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Modern Technologies for the Treatment and Disposal of Wastewater Generated in the Oil Refining Industry

Abstract

The oil refining industry currently plays a major role in the economy of our state. Unfortunately, the processes of oil production, processing, transportation, and storage are always accompanied by the release of hydrocarbons that pollute the environment. Oil refining and petrochemical plants are among the largest polluters of the environment.

The enterprises of this industry pollute the air, water bodies, and soil, negatively affecting the ecological situation of Baku, Absheron, and Sumgait. In terms of wastewater discharge, these enterprises are the largest source of pollution of water bodies. Therefore, one of the most important problems of the oil-producing and oil-refining sectors is the problem of protecting the production environment and the environment. The oil refining industry is rightfully attributed to the sectors that bear the greatest responsibility for public health. Oil refineries discharge the main part of wastewater into water bodies.

Wastewater of oil refineries mainly contains oil pollution. During the oil refining production and its development at these plants, wastewater is enriched with a number of water-soluble polar compounds: organic acids, alcohols, aldehydes, ketones, and hydroxy acids. The purification of these wastewaters to the parameters provided by the currently applied regulatory requirements and traditional methods is economically expensive. In addition, in some cases, high pollution of water used in technological processes causes significant economic losses, which in most cases are irreversible.

In this regard, issues such as the assessment of wastewater treatment methods at oil refineries, the study of wastewater treatment methods at oil refineries, the introduction of a new type of wastewater treatment, and the calculation of the proposed treatment method are among the urgent problems of environmental protection and ecology. Therefore, the analysis of the impact of oil refining complex enterprises on the environment is important. Thus, the topic of the presented article is relevant.

Keywords: *wastewater, oil refining, technology, methods, cleaning*

Introduction

Wastewaters of oil refining enterprises are formed in all technological facilities, depending on their composition. They are formed after condensation, cooling and washing with water of oil products, from electric desalination plants, alkalization of transparent oil products and liquefied gases, from barometric mixing condensers, mixing plants and from the platform for pouring ethylated gasoline, as well as from cleaning equipment and devices, washing the floors of industrial buildings, cooling equipment and cleaning the circulating water supply system. Precipitation water from the places (sites) where technological facilities are located also join the production wastewater. There are several types of wastewater: neutral wastewater containing oil products - sometimes it is also called neutral oily wastewater; salty wastewater; sulfur-alkaline wastewater; acidic wastewater; wastewater containing hydrogen sulfide. In addition to intermediate and final products of oil refining, wastewater contains oil, naphthenic acids and their salts, emulsifiers, resins, phenols, benzene, toluene, as well as sand, clay particles, acids and their salts, alkalis (Jassi, Braihi, Shabeeb, 2024: 1-3).

Thus, production wastewater at an oil refinery is generated in almost all technological units.

Depending on the sources of generation, production wastewater at an oil refinery is divided into:

1. Neutral wastewater containing oil or oil products. These waters constitute the main part of the water in the first system of industrial wastewater sewage. These include wastewater obtained during condensation, cooling and washing of petroleum products (except for water from barometric condensers of AVB), after cleaning them from their corresponding apparatuses, after cleaning the floors of industrial buildings, water from cooling of pump bushings, drainage water from trays (containers) of technological facilities (except for water from control units in raw material parks), water from the main wells of apparatuses and pumps, as well as wastewater consisting of waste and seepage water from the sites of technological facilities. Oil is mainly present in these waters in the form of an emulsion. Its concentration reaches 5-8 g/l, and the total salt content is 700-1500 mg/l. The relatively low salt content allows the use of wastewater to fill secondary water supply systems after appropriate treatment.

2. Salt-containing wastewater (ELOU wastewater), containing a high content of emulsified oil and a large amount of dissolved salts (mainly sodium chloride). They come from electrodesalination plants and raw material parks. These also include rainwater from the territory of the specified facilities. If accidental waste is not taken into account, the maximum permissible amount of oil products in them should not exceed 10 g/l. Studies of wastewater from ELOU facilities show that the amount of oil in individual samples can reach 30 g/l, which is associated with a violation of the hermeticity of technological equipment, leaks and operational defects. The salt content in the waters of this group depends mainly on the quality of the oil entering the plant.

3. Sulfur-alkaline wastewater is obtained from the alkalization (alkaline treatment) of transparent petroleum products and compressed (liquefied) gases. In the alkaline treatment process, mainly hydrogen sulfide, mercaptans, phenols and naphthenic acids are removed from petroleum products.

In accordance with technological requirements, the composition of sulfur-alkaline wastewater should be as follows: COD (Chemical Oxygen Demand) - up to 85,000 mgO2/l, BOTful (Biochemical Oxygen Demand) - up to 75,000 $mgO_{2/l}$, sulfides (in terms of H2S) up to 26,000 mg/l, total sulfur content up to 35,000 mg/l, volatile phenols up to 5,000 mg/l, petroleum products up to 3,000 mg/l, total alkalinity (in terms of NaOH) - 10,000 mg/l, pH-14.

Chemical oxygen demand (COD) refers to the amount of oxygen required for the oxidation of carbon-containing compounds to carbon dioxide, sulfur-containing compounds to sulfates, and phosphorus-containing compounds to phosphates.

The total biochemical oxygen demand (BOD) is determined by the amount of oxygen consumed by microorganisms for aerobic biochemical oxidation (decomposition) of volatile organic compounds in water, that is, mixtures, over a certain period of time (Gautam, Saini, 2020: 1-4).

However, the composition of wastewater of this category can differ significantly from the established standards or norms. The periodicity of discharge of alkalis, sulfur-alkali wastes used in various plants into the sewer can vary from 2 to 45 days, depending on the type of technological facilities and their capacity, the adopted oil refining regime, the quality of the initial raw materials received, the alkalization (cleaning with alkali) scheme, the hydraulic load in alkaline sedimentation tanks and other factors. The average daily discharge of these waters (excluding washing waters) varies between 0.0009 and 0.0019 m^3 per 1 ton of processed oil.

4. Acidic wastewater from the sulfuric acid regeneration shop is formed as a result of acid losses due to leaks and lack of hermeticity of connections in equipment and apparatus, as well as due to corrosion of equipment, and can contain up to 1 g/l of sulfuric acid.

5. Hydrogen sulfide-containing wastewater mainly comes from barometric mixing condensers. When barometric mixing condensers are replaced with above-ground ones, their volume decreases by 40-50 times.

In addition to barometric waters, hydrogen sulfide is also found in technological condensates of the so-called AVB unit, catalytic cracking, delayed coking, hydrotreating (hydrocleaning) and hydrocracking units, but in addition to hydrogen sulfide, phenols and ammonia are also present in these wastewaters.

When oil refineries and petrochemical plants are combined, wastewaters contaminated with petrochemical synthesis products are formed. Their composition is determined by the type of product obtained. Thus, wastewaters from the production of protein and vitamin concentrates from liquid petroleum paraffins have BOD (Biochemical Oxygen Demand) - up to 1000 mg $O_{2\ /\ 1}$, COD (Chemical Oxygen Demand) - 2200 mg $O_{2\ /\ 1}$, pH - 4.8-5.6.

Other sources of wastewater include wastewater from ethyl blending facilities and water from piers for pouring leaded gasoline containing up to 10 mg/l of petroleum products and tetraethyl lead, as well as sour wastewater from a synthetic fatty acid plant.

Thus, a large amount of organic substances enter the waste (waste) waters of an oil refinery, of which the final and intermediate products of oil distillation are of greatest importance: oil, naphthenic acids and their salts, demulsifiers, resins, phenols, benzene, toluene. The composition of waste wastewater also includes sand, clay particles, acids and their salts, alkalis.

The data presented show that the composition of individual compounds in wastewater, for example, the content of phenols and oil in sulfur-alkali wastewater, varies within wide limits. The most dangerous for biological treatment plants and water bodies are sulfides and sulfohydrates, which are not allowed in the waters of reservoirs for drinking water, fisheries and cultural and domestic use (Farzana, Haque, Sonali, Saha, 2023: 56-69).

Oil and oil products in industrial and production wastewater are in a dissolved, colloidal and emulsified state. The majority of organic substances dissolved in water are usually determined by biochemical oxygen consumption or chemical (bichromate) oxygen consumption in a water sample.

Research

One of the unique features of oil refining enterprises is that wastewater, as a rule, is a set of flows collected not from isolated production processes or departments, but from the enterprise as a whole. Modern refineries are divided into: fuel and fuel-oil plants, petrochemical plants. The differences in oil refining technology and the profile of production, the depth of oil refining and the types of final products also determine the plant's waste.

The main technological processes of oil refining include:

1) oil preparation, its dehydration and desalination;

2) atmospheric and vacuum distillation; destructive processing (cracking, hydrogenation, isomerization); purification of light-colored products;

3) production and purification of oils.

1) With the depth of oil refining, water consumption for industrial purposes and the volume of wastewater increase. The composition of various pollutants in wastewater is determined by the quality of the processed oil, its processing technology and the quality of the final products. The greatest water consumption is observed at the stage of oil preparation, in the process of dehydration and desalination (Lee, Yeo, Cools, Morent, 2018: 3578-3590).

Electrical water desalination and dehydration. Oil coming from oil fields (fields) contains up to 2% water and up to 0.5% salt. It should be noted that oil containing no more than 0.0005% salt and 0.1% water is considered suitable or suitable for processing. Therefore, oil supplied to the oil refinery is first subjected to dehydration and desalination in special electrical desalting units called ELOU. Water is added to crude oil, then the resulting emulsion is divided into two stages: the first is thermal precipitation at 75-80°C; the second is the process of breaking the emulsion and dehydration in electrohydrators. In the process of dehydration and desalination of oil, demulsifiers OP-7, OP-10, diosolvan, OJK, etc. are used to break up a stable emulsion. The water separated in the ELOU units is discharged into a special sewage network. It contains salts, oil, sulfur compounds and other substances in the form of a mixture contained in crude oil.

Oil processing in atmospheric and vacuum conditions. The initial technological process of oil refining is its direct distillation in atmospheric vacuum tubes (AVB) with the production of light distillates and oil fractions. After ELOU, the oil passes through heat exchangers (heat exchangers), then it is heated in the furnace of the atmospheric part of the AVB unit and fed to the atmospheric rectification column, where the separation (fragmentation) of oil occurs with the removal of light products. The light products of the atmospheric column - gasoline, kerosene and diesel fuel - are cooled, condensed in heat exchangers and condensers. The remaining part of the oil products remaining from the atmospheric column passes through the tubular furnace of the vacuum part and enters the vacuum column, where oil distillates and cubic residues are obtained as a result of distillation in vacuum. During the initial distillation of oil, the decomposition of sulfur compounds occurs. Some of them pass into the light distillate and contaminate it, while others are converted into gases and the rest of the oil products. In the mixing barometric condensers of the AVB vacuum columns, the vacuum is created due to the direct contact of water with vapors of oil products and gases. As a result, the water that has undergone the processing process (used) is contaminated with vapors of oil products and hydrogen sulfide. Currently, in a small number of AVB installations, in order to avoid the formation of contaminated wastewater, barometric mixing condensers are replaced with surface (surface) type condensers, in which water does not come into contact with oil products. Two types of products are formed in the direct distillation of oil: distillate (gasoline, kerosene, ligroin (naphtha), diesel fuel, solarium oil) and residue (fuel oil, tar, gas oil). Fuel oil is also partially used as fuel.

Due to the aggressive effect of sulfur compounds on technological equipment made of metal, their presence in commercial oil products is not allowed. Oil products are cleaned of sulfur compounds with aqueous solutions of alkalis (caustic soda). At this time, hydrogen sulfide, mercaptans and other sulfur compounds, as well as phenols, pass from petroleum products to alkaline solutions. After repeated use, alkaline solutions containing large amounts of sulfur compounds, as well as other pollutants, are discharged into a special network - the sulfur-alkali sewage network.

Thus, at the stage of atmospheric-vacuum processing of oil, two types of wastewater are formed: sulfur-alkaline (alkaline-sulfide) during the purification of oil products from sulfur compounds and wastewater after barometric mixing condensers. Both of them contain oil, oil products and sulfur compounds (Zakaria, Shibahara, Bhuiyan, Nakane, 2022: 50-89).

Destructive processing of oil. During deep processing of oil, the residues of direct distillation are subjected to cracking and pyrolysis. Various types of cracking are known:

a. catalytic cracking, which occurs in the presence of catalysts (aluminum chloride, aluminosilicates);

b. hydrogenation cracking (hydrogenation) in a hydrogen atmosphere - here clay is used as a sorbent;

c. dehydrogenation cracking, accompanied by massive hydrogen release; oxidative cracking in an oxygen or air atmosphere.

At modern oil refineries, mainly hydrogenation cracking is more developed.

In catalytic cracking units, the products of distillation (extraction) of oil directly after AVB are subjected to direct decomposition of heavy hydrocarbon molecules to produce high-octane hydrocarbons (gasoline and individual aromatic hydrocarbons). The process is carried out at high temperatures and pressures. Purification of liquid products is also carried out with alkali. Cooling and condensation of finished products are carried out with the help of water in surface (surface) condensers and coolers. At this time, the water is heated to 70-80°C. The possibility of contamination of cooling water with oil products is possible only in case of malfunction and violation of the hermeticity of the apparatus.

During the deep processing of oil using cracking processes, the following are formed:

- gaseous hydrocarbons with a high content of neutral hydrocarbons, which are subsequently sent as raw materials to petrochemical production of oil refineries for the synthesis of alcohol, glycol, glycol derivatives, etc.;
- liquid distillates – cracking - gasoline, aromatic hydrocarbons (for example, benzene, toluene); from liquid products, a number of other compounds are obtained during the pyrolysis of oil at petrochemical enterprises (isoprene, synthetic fiber raw materials, etc.);
- solid decomposition products – the residue (coke) that does not pass through the distillation process of oil. During the condensation of finished products, in addition to the water used to cool them, water is also discharged into the sewer from water separators. The latter, which is mainly called technological condensate, is formed as a result of the condensation of water vapor entering

the apparatus of the installation. Since it is in direct contact and contact with oil products, a significant amount of hydrocarbons can be expected in the technological condensate, and during the processing of sulfur and high-sulfur oil, ammonium sulfides and phenols can also be found (Pervov, Telichenko, 2005: 70 – 74).

Purification of oil products. Acid and alkaline cleaning and washing are used for the purification of oil products. During acid cleaning (periodic and continuous), light fractions of oil are processed in special apparatuses with mixers. Then they are neutralized, washed with water and subjected to alkaline treatment. As a result of cleaning, a large amount of waste is obtained - sour tars, alkaline wastewater, which are difficult to degrease and utilize. However, currently, the solution of this problem is extremely important for protecting the environment from pollution.

Along with general methods for the purification of oil products, special methods are used, for example, desulfurization methods, the most promising of which are catalytic hydrogenation, purification with the help of selective solvents, and others.

Production and purification of oils. The raw material for the production of oils is oil distillates (epaulettes) obtained from AVB units. In order to remove mineral impurities (sulfur, nitrogen, asphalt-resinous substances and other components undesirable for oil) from oil fractions, they are subjected to cleaning using solvents in special installations. This type of installation mainly includes the following devices: deasphalting of oils with propane, dewaxing of oils in acetone - benzene - toluene, hydrotreating of oils and contact cleaning with bleaching clays.

In the deasphalting installation, liquid propane dissolves asphalt-resinous substances contained in the oil epaulets (oil repellents) of the AVB. These substances precipitate and separate in the form of sediment. In this installation, oil products can enter the sewers as a result of leaks in the pump glands (seals) or other malfunctions when washing the floors (Goncharuk, Garkavy, Popenko, Kravets, Boyko, 2004: 479-484).

Pollution of wastewater in the facilities for selective purification and deasphalting of oils from resinous substances and other phenolic compounds is possible only through the sewage discharge of washings from the floors of the pumping station, as well as through leaks in the equipment.

During normal operation of technological equipment, pollution in the dewaxing unit is not significant. However, in case of an accident and in cases of leaks, it is possible for petroleum products with a high freezing point, as well as solvents, etc. to enter the sewage system.

During proper operation of oil hydrotreating units, oil is excluded from being discharged into wastewater. Discharge of oil components into the sewer is possible only in case of an accident and in cases of leaks at the joints of pipelines. A significant amount of pollution enters the wastewater of oil refineries from reservoir parks and during equipment repairs.

An additional source of pollution of the sewage system with oil products and mechanical mixtures is rain and melt water.

Improvement of wastewater treatment systems at oil refining enterprises.

Mechanical treatment of wastewater. Mechanical treatment units are designed for the primary treatment of wastewater from oil products and mechanical mixtures consisting of solids. Mechanical treatment is carried out in sand traps (traps), settling tanks, hydrocyclones, centrifuges, and filters (Temerdashev, Temirkhanov, Musorina, 2006: 111-113).

Figure 1. Description of the mechanical treatment of wastewater

Sand traps (traps) are used to retain large mineral impurities and coarsely dispersed oil products. Sand traps (traps) for oil refineries with a low content of solid organic matter in wastewater are designed based on the storage conditions of most oil products. According to VUTP-97 - i.e., the Guidelines for the technical design of industrial water supply, sewage and wastewater treatment of oil refining enterprises ("Departmental instructions for the technical design of industrial water supply, sewage and wastewater treatment of oil refining enterprises - VUGP-97"), the volume of sand traps is taken from the calculation of the five-minute residence time of wastewater. Sand traps are equipped with devices for collecting floating oil products, such as oil, and removing sediment. The efficiency of oil products retention is up to 75%, suspended solids up to 20%. In the treatment plants of oil refineries, sewage plants, horizontal (horizontal-rectangular) and round (circular) sand traps with circular movement of the working flow are used.

Oil traps (traps) are designed to remove the main part of oil products and small mineral particles. The residual concentration of pollutants in the purified water after oil traps is 100 mg/l for oil products (purification effect 90 - 95%) and 90 mg/l for solids (purification effect 55 - 70%) for the first sewage system, and -150 mg/l (purification effect 90 - 95%) and 85 mg/l (purification effect 45 - 65%) for the second sewage system, respectively.

The efficiency of wastewater treatment due to oil products depends on the initial amount of oil products in the wastewater, their dispersion and should be carried out according to sedimentation curves determined by plant laboratories or industrial research institutes. For new plants, the volume of oil catchers (traps) is assumed to be equal to the two-hour flow of wastewater.

In recent years, for the treatment of oil-containing wastewater, shelf (thin-layer) oil traps (traps) have been increasingly used, the working volume of which is divided into separate sedimentation zones by inclined plates, which ensures thin-layer sedimentation and clarification. In such sedimentation tanks, the influence of density and convection currents on the sedimentation and clarification process is practically excluded, and the uniform distribution of the working flow provided at the beginning of construction is maintained along the entire length of the latter, therefore the volume utilization factor can be 80 - 85%. The sedimentation height in these structures is equal to the (vertical) distance between the plates and is many times less than the height of the sediment layer in conventional sedimentation tanks, and therefore the duration of the process of proper wastewater treatment is much shorter (35-40 minutes).

Figure 2. Thin-layer oil trap block

Thin-layer multi-layer (level) oil traps (traps) have a significantly smaller volume (4-6 times) and occupy a smaller area. Their use allows you to do without additional sedimentation and settling tanks, since the concentration of oil products in the purified water supplied for physicochemical treatment is 40-50 mg / l. However, the results of inspections at oil refineries show that the concentration of oil products can be 150 g / l and more. When using shelf (hollow) oil traps, which have a volume 5-6 times smaller, the process of accumulating oil products occurs very quickly. Therefore, their constant continuous discharge is required. Otherwise, oil products can be removed with purified water. All this requires precise operation of treatment facilities. In addition, heavy oil products falling into the oil trap adhere to the surface of the plates in the layers and eventually destroy them. Therefore, during the operation of multi-layer oil traps (traps), it is necessary to determine the oiling period of the layer space in order to determine the period between washing the blocks (Ilyin, Kolesnikov, Denisova, 2006: 3-4).

Attention should be paid to the selection of materials for plates with low adhesion to heavy oil products in the block and to taking measures to prevent clogging of the block space (clogging area). In this regard, the VUTP-97 guidelines, i.e., the Technical Design of Industrial Water Supply, Sewage and Wastewater Treatment of Oil Refineries, recommend the use of oil traps (traps) with parallel plates in wastewater streams containing transparent oil products and not containing high-viscosity oil products (tar, bitumen, etc.).

Currently, it is recommended to combine sand traps (traps) with oil traps (traps). The nature of the pollutants deposited in sand traps and oil traps is the same, and they differ only in size. Combining these two structures allows you to save on the production areas occupied by these structures. In order to separate the sand from the fine clay fraction formed during longer settling, it is necessary to arrange two rows of holes in the oil or oil traps along the movement of water. In this case, larger particles (sand) will be collected in the first hole, which can be removed from the oil and oil trap (trap) regardless of the removal of fine sediments collected in the second hole (Magid, Kuptsov, 2006: 13-14).

Hydrocyclones, which play the role of sand traps (traps) and oil and oil traps (traps), are increasingly used to purify wastewater containing oil or oil products from oil products and solid particles from oil refining enterprises.

Pressure hydrocyclones have a relatively small diameter of the cylindrical part, D = 15-1000 mm. The impurities in them are separated and released as a result of centrifugal forces that exceed the force of gravity by hundreds and thousands of times. Therefore, the duration of the process is correspondingly reduced, and the volume required for treatment is also reduced compared to the volume of sedimentation tanks.

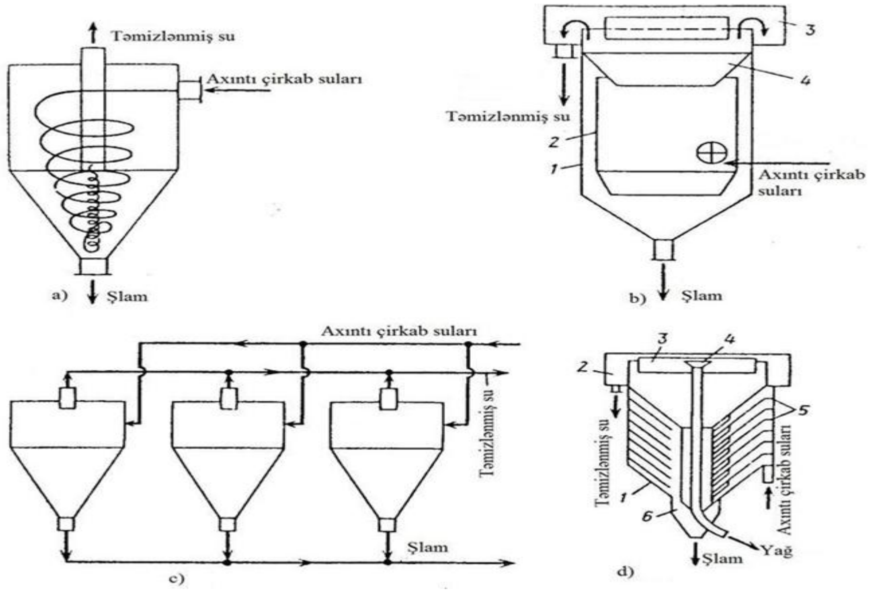

Figure 3. Hydrocyclone operating scheme.

a – pressure, b – with an internal cylinder and a conical diaphragm: 1- housing; 2-internal cylinder; 3 – annular trough; 4 – diaphragm. c – block of pressure hydrocyclones; d- Multi-tier hydrocyclone with inclined pipes for removing purified water:1- conical diaphragms; 2 – trough-container; 3 - top; 4 - oil collecting container (funnel); 5 - distribution containers; 6 – slit for discharging sludge.

Non-pressure hydrocyclones have a diameter of D = 2 -12 m, the centrifugal forces in them are very small. However, during the rotational movement of the flow, conditions are created that facilitate the agglomeration of suspensions and, therefore, their more intensive separation and removal. In addition, when the flow moves in a spiral, the volume of the apparatus is used more fully. The above-mentioned advantages allow for the wider application of small-volume open hydrocyclones compared to settling tanks; they operate at high specific hydraulic loads, which reduces the area required for the placement of treatment facilities.

Physicochemical treatment of oil-containing wastewater. Physicochemical methods are used to treat oil-containing wastewater from colloidal and dissolved contaminants. A large number of physicochemical methods are known for treating wastewater from this type of contaminants: coagulation, flocculation, flotation, electrocoagulation, electroflotation, sorption, ozonation, electromagnetic separation (separation), liquid phase oxidation, coalescence, ultrafiltration, and others. Currently, coagulation, flocculation, flotation, and sorption treatment are most often used at oil refining enterprises.

Coagulation is used in wastewater treatment to accelerate the settling of finely dispersed mixtures (dirt) and emulsified substances. During coagulation, the interaction of dispersed particles with coagulants and their aggregation into aggregates leads to the enlargement of dispersed particles. Coagulants are more effective for removing colloidal particles from water, i.e. particles with a size of 1 - 100 microns. Coagulants in water form flakes, which quickly settle under the influence of gravity. The most commonly used coagulants are aluminum sulfate $Al_2 (SO_4)_3$ 18 H_2O, aluminum oxychloride $Al_2 (OH)$ 5 Cl, etc.

Reagent treatment of wastewater with mineral coagulants has the following disadvantages:

- relatively large doses of coagulants (for example, the dose of aluminum sulfate for the first sewage system is 50 mg/l, for the second system - 100 mg/l);

- high content of SO-2 and Cl-1 ions in the treated water, which leads to corrosion of the water supply circulation systems during water reuse;

- The formation of significant volumes of high-moisture sediments makes it difficult to dewater these sediments (Seyfullayeva, Ələkbərova, Məmmədova, 2006: 43-89).

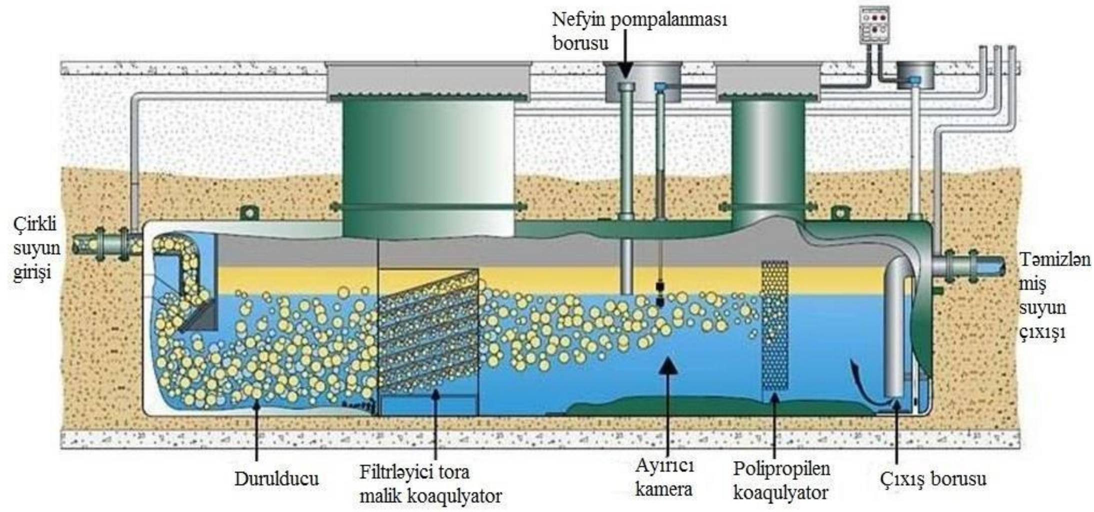

Figure 4. Schematic representation of the coagulation process

During flocculation, unlike coagulation, aggregation (combination) of solid particles occurs not only during direct contact of the particles, but also as a result of the interaction of molecules adsorbed on the flocculant particles. Flocculation is carried out to intensify the process of formation of flakes of aluminum and iron hydroxides, in order to increase the rate of their sedimentation. The use of flocculants allows you to reduce the dose of coagulants, reduces the duration of the coagulation process and increases the rate of sedimentation of the resulting flakes.

The flotation method consists in the formation of "particle-bubble" complexes, their floating or surfacing, and the removal of the foam layer formed from the surface of the water being treated. Adhesion of particles to the surface of gas bubbles in a liquid can occur if there is no wetting of the particles by the liquid or if weak wetting is observed. Flotation treatment can be effective in removing impurities that have natural hydrophobicity (oil, petroleum products, oils, synthetic detergents, etc.). Coagulation and flocculation significantly intensify the flotation process of impurities, since in this case the hydrophobicity of particles increases, the size of aeroflocs increases, and accordingly the forces that raise impurities to the surface of the water in the flotation chamber increase (Ponomarev, Boyev, Chuchalin, Porkhachev, Khananov, 2003: 38-42).

Electrochemical purification methods (electrocoagulation, electroflotation) have a number of significant advantages over reagent methods: they do not increase the mineralization and salinity of wastewater, which plays an important role in the organization of water supply circulation systems; less sediment is formed; they simplify the technological scheme of purification; there is no need to organize a reagent economy; the possibility of full automation of production facilities is provided; Small production areas are required to accommodate electrochemical purification units.

The sorption method is used for deep purification of water from oil products in finely emulsified and dissolved states. Currently, a large number of organic and inorganic materials are used for the production of oil sorbents: coal, peat, expanded clay, perlite, silica gel, zeolites, sawdust, sapropel, shale, polypropylene, polyurethane, teflon and others.

There are three main methods for the regeneration (restoration) of activated carbon: chemical, low-temperature and thermal. All these methods are expensive and energy-intensive, require special equipment. In addition, due to the porous structure, sorbents have low mechanical strength, and the loss of sorbents as a result of wear during washing is 0.1 - 2% per cycle, during hydraulic overloading - 0.3 - 4%, the loss of mass of the sorbent during regeneration reaches 10%.

In recent years, due to the development of membrane technologies, the scope of application of membrane filters has expanded significantly. Membrane filtration is a type of filtration, when the filter has a thin partition of less than 0.1 mm and a high degree of porosity, it is called a membrane filter. The range of particles removed by filtration through a semipermeable membrane is quite wide and is usually 0.0001 - 10 microns. The role of the membrane is to serve as a selective barrier, allowing some components in the liquid to pass through and retaining others. Membrane filtration is divided into microfiltration, ultrafiltration, nanofiltration, reverse osmosis, dialysis and electrodialysis filtration (Galleev, Saifullin, 1996: 36-39).

Conclusion

1. Pollution of the environment, i.e. air and water basin, soil occurs during all technological processes of oil refining: in atmospheric-vacuum and vacuum units, in catalytic and thermal cracking units, in the process of contact cleaning and coking of oils, in the process of hydroforming and dewaxing, in the production of bitumen. Sources of pollution include tube furnaces, flares (torches) and general plant facilities; oil and oil product storage tanks (reservoirs), open drains of columns and units, chutes, sewage wells and open surfaces of treatment facilities - sand traps, oil traps (traps), additional sedimentation ponds, quartz filters, aerotanks of I and II stages, second and third sedimentation tanks after aerotanks, storage pools. The main pollutants of the air basin are hydrogen sulfide, sulfur dioxide, nitrogen oxides, carbon monoxide, saturated and unsaturated hydrocarbons. Additional air pollution occurs when the equipment is not hermetically sealed

2. An analysis of the environmental impact of the oil refining and petrochemical industries has shown that they are currently the largest source of water pollution in terms of wastewater discharge. When wastewater is discharged into water bodies, the degree of compliance of wastewater with established standard indicators is not achieved. The reason for the discharge of insufficiently treated wastewater into water bodies is mainly due to the inefficient operation of existing wastewater treatment systems at enterprises.

3. A comparative analysis of wastewater treatment methods was conducted. All the described methods for treating wastewater from oil products have certain disadvantages, which make them unsuitable for use in their pure form for treating wastewater from oil refineries. First of all, this is unacceptable from the point of view of high operating costs, the complexity of the technology, ecology and environmental protection. In addition, wastewater from oil refineries is characterized by high pH and concentration of petrochemical compounds, which makes it impossible to use membrane bioreactors directly for wastewater treatment.

4. It has been established that membrane technologies are one of the priority directions of the scientific and technological process. The reverse osmosis method, as one of the types of membrane technology for water desalination and desalination, allows creating resource-saving and waste-free technological processes, thereby solving the environmental problems of water resource protection.

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