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WAYS OF RATIONAL USE OF WATER RESOURCES IN THE OIL INDUSTRY

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ABSTRACT

This article talks about promising ways of development of petrochemical and oil refining industry and efficient use of water resources. Water affects most segments of the petroleum industry, and therefore efficient water management plays a key role in oil and gas exploitation. In most process industries, water is vital to many operations and is used for a variety of purposes such as product preparation, cooling, high purity water makeup water systems, general plant service water, waste handling/conveyance, potable/sanitary service, and fire protection, The water to be managed is produced together with hydrocarbons, formed as a by-product during oil and gas processing. Water has been identified as one of the top four challenges facing the exploitation of one of the largest crude oil fields (oil sands extraction). Large volumes stored in tailings ponds from oil-sand separation must be managed with a long-term view, as dike failure can cause a major environmental disaster.

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Introduction.

Effective use and protection of the environment, especially water resources, as well as natural resources obtained as a result of minerals, occupy an important place in complex measures. Oil refineries are the largest consumers of fuel and energy resources, including furnace fuel, heat and electricity. The rationality of their use in the oil refining process is mainly determined by the efficiency of the plant's technological equipment. The oil industry is a potentially dangerous industry for the environment. It affects the subsoil, soil and vegetation, atmospheric air, surface and underground water at practically all stages of oil field development. In many cases, especially during the development of large fields, the landscape and ecosystems change, adversely affecting the animal world and, ultimately, the health of both workers working in oil production facilities and the population of nearby settlements.

During the processes of gathering and preparing oil, gas and water in the fields, formation waters are contaminated with various chemical substances, mixed with various wastes (bottom water, water flowing from the area, etc.), highly mineralized waste, containing suspended particles of various composition and origin, emulsified and dissolved oil, hydrogen sulfide, various chemicals, primarily surfactants, are characterized by high corrosion. The natural gas and oil industry uses water in many ways.

- In oil sands mining, hot water is used to separate bitumen from sand and clay.

- In oil sands in situ operations, steam is generated to heat the bitumen underground, allowing it to flow to the surface.
- In older, conventional fields involving enhanced oil recovery, water is pumped down the well to force the oil out of cracks and pores in the rock so the oil can be pumped to the surface.
- In hydraulic fracturing, water is pumped at high pressure into tight formations to open fractures in the rock, allowing natural gas and crude oil to flow to a well for recovery.
- Once a well is producing, water may be used for dust control or for washing equipment.
- Water is also used for construction purposes such as freezing winter roads.

Water used in oil fields can be broadly divided into two groups: natural water and waste water. Rivers, lakes, coastal waters, groundwater and aquifers are the main source of natural water. Important issues related to natural water include the availability, availability, and pumping capacity of water. Wastewater is generated during drilling, completion and extraction of hydrocarbons from underground reservoirs. The generation, quality, quantity, sustainability and composition of wastewater is one of the important issues. The objective control system of pollutant emissions and discharges in the industry is not sufficiently formed. One of the main environmental risk factors for public health in petrochemical and oil refining processes is the discharge of waste water into seas, lakes and rivers [1]. Formation water is the largest waste stream generated in the oil and gas industry. Formation waters consist of a mixture of various organic and inorganic compounds. Use of recycled water in industry, it is very common in developed countries many industries, since it does not need drinking water quality reclaimed water is ideal industrial wastewater in-plant recycling, usually part of the process. It is implemented as a part [2].

In industry reclaimed water, cooling towers, ash irrigation, dilution of radioactive waste, flue gas scrubbing, such as oil refineries, metal plants and boilers can be used in processes. The physico-chemical properties of oil and water have a great influence on the efficient processing of the formation and the oil yield coefficient. Certain it was found that the main indicator in the effect of water on oil production is its is the ability to wash oil from rock. The ability of water to wash away oil depends on the surface tension at the nert-water boundary. Surface tension and the price depends on the physical and chemical properties of both oil and water it depends. For example, at the boundary between hard water and sea water for most oils surface tension is always greater than that of petroleum-alkaline water. The degree of activity of oil also has an effect on oil yield. For example, with sea water and alkaline water of low activity oil soil yield to compression, compared to oil with high activity (3÷4) % is high. Adsorption in rocks when oil is displaced by alkaline water organic acids are saponified and eventually from the rock grains the oil layer is separated, the water enriched with salts of organic acids in the rock wet with as a result, water enters the small channels of the porous medium entering and displacing the oil from there, which increases the oil yield coefficient increases. Active oil containing calcium and magnesium salts and compression by seawater or hard water is another mechanism stutter. So, oil and seawater containing organic acids and or water-insoluble calcium from contact with hard water and magnesium soap is formed. Large surface on the border with oil hard water or seawater that has tension into small pores unable to enter and moving through large permeability channels increases compression speed. As a result, quickly the amount of water in the production increases, the formation becomes watery and the oil yield decreases. Calcium and magnesium salts in contact of oil with hard water formation deposition due to formation oil by hydrophobizing the rock surface reduces conductivity. Cooling waters alone constitutes the largest industrial water demand and many most common recycled water for industry is the method of use [3]. However, as a coolant in case of using recycled wastewater; corrosion, precipitation and microbial growth attention should be paid. This situation, which is foreseen and obvious, will help existing water resources and create new emphasizes the importance of methods and practices. Treatment and reuse of wastewater use is at the forefront of these applications and the need to increase in the future increases in parallel with the rates. In particular, the industry and population. The lack of sufficient water in the cities where the challenges, rapid increases in water and wastewater charges, wastewater reuse brought the issue to the fore. Recycling of wastewater the benefits are listed below:

- Allows use as a sustainable alternative water source.
- It is a reliable source of water under control.
- It causes less energy consumption.
- It causes less consumption of new water resources.

- Recovery of treated wastewater, surface waters with wastewater discharges reduces the deterioration of quality.
- Purification and water supply by classifying the waters according to their usage purposes leads to lower costs.

Drinking water in all boilers and the hardness of the treated wastewater is close to zero. Is desired to be. In boilers; calcium, aluminum; because magnesium and silicon precipitate purification are desired [4].

Due to the increase of waste in the world in the current decade, the consequences and effects of groundwater discharge into the environment have recently become an important issue of environmental concern. The most rational way to solve the problem of formation water disposal is to use it in the formation pressure maintenance system of oil fields, which is used to maintain formation pressure. In the natural state of oil field development, most floods regimes are encountered. In this mode, also pressure in layers artificial speed is created in cases of storage and restoration. In the waterflooding mode, oil is either external or with water injected into the formation is pressed to the bottom of the well. Oily part watery part in compression process is replaced by However, it has been proven that water completely displaces oil doesn't know the viscosity of oil is greater than the viscosity of water and porous water in the compression process due to the inhomogeneity of the medium particles enter the oil field unevenly. Of this as a result, the degree of saturation of the porous medium with oil and water behind the oil-water boundary and the effective permeability due to oil-water are continuous. changes to When the water saturation coefficient reaches the value of (50-60%) the amount of water in the liquid mixture increases. In this case, oil with water cannot be compressed; it only by joining the water flow to the well delivered. So, with several different oils and water throughout the formation saturation zones are formed. Water can be used as a drilling solution in cases where its shortcomings do not adversely affect the progress of drilling. However, water as a drilling solution also has its advantages:

- water cools the ax and rotating parts of the drilling tool better than other drilling solutions;
- if a high velocity is created in the annular space, it can completely remove the excavated rock particles from under the working surface of the ax and keep the wellbore clean;
- if the hydrostatic pressure created by the water is higher than the formation pressure, it can prevent oil, gas and water from entering the well from the formation;
- since water cannot retain excavated rock particles, it is very easy to clean it from rock particles, and for this purpose, the simplest cleaning methods can be used;
- water reduces the intensity of abrasive wear of pistons, cylinder grooves, pump valves and parts of the turbine excavator;
- since water has a small specific gravity compared to the drilling solution, the pump for its circulation works under a relatively low load;
- the technical and economic indicators of drilling with water are higher than the indicators of drilling with drilling solution;
- in drilling with water, the working conditions of the members of the drilling team improve, as there is no need to prepare the drilling solution and the workers are freed from additional physical work;
- there is no need for clay and chemical reagents in drilling with water, no additional physical strength and material resources are spent on their transportation and preparation;
- in drilling with water, the possibility of the drilling tool moving and getting stuck is reduced.

However, water is not a universal drilling fluid and it has many disadvantages that prevent drilling with water. So, when water comes into contact with some mountain rocks (clays, argillites), it changes their mechanical properties, as a result, the rocks lose their stability, their tendency to flow increases and they are pushed into the well.

- Water not only cannot prevent this situation, on the contrary, it helps this type of complication to happen quickly;
- because water cannot form a strong and thin clay crust on the well wall, it cannot protect the well wall from being blown off and prevent the formation from percolating;
- because water has a high fluidity property, it easily soaks into the small pores of the rock, which is unpleasant and reduces the oil yield of the reservoir;
- water can be absorbed very quickly in rocks with high porosity and cracks, especially in rocks with very low formation pressure, which, in turn, has a negative effect on the cleaning of the bottom of the well and wellbore, significantly increasing the cost of water used [5].

Produced waters are considered to be oilfield wasted in vain or a commodity, groundwater management has a cost. Three-level pollution prevention hierarchy for groundwater management followed by:

1. Application of technologies for minimizing formation water production,
2. Reuse and recycling,
3. If none of these levels is viable, the last option is disposal.

Some of the options available to oil and gas industry operators for managing aquifers include:

1. Injection: injection of formation water into the same formation from there, oil is extracted or transferred to another reservoir.
2. Discharge: treatment of groundwater in accordance with land or sea discharge regulations.
3. Reuse in oil and gas production: treatment of formation water to the quality required for its use in normal oil and gas field operations.
4. Consumption for useful purposes: reaction to the treatment of produced water quality required for beneficial uses such as irrigation, grazing restoration, animal husbandry and consumption, and drinking water.

Produced water treatment is an efficient option for production water purification. It has the potential to purify produced water. Let it be a harmless and valuable product, not waste. General the tasks of groundwater treatment operators are as follows.

1. Degreasing: removal of dispersed oil and fat,
2. Removal of soluble organic matter,
3. Disinfection,
4. Removal of suspended particles and sand,
5. Removal of dissolved gases: removal of light hydrocarbon gases, carbon dioxide and hydrogen sulfide,
6. Desalination: removal of dissolved salts,
7. Softener: elimination of excess water hardness.

Many physical, chemical and biological separately and combined proposed methods of purification of underground waters. Produced water organic compounds (and some heavy metals) adhere to the porous media of carbon surfaces. After several runs moist air oxidation process can regenerate activated carbon. Activated carbon can remove soluble BTEX but not organic clay can remove insoluble free hydrocarbons that contribute to the overall petroleum hydrocarbons (TPH) and oil and gas measurements organic clay produced by combining sodium with montmorillonite clay cationic salt of a quaternary amine. When using organic in combination with activated carbon, the concentration of hydrocarbons is reduced below water quality standards. Copolymer beads are made based on methyl methacrylate (MMA) and divinylbenzene (DVB). suspension polymerization. These copolymers can reduce the oil content of produced water by up to about 85%. Formation water is conventionally cleaned by various physical, chemical and biological methods during the operation of oil and gas fields. Due to some limitations, compact systems are used during the operation of oil and gas wells on offshore platforms. When using formation water to maintain formation pressure in oil fields, two main problems must be solved:

1) develop scientifically based technological requirements for the quality of waste water injected into productive layers;

2) to develop equipment and technology for their treatment and preparation in order to adapt the quality of waste water to the technological requirements for water quality.

However, current technologies cannot remove small-suspended oil particles and dissolved elements. Biological pretreatment of oily wastewater at land-based facilities can be an economical and environmentally friendly method. Since high salt concentration and changes in influent properties have a direct effect on effluent turbidity, it is reasonable to include a physical purifier such as a membrane for final effluent treatment. For these reasons, future research efforts may focus on optimizing current technologies and using physicochemical or biological treatment of aquifer to meet reuse and discharge limits. On the other hand, due to the formation of large volumes of aquifers, many countries with oil deposits, as well as countries with water problems in general, are paying more and more attention to efforts to find effective and economical treatment methods to remove pollutants [6].

Wastewater contains oil products and substances dependent on it, phenols, chlorides, surfactants, sulphides, benzene, toluene, etc. happens. It happens that they are found both in the main technological processes and in individual petrochemical plants, pumping stations, tank parks. Petroleum products can be in different states in water - easily separated (insoluble), difficult to separate (colloidal) and soluble. Which is not in most cases, it is not possible to apply the same disposal for the removal of all types of oils and petroleum products. The amount of water in the secondary water supply system of oil refineries exceeds the amount of waste water by 10-20 times. 25 -30 mg/l oil products, 25 mg/l suspended substances, 500 mg/l sulphates, 300 mg/l chlorides in circulating water, temporary hardness of carbonate should not exceed 5 mg/l. A convenient method from meat is to use special organic inhibitors.

Gravel to clean small mechanical impurities inside the water filters are used. Filters sand or other granular materials consists of spilled reservoirs. Water flows at a certain speed they pass through the reservoir. Suspended particles remain in the filter, and purified water sent to injection wells through pumps. Magnesium and calcium salts from it to often the water separation, or decarbonization of water, heating of water in formation preventing the formation of calcium-carbonate deposits as a result apply to get. For this, water with lime or lime juice they wash irrigation as a result of clay swelling in some layers with a lot of clay minerals the effect of the process decreases. This is the adsorption of water layers on the clay surface as a result. At this time, the volume of the clay increases and swells porosity decreases. To avoid this, before watering in the US the well bottom zone is treated with an appropriate amount of hydrochloric acid. Chloride acid goes up to a distance of 1.2-1.5 m. At this time, the crystalline network 90 ions are replaced by hydrogen. Then the injection of water begins. At this time water with a small amount of non-ionic and cationic surfactants in solution carries substances. Adsorption of cation compounds on clay particles and makes it impermeable to water. As a result, prevention of clay swelling is taken [7].

The following fundamental solutions form the basis of the plant's water use scheme without discharging waste water into layers at the oil refinery:

- local treatment of the most polluted waste water (sulfide-containing technological condensates, sulphide-alkaline with tetraethyl lead, coke hydroxide waste water);
- grouping of wastewaters according to discharge systems, taking into account pollution characteristics; separate treatment of wastewater with drainage systems and their reuse [8].

Oil refineries have a basic industrial sewage system. This sewage system receives neutral industrial and industrial rainwater from most process plants, pumps and tanks containing no more than 2 g/l of mineral salts, about 3 g/l of oil products and 100-300 mg/l of suspended solids, and the washing of oil products is used during Currently, two schemes are used for wastewater treatment in local enterprises. The first involves the cleaning of oil traps, ponds, flotation tanks, sand filters, etc., and the treated water is used to feed circulating systems. The second, more promising scheme includes mechanical and physical-chemical treatment plants, as well as biological treatment and sometimes wastewater treatment plants. It contains about 5 g/l of oil products, 300-500 mg/l of suspended solids, as well as salts, reagents and other organic and Emulsion-mineralized wastewater with inorganic substances is discharged to the second system. Waste water from the second sewage system undergoes mechanical and physical-chemical treatment of sulfur-alkaline wastewater, as well as two-stage biological treatment. The units can be used for heat exchange of salty waste water, the condensate is returned to production and the resulting salt is disposed of [9].

Depending on the type and concentration of pollutants, the secondary sewage system includes a number of independent networks:

- oil waters of oil refineries, bottom waters of raw material parks, washing racks, washing and steaming stations;
- condensed sulphurous-alkaline waters, condensates formed from the alkalization of petroleum products;
- wastewater from the production of synthetic fatty acids (FFA) containing organic acids, paraffin and other substances;
- waste water of petrochemical industry (ethylene, propylene, butyl alcohols);
- acid waste water contaminated with mineral acids and salts [10].

The generally accepted scheme in oil refineries includes three stages of waste water treatment:

1) mechanical cleaning of liquid and solid impurities;
2) physical and chemical purification of colloidal particles, detoxification of sulfuric-alkaline waters and sewage of electric desalination plants (ELOU);

3) biological treatment of dissolved wastewater. In addition, additional treatment of biologically treated waste water is carried out.

In some cases, they temporarily store some of the treated wastewater in surface pits for evaporation. This affects local air quality and can contaminate groundwater supplies if the pits leak. In many places, large amounts of wastewater are disposed of through deep underground injection wells. This causes earthquakes in some parts of the country. Access to disposal wells, earthquake prevention, water needs of other wells, volume of waste water and treatment costs, as well as decision-making on how to dispose or clean and reuse oil-contaminated water is an important process for present and future generation the industrial wastewater optimization is in many cases a tailor made problem. The present work demonstrates that innovative wastewater treatment technologies together with optimizing the water/air cooling system is able to show that is possible to reach the "almost zero discharge" under technical and economical point of view.

Conclusions.

With the predicted increase of oil and gas extraction, at least over the next two decades, and with the maturation of a larger number of oil fields, it is expected that the volume of oil and gaz produced water (PW) from oil and gas field operations will increase over the next years. The passing of new, more stringent environmental laws will restrict the disposal and use of PW even more than today.

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