploitation of the field, the technological scheme for collecting and preparing well products for transport, the cooling system, etc. /1/
As we know, the composition of oil-field waters is very diverse. These waters are very important for obtaining certain chemicals. In this sense, oil field waters located in Absheron are no exception.
The selection of methods of oil mining wastewater treatment mainly depends on their characteristics and the spread of pollutants in water. Taking into account the diversity of Absheron's oil field waters, the waters of the Binagadi Oil and Gas Extraction Department are of greater interest as a research object for the development of complex processing technology. First of all, this is explained by the fact that thermal processing of underground layers is carried out in the Department.
On the other hand, this Department is close to the industrial zone of Absheron. The ionic composition of the waters of the Binagadi Oil and Gas Extraction Department is given in table 1 /2/.

Table 1: Ionic composition of oil-field waters of Binagadi Oil and Gas Extraction Department

№	Wells №	Water salinity g/l	Equivalence					
			$Ca2+$	$Mg2+$	Na^{+}	Cl^{-}	$SO_4 2-$	HCO_3^{-}
1	2252	13,03	0,3	0,41	99,27	92,58	0,93	7,7
2	737	7,25	1,33	1,67	97,06	90,11	0,11	10,53
3	2040	14,92	0,3	1,26	98,64	92,1	1,6	6,2
4	2053	16,6	0,33	0,71	98,96	94,52	1,73	3,47
5	457	13,69	1,09	1,0	98,00	49,09	0,47	54,90
6	1907	8,28	2,0	1,82	96,15	92,09	0,06	7,2
7	2093	5,29	0,26	2,1	97,7	68,97	0,06	31,36
8	1772	2,75	0,8	1,33	97,4	46,92	0,08	53,33
9	1033	14,76	0,34	0,97	98,87	93,9	16,9	4,82
10	586	3,09	0,4	0,83	98,83	53,28	3,0	43,6
11	1154	2,4	2,27	2,11	95,67	64,05	5,08	31,07
12	1169	2,02	2,0	1,5	97,0	33,87	1,4	65,00

It is known that the extraction of oil and gas resources is always observed with water. In oil fields, water can be in the same layer as oil or in separate layers. Sometimes water is located in fertile layers.
In the oil fields of Azerbaijan Republic, commonly sea water is used as technical water, and it belongs to the type of hard waters distinguished by a high amount of sulfate.
The amount of petroleum products in mining wastewater varies in the range of 0.5-20 g/l. The amount of petroleum products in mining wastewater varies in the range of 0.5–20 g/l. The presence of various salts and valuable components in the oil mine water led to the discovery of these waters as a source of mineral raw materials. Iodine, bromine, and lithium are among the valuable components.
Iodine concentration in oil water ranges from 1-100 mg/l, depending on a number of variables, according to several research done in these locations. /3/
The main salt component of petroleum waters is table salt. Therefore, the purchase of this salt on an industrial scale from those waters is of great interest. It is important to note that the technology of extracting salts from oil-field water is

very similar to the technology of wastewater treatment at chemical water treatment plants in industrial enterprises.

In most cases, the composition of wastewater is explained by the $NaCl$-$CaCl_2$-$MgCl_2$-H_2O system. These processing technologies are carried out according to the scheme given in Figure 1.

As can be seen, the water treated according to the first scheme (a) undergoes a two-stage thickening. The total mineralization of water increases to about 150–200 g/l at the initial stage of thickening. At the second stage of thickening, the mineralization of the treated solution is adjusted to 400–450 g/l. As a result, most of the NaCl crystals are destroyed. The resulting NaCl suspension is centrifuged, and the crystals are separated from the solution. Thus, only one is separated from the three-component system, and the remaining components ($CaCl_2$, $MgCl_2$) are discarded as unnecessary. According to the second scheme (b), after the initial stage of thickening, $Mg(OH)_2$ is precipitated by liming the solution. At the last stage, NaCl is obtained due to deep thickening, as in the first scheme.

According to the third scheme (c), after the initial stage of thickening, the solution is sodaized and $CaCO_3$ is obtained. At the last stage, NaCl crystals are obtained from the $MgCl_2$ solution. As it can be seen from the analysis, the main disadvantage of these technological schemes is that no measures are taken to prevent encrustation, and only the thermal method was used in the initial thickening stage. Despite the fact that many studies have been conducted on the complex processing of Caspian Sea water, the problem remains unsolved. The main reason for this is the complexity of the problem.

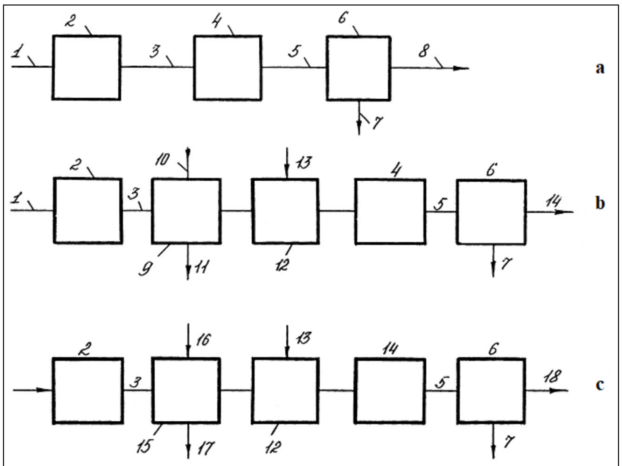

Fig 1: Proposed functional schemes for complex processing of $NaCl – CaCl_2 – MgCl_2 – H_2O$ system

a. processing without reagent; b) liming method; c) sodaization method

1 – treated water; 2 – concentration; 3 – concentrate; 4 – crystallization of NaCl; 5 – suspension of NaCl; 6 – separation of NaCl from the solution; 7 – crystals of NaCl; 8 – residual $CaCl_2$ + $MgCl_2$ solution; 9 – Mg precipitation; 10 – $Ca(OH)_2$; 11 – $Mg(OH)_2$; 12 – neutralization; 13 – HCl; 14 – $CaCl_2$ solution; 15 – Ca precipitation; 16 – Na_2CO_3; 17 – $CaCO_3$; 18 – $MgCl_2$ solution.

The research consists of simplification of basic technologies and reduction of costs. Taking this into account, the issue of obtaining pure sodium salts during the complex processing of sea water was accepted. A complex processing technology has been developed to purify acidified sea water from sulfate ions by the Cl anionization method /4/.

First, after thickening the residual solution with sea water, it is purified from sulfate ions on an anion-exchange filter, and sulfated water is sweetened in a reverse osmosis apparatus. At the outlet of the device, a thickened concentrate is taken together with sweetened water. The concentration of that solution goes up to 400–500 mg/l. As a result, in the $NaCl$-$CaCl_2$-$MgCl_2$-H_2O system, NaCl salts with lower solubility crystallize and separate from the solution.

$Mg(OH)_2$ is precipitated by liming the residual solution. Gypsum is obtained by mixing the residual solution with the processed regeneration solution of the anionite filter. First, a part of the $CaCl_2$ solution is removed. With this, the balance of $Ca+Mg=SO_4$ is added. /5/ From the results of the research conducted, it is known that during the simplification of the technology, substances are mixed. In industry, this mixture can be divided into separate components.

The Cl-anionization process, as in all ion exchange processes, has two technological indicators: the working exchange capacity of the anionite and the residual concentrations of sulfate ions. These parameters of the sulfation process are considered the output function: pH of the water, its filtering speed, regeneration, concentration of the solution, height of the anionite layer, and brand of anionite.

The physical model of the Cl-anionite filter is the main element of the device. It consists of a glass tube filled with anionite. The height of the anionite layer is 72 cm, and the volume is 360 cm. Both a straight and a reverse flow were used to complete the process. The study used a seawater solution consisted of following components (mg/l): NaCl (140 mg/l), Na_2SO_4 (70 mg/l), and $NaHCO_3$ (4 mg/l).

Thus, we can say that the water processed by this method can be used in the water supply system in the oil refining, petrochemical, and oil extraction industries.

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