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WASTEWATER TREATMENT OF FAT AND OIL ENTERPRISES USING COAGULANTS

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ABSTRACT

Studies of the hydrolysis of salts used as coagulants show that under conditions of water treatment, hydrolysis and polymerization (corresponding to the stages of induction and nucleation) occur almost instantly. Therefore, the most practical interest in terms of process intensification is the subsequent "coagulation" stage of flocculation. In the process of water treatment, the most important role is played by primary particles, micelles and larger spherical sol particles, characterized by high surface energy. The initial act of water purification, apparently, is the interaction of dimers and other polynuclear aquahydroxo complexes with ionically and molecularly dissolved, and then colloidal substances.

INTRODUCTION

Food production requires large amounts of water, a significant part of which is returned in the form of effluents containing the emulsified phase of fatty compounds and their decomposition products, which reduces the oxygen content and upsets the balance of water ecosystems. Mechanical and physico-chemical methods of separation of emulsion dispersions operating at oil processing enterprises do not ensure their purification to the standard values for wastewater discharged into the sewer.

Food production requires large amounts of water, much of which is returned to nature as runoff. Waste water from oil processing enterprises is mainly contaminated with organic compounds in the form of emulsified fat-like substances (vegetable oils, animal fats, soaps, etc.) and is characterized by a low concentration of the dispersed phase in the dispersion medium, as a result of which these emulsions are very resistant [1].

METHODS

An analysis of the literature and production regulations made it possible to assess the indicators of pollution of wastewater from various workshops (Table 1). From the data given in Table 1, it can be seen that wastewater is a system with a high content of organic compounds, often in the form of emulsified fat-like substances, so one of the main tasks of wastewater treatment at Fat and oil industry is to remove these

contaminants[2].

Removal of contaminants from wastewater from Fat and oil industry, which, due to the presence of soaps and other surfactants, are highly stable heterogeneous systems, is a complex and rather expensive task. The treatment of such effluents should be carried out in stages.

Fat and oil industry wastewater is unstable, due to a number of technological features of production, as well as a constant change in the product range. In most plants, industrial effluent treatment involves sequential settling in a grease trap, separation of the dispersion in the flotation process, and ultrafiltration. However, the existing treatment facilities do not allow obtaining water with standard indicators, upon reaching which water can be discharged into the city sewer[3,4].

Table 1

Table of indicators of wastewater JSC "Urganch yog'-moy"

№	Name of waste water	pH	Weighted substances, mg/l	Fat things. mg/l	Chlorides, mg/l	Sulphates, mg/l	COD, mg/l
1	REFINING From oil flush	9-10	250-5000	750-1500	100-4300	150-350	1500-3000
2	From soapstock decomposition (after neutralization)	5.5-6.5	1000-2000	1500-2000	100-200	60-90	3000-4000
3	DEODORATION baromitric	7-7.5	50-150	50-150	50-150	35-55	100-300

The problem of industrial wastewater treatment cannot be considered completely solved if the stage of collecting and neutralizing the extracted pollution is not provided. The composition of the effluent (before neutralization) of the process of decomposition of the soap stock to obtain fatty acids is given in table. 2 [5].

Table 2

Table of indicators of wastewater from the decomposition of soap stock (before neutralization)

Cations	mg/l	meq / l	% -eq / l	Anions	mg/l	meq / l	% -eq / l
H^+	100	100	87	Cl^-	38116	1075	50
Na^+	43158	1876.46	-	SO_4^{2-}	48145	1003.03	47
K^+	-	-	-	NO_2^-	20.01	-	-
NH_4^+	100	5,54	-	NO_3^-	840	13.55	-
Ca^{2+}	300	15	1	CO_3^-	-	-	-
Mg^{2+}	1824	150	7	HCO_3^-	3446	58.50	3
Fe^{3+}	0.3	0.01	-	Total		2148.08	100
Fe^{2+}	30	1.07	-				
Total		2148.08	100				

RESULTS

To study the interaction of hydroxosalts of aluminum and iron with the main organic pollution of wastewater from food enterprises, solutions containing about 20% of basic salts were used as coagulants. The studies were carried out on model systems, components which corresponded to the main pollution of effluents and their combinations. The concentrations of the compounds were selected based on the data of the analysis of wastewater from the oil and fat enterprise. In all cases, the concentrations of substances, COD indicators, pH were determined before and after coagulation cleaning.

Effluent is a stable microemulsion, the alkalinity of which is due to the use of traditional detergents. They usually include soda ash and caustic. Oil and fat mixing products, soap stocks (alkaline oil refining products) impart alkalinity to waste water due to the hydrolysis reaction of sodium alkyl carboxylates. Therefore, we have studied a number of model systems containing sodium carbonate or hydroxide in combination with sodium alkyl carboxylates and glycerol.

Depending on the type of facilities used for wastewater treatment and sludge treatment, the latter can be divided into the following types:

coarse impurities (garbage) retained by the grate; heavy impurities (sand) retained by sand traps;

floating impurities (fatty substances) floating in sedimentation tanks;

wet sediment - a suspension, including mainly settling suspended solids, which are retained by primary settling tanks; activated sludge retained in secondary settling tanks - a complex of colloidal microorganisms with adsorbed and partially oxidized contaminants extracted from wastewater in the course of biological treatment; sludge anaerobically digested in clarifiers - decomposers, two-tier settling tanks and methane tanks (anaerobic digestion can be subjected to sludge from primary settling tanks or its mixture with excess activated sludge);

aerobically stabilized activated sludge or its mixture with sludge from primary settling tanks in aeration tanks;

condensed activated sludge in separators, compacted activated sludge or sediment in compactors; dehydrated on mechanical devices;

dried on sludge beds;

thermally dried in various dryers.

Based on the presented material, we divided the organization of wastewater treatment containing oily contaminants into the following stages:

- production of metal hydroxysulphates;
- coagulation cleaning;
- sludge disposal.

The preparation of the coagulant is carried out in a dissolution reactor, where water, sulfuric acid and aluminum or iron oxides are supplied. The synthesis is carried out in 2M sulfuric acid at a twofold molar excess of the solid phase relative to the stoichiometry of the dissolution reaction, at a temperature of 100-110°C for 2-3 hours.

The conditions found by us make it possible to obtain a coagulant solution containing about 10% hydroxosulfates in its composition. After filtering the resulting product, the precipitate is returned to the dissolution stage, and the mother liquor in the mixer is brought to a working concentration of 4.0-4.5 g Al_2O_3/l and dosed into the coagulation purification reactor. The amount of injected coagulant, depending on the amount and type of

pollution, ranges from 0.1 to 0.5 g Al_2O_3/l of runoff. With the introduction of the coagulant, intensive mixing is provided for 1-3 minutes, followed by 2-3 hours of settling.

After filtration, purified water can be used in the circulating water supply system. The resulting sludge sediment contains 45-50% fatty organic compounds at 40-45% humidity. It is expedient to use the sludge of such a composition in the production of water-dispersion paints for construction purposes. In addition, it is possible to utilize the sludge sludge by using it as part of putties, as well as preparing compositions for cold curing of alkyd oligomers based on organoaluminum compounds.

DISCUSSION

The process of coagulation wastewater treatment can be significantly influenced by dielectric and magnetic fields, ultrasonic vibrations, etc. Thus, the imposition of electric and magnetic fields can lead to a decrease in the stability of a disperse system. Ultrasonic vibrations, under certain conditions, can also cause a decrease in the stability of disperse systems and, especially, the elimination of adsorption-solvation and structural-mechanical factors for stabilizing oil-water emulsions.

CONCLUSION

Obtaining sulfates and chlorides of aluminum and iron in a wide range of variation of the parameters of the dissolution process made it possible to establish that the synthesis of coagulants for the purification of oil and fat effluents should be carried out using oxide forms of aluminum and iron, a solution of 2M sulfuric acid, at a molar ratio of Me_2O_3;H_2SO_4 = 2: 3, for 2-3 hours at a temperature of 100-110°C and constant stirring. The possibility of reusing the undissolved precipitate from the coagulant synthesis stage has been experimentally confirmed, which makes it possible to develop a low-waste technology for their production. The intensification of the dissolution of metals during the synthesis of coagulants can be achieved by introducing acetic acid, taken in an amount that provides 0.5-1.5% by weight of sulfuric acid.

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