СЕКЦІЯ 2
ЕКОЛОГІЧНА БЕЗПЕКА ЕНЕРГЕТИКИ ТА ПРОМИСЛОВОСТІ

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RECONSTRUCTION OF OILFIELD WASTEWATER TREATMENT SYSTEMS

The oil and gas industry is one of the most environmentally hazardous subsurface use industries and causes huge damage to the environment. It is characterized by high energy intensity and significant pollution of territories. Petroleum products and reservoir waters are the main environmental pollutants in this area. Reservoir waters brought to the surface change the microrelief of the territory and are sources of secondary salinization of soils around. They have high geochemical activity and toxicity. They contain petroleum hydrocarbons, various salts and mechanical impurities, which are absorbed by the soil and, getting into the ground water, dramatically change their chemical and physic-chemical properties – salt composition, alkalinity, reaction of soil suspensions, soil-absorption complex, violate the water-air regime and carbon-nitrogen balance. Environmental consequences of oil spills are always difficult to predict, since when contaminated with oil and petroleum products, it is impossible to forecast all environmental consequences that disrupt all natural processes and relationships in the environment. To increase the efficiency of treatment of oilfield wastewater, it is recommended to hydrodynamic treatment in swirling streams, and bring them to the desired technological characteristics, followed by pumping them into the reservoir pressure system in the oil field. Flooding of oil reservoirs can increase oil recovery by 1.5-2 times [1].

The creation and development of technology and installations for the treatment of oilfield wastewater (OFW) for disposal in oil reservoir flooding systems is an actual problem. Wastewater contaminated with emulsified petroleum products and solid suspended solids is often formed during the production process. The properties of OFW, especially the state of the armor shells on the droplets of the dispersed phase of oil, determine the methods of destruction, purification of OFW for a certain time. The purification of OFW for the purposes of flooding of productive horizons consists in the removal of oil and mechanical impurities from them to the specified industrial standards. Utilization of purified OFW in oil formation flooding systems is an economically and environmentally beneficial way to eliminate them in the oil fields. The quality of the OFW purification process assumes a fairly complete and rapid decrease in the aggregative and kinetic stability of OFW by destroying the adsorption armor shell on oil droplets, the OFW movement mode, which ensures the enlargement of these droplets. These processes are carried out most fully and intensively with a preliminary certain degree of turbulence of the OFW flow in the cavities of various hydrodynamic droplet generators with subsequent settling. A high and stable effect of purification can be achieved by preliminary hydrodynamic treatment of the mixture in a swirling stream [2].

The modernized technology of purification of OFW provides for the preliminary destruction of the armor shells on oil droplets, the enlargement and reduction of the polydispersity of oil droplets by preliminary hydrodynamic treatment of the initial OFW using centrifugal swirling flows. For the separation of OFW, an installation has been developed that operates according to the technological scheme of the multihydrocyclone block - separator tank (hydrodynamic purification unit).

The multihydrocyclone block - separator tank for the treatment of oily wastewater, equipped with coalescing nozzles included in the design of the sump for thin-layer separation. At the same time, in pressure hydrocyclones, not only the destruction of the armor shells on oil droplets and partial delamination of oil-in-water emulsions is carried out, but also coalescence of oil droplets occurs, an increase in the monodispersity of oil emulsions, which significantly intensifies the subsequent process of purification of oily wastewater by settling in sedimentation tanks – separators. The scale of linear and angular dimensions of the hydrocyclone for the model is adopted is follows: diameter D = 150 mm, taper angle a = 5°; diameter: inlet pipe d = 50 mm, upper drain d = 40 mm, lower drain d = 50 mm, immersion depth of the upper drain pipe h = 100 mm. The mode of fluid movement in a hydrocyclone is characterized by the Reynolds number along the radius in the range of 30000-40000.

To improve the efficiency and reliability of the OFW purification units and oil mixture separation systems was developed a new construction of hydrocyclone. Thus, the combination of centrifugal separation processes in a hydrocyclone makes it possible to remove dispersed and floating organic impurities, as well as gas from the wastewater. This reduces the multi-stage process of water treatment, allowing to achieve the set goals. Hydrocyclones used for the OFW treatment are characterized by high performance, absence of moving parts, compactness, simplicity and ease of maintenance, low cost and wide scope of application. In addition, finer separation can be achieved in hydrocyclones with a higher discharge density and without enlargement (flocculation) of small particles. Local treatment equipment, consisting of an averager, four product hydrocyclones and separators with coalescent plates, will allow organizing water purification systems at wells and using purified wastewater for formation pressure maintenance systems.

References

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