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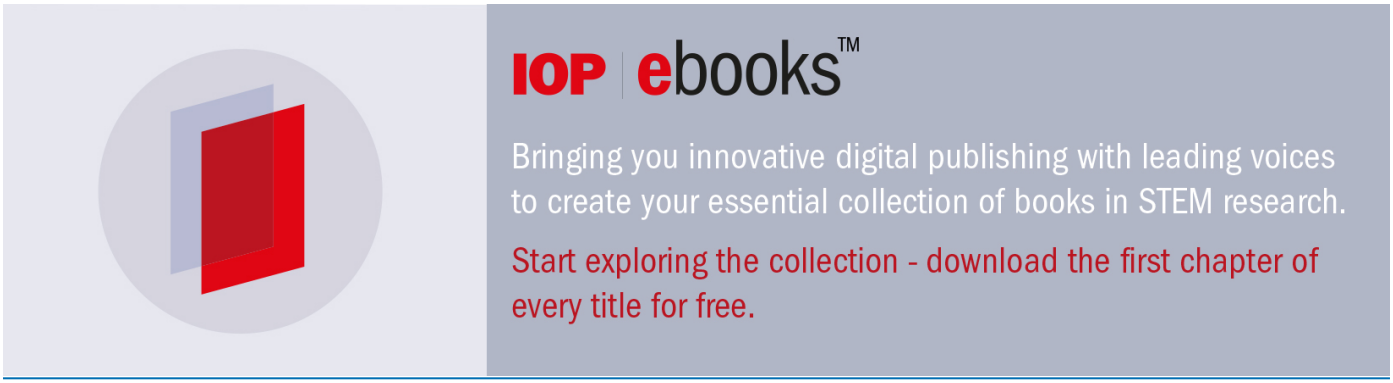

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Methods of separation of stable oil-water emulsions into phases and their application at production sites

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Abstract. In this paper, the problem of accumulation and disposal of oil sludge, which includes a stable water-oil emulsion, is touched upon, existing processing methods are studied from the point of view of dividing it into separate components. The classification of physical separation methods, including gravitational sedimentation, separation using centrifugal forces, extraction is given; chemical and combined. It is proposed to use the technology of processing the intermediate layer with a chemical reagent such as SNPCH-4802 with an aromatic solvent. This physico-chemical method for processing tank sludge is to add demulsifier reagents to the emulsion, followed by stirring, heating and separation from water and dirt.

Currently, all the oil sludge is accumulated at oil fields, and then disposed of by incineration in specialized installations. In turn, tank oil sludge includes a stable water-oil emulsion, which can be separated for further oil and water use. This is a more environmentally friendly method for processing and disposing of oil sludge waste. Therefore, it becomes relevant to study and develop possible methods of persistent water-oil emulsions destruction that will allow more efficient use of tank waste and reduce the total amount of oil sludge burned [1].

Taking into account all the variety of different oil wastes characteristics all oil sludge can be divided into three main groups in accordance with their formation conditions, namely groundwater, near-bottom and tank sludge types.

The first ones are formed as a result of petroleum products spills into the soil during production operations, or in emergency situations. Near-bottom sludge is formed when oil settles at the bottom of water bodies, and tank type sludge is deposited during oil products storage and transportation in tanks of different designs [2].

In its simplest form, oil sludge is a multicomponent stable aggregative physicochemical systems consisting mainly of oil products, water, and mineral additives (sand, clay, metal oxides, etc.).

A review of scientific and technical literature on available methods and technical solutions for the preparation of oil traps showed that in foreign and domestic practice, some experience has been accumulated in the destruction of oil waste, but there are no materials for the formation and destruction of stable water-oil emulsions at oil pumping stations.

The main methods published in the literature over the past two decades include the following:

- physical
- chemical;

- a combined method involving the recycling of partially dehydrated oil waste to the oil treatment installation.

Since water-oil emulsions of the intermediate layer are part of tank-type sludges, it is advisable to study the existing methods of processing oil sludge from the point of view of dividing it into separate components. [3]

A) Physical methods are divided into:

1) Gravitational upholding.

As settlers periodic actions usually used cylindrical septic – tanks (settling tanks). Crude oil subjected to dehydration is injected into the tank by means of a distribution pipeline (masterbatch). Oil is kept in the tank for a certain time (48 hours or more). In the process of aging, a connection of water drops is formed. Larger and heavier drops of water under the influence of gravity (gravity) settle to the bottom and accumulate in the form of a layer of bottom water. The oil is then collected at the top of the tank. Settling is carried out at a calm (stationary) state of the processed oil (figure. 1).

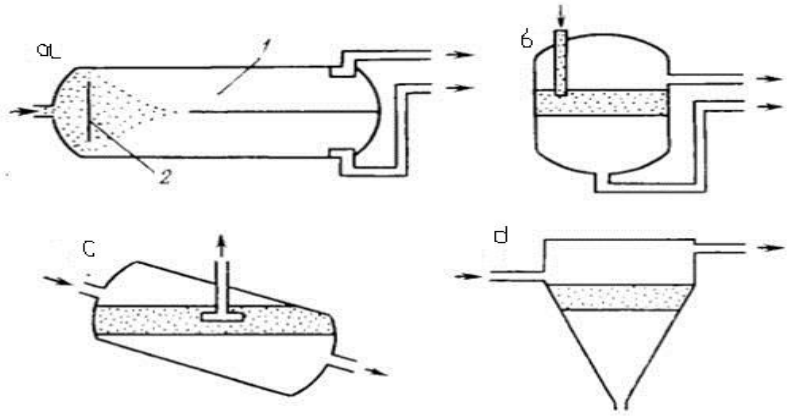

Figure 1. Continuous settling tanks: a – horizontal; b – vertical; c – inclined; d – conical; 1 – partition surface; 2 – partition.

The disadvantages of the method include its low efficiency, limitations on the raw materials used and the duration of the process. It should be noted that with long-term sludge, even in the presence of demulsifiers, as a rule, the upper layer of dried oil and the lower, compacted layer of highly watered emulsion appear. Removing the bottom layer creates new problems.

2) Separation using centrifugal forces.

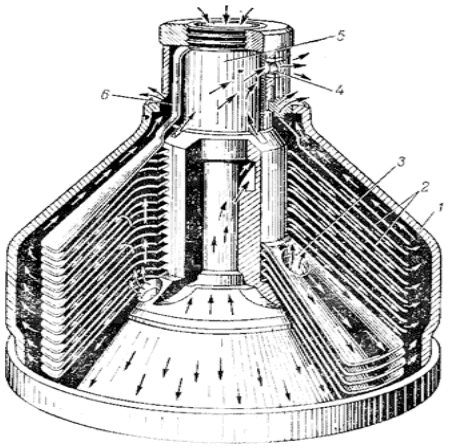

Figure 2. Separator: 1- drum; 2- conical plate; 3- the holes in the plates; 4- liquid supply pipe; 5- channel for leaving heavy liquid.

In the literature there is a lot of information about the use of centrifuges for the separation of trap oils. The technology is based on the use of oil centrifuges of special design, which produce high gravitational force. In order to achieve the greatest effect, two-stage centrifugation is used: the first stage is a horizontal screw centrifuge, the second is a disc centrifuge.

This method is considered the most effective, but it does not guarantee the completeness of separation of petroleum products from the formed sedimentk and wastewater. Also, the necessary equipment is quite expensive and requires high energy costs to maintain the process, which is not economically feasible. Due to the above disadvantages, the centrifuging method is not widely used.

3) Extraction (use of solvents).

Extraction is used to extract the oil component from the mixture, based on the selective solubility of petroleum products in organic solvents. Solvents must be fully and fairly simply regenerated, with low energy consumption.

The essence of this method is to reduce the viscosity of slop oil, which leads to a decrease in the stability of the emulsion and a better separation of it into water, mechanical impurities and organic parts. Old sludge, having in its composition a high content of paraffins, asphaltenes and resins, have a low dissolving ability in polar solvents, therefore this method is ineffective with respect oil wastes.

B) Chemical methods for the destruction of slop oil.

The use of chemical reagents is the main component of any method for the separation of persistent oil-water emulsions.

The main role in the preparation of slop oil is played by demulsifier reagents. The analysis of demulsifier reagents used in the preparation of slop oil, as well as laboratory studies and field practice suggest that one of the ways to solve the problems of preparation of slop oil is using wetting agents, detergents or their mixtures that have better wetting properties. and washing abilities.

The insufficient amount of the demulsifier in the oil emulsion is the cause of the incomplete destruction of the reserving shells of water globules and an increase in the aggregate and kinetic stability of the emulsion. On the other hand, when the concentration of the demulsifier in the oil emulsion is higher than optimal, the formation and increase in the number of associates occurs, leading to an increase in the stability of the emulsion.

C) Combined methods

The above methods are used in various specific conditions depending on the properties of slop oil. In the presence of highly stable "old" slop oil to improve the efficiency and reliability of their dehydration processes should be used more complex combined methods.

Since it is not always possible to achieve a one-stage process in the processing of slop oil, complex processing schemes are used. Often, only mechanical or physico-chemical methods can not give an effective separation, while there is a pattern: the longer the slop oil is stored, the higher its stability. And in such cases, complex processing schemes are usually used, including settling, flotation, degassing, drying, treatment with coagulants and flocculants, compaction, separation, electromagnetic and electrostatic effects. [4-6].

As a result of the above, it can be concluded that the modern technological scheme of the oil preparation process should take into account the properties of the intermediate layers and ensure that certain conditions are met:

1) The use of screw pumps in the process of pumping oil helps to avoid "hard" mechanical effects on the emulsion.

"Hard" action - this is a mechanical effect, which is accompanied by a high shear rate of the liquid phase. It contributes to the dispersion of droplets and increase the stability of the intermediate layer.

A “soft” action is a mechanical effect that is accompanied by a low shear rate of the liquid phase. This effect, on the contrary, contributes to the strengthening of water droplets.

2) The use of thermochemical methods for the separation of water and oil.

3) The use of washing intermediate layers, stabilized by mechanical impurities, and surfactants, and technical detergents.

4) The use of ultrasound and other methods for enlarging water droplets. This contributes to the reduction of viscosity and centrifugation time, which reduces the cost of product preparation. [7].

But these are just some of the elements possessed by technological the processes of preparation and pumping of oil, in order to reduce the negative factors of the presence of a stable intermediate layer on the work of the oil treatment unit.

At the present time, at the production sites, the intermediate layer is pumped out and utilized as part of cistern-type sludge, as a rule, contracting organization using the combustion method in specialized installations. Therefore, the issue of processing the intermediate layer more environmentally friendly methods to reduce the total amount of waste in the form of sludge.

As a result of the separation of a stable water-oil emulsion intermediate layer, it is possible to obtain conditioned oil, which can be sent to the end of the oil preparation process and compounded with the general flow, and the separated water can be sent to the after-treatment and production process.

The most successful methods for separating water-oil emulsions are methods for processing the intermediate layer with a specially selected demulsifier.

Currently, the technology of processing the intermediate layer with a chemical reagent such as SNPCH-4802 together with an aromatic solvent is effective.

Reagent SNPH-4802 is designed for processing oil sludge, persistent trap water-oil emulsions. SNPH-4802 is a mixture of non-ionic and anionic surfactants in aqueous-alcoholic solutions. It is a water soluble reagent. Does not contain organochlorine compounds. [8].

The physico-chemical method of processing tank sludge is to add demulsifier reagents to the emulsion followed by mixing, heating and deposition from water and dirt. All the necessary equipment for this purpose is a settling tank, a small reagent tank, a mixing device, a steam heating coil, a metering device, a booster pump and a pipeline.

On oil treatment plants there should be separate storage tanks, where the intermediate layers from all devices are dumped.

The procedure for technological operations for the effective destruction and dehydration of the intermediate layer is as follows:

- pumping the intermediate layer into a special accumulative capacity;
- mixing interlayer in RVS using the device "Typhoon" for 14 hours before the start of treatment;
- temperature of the process - 30 ° C;
- treatment of the layer with the reagent SNPCH-4802 with an aromatic solvent and a solution of 5% surfactant, in a ratio of 5: 1, respectively;
- mixing the interlayer with the reagent SNPCH-4802 using the “Typhoon” device for 2-4 hours;
- sedimentation after processing with reagent SNPCH-4802 for 20 hours.
- pumping oil to the end of the process of oil preparation and compounding with the general flow, pumping out water to the treatment plants.

As a result of settling, up to 25% of commercial oil is obtained, with a water content of up to 0.24%, a secondary layer 32%, and water up to 43%.

The secondary layercan be further processed with SNPCH-4802 for separation into phases.

The use of this method of processing the intermediate layer, which is part of the tank type, allows to reduce the environmental burden on the environment, thereby reducing the amount oil sludge and the cost of their disposal.

Oil refineries should carry out their production activities taking into account the balance of environmental and economic interests. Therefore, the issue of reducing the amount of waste in the form of oil sludge should be given special attention as part of measures to improve environmental performance.

Today, the problems associated with the intermediate layers are not fully resolved and require additional research and development of methods that will fully separate the oil-water emulsion, with a high indicator of water and oil quality.

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