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Research Article

Enhancement Of Aqua Scourings Technology From Petrochemical

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Abstract. Currently, there are sorbents, both natural and modified, that allow you to simultaneously purify water from various pollutants, for example, from ions of heavy metals and petrolium products. A new modified sorbent was obtained using the sol method. This sorbent is granules of co-precipitated magnesium and aluminum hydroxides with a layered structure. To characterize the structure of the systems under study, analysis was carried out. The study of the mechanism of interaction of the sorbent with heavy metal ions was carried out by studying the chemical composition of the sorbent and the state of adsorbed ions by spectroscopy analysis. It is concluded that the modified inorganic sorbent based on magnesium and aluminum hydroxides has a number of distinctive features and advantages over other filter materials.

Keywords: Aqua scourings technology, enhancement, method of liquidation, petroleum and petroleum products, petrolium spills, water.

Introduction

At present, the problem of environmental pollution is becoming increasingly important. One of the types of environmental pollution is pollution by oil, heavy metals and other toxic substances of both waste and surface waters.

Chemical and petrochemical enterprises are the main sources of pollution of surface and waste waters with oil products. Existing and outdated technologies in the industry create many environmental problems that dramatically worsen the environmental situation[1,2,3,4,5]. Currently, oil pollution of the aquatic environment is often observed by enterprises with frequent wastewater discharges, washing of industrial equipment, and so on. In addition, water pollution processes can occur at all stages of oil production and refining, as well as due to the discharge of oil and gas waste into wastewater, as a result of mixing water with oil and sunken ships in the sea.

Pollution of water resources is one of the most dangerous, since water is the source of life for vegetation, as well as a habitat for many animals. Seeping into the soil, polluted waters saturate it with harmful substances. Thus, the soil itself becomes a source of pollution[6,7,8,9,10]. There are various methods of water purification, which make it possible to effectively extract pollutants, including heavy metals and oil products contained in them in various forms. The existing methods and methods of cleaning have their own advantages and disadvantages. The need to use this or that method is determined by the type, scale of pollution, composition and condition of pollutants. An important role in the choice of one or another sorbent is played by its cost, namely economic efficiency.

Methods of research

The variety of existing methods and an active search for a new technology that makes it possible to effectively combat oil and oil product pollution and at the same time has a low cost, proves the urgency of the existing problem. At the moment, there are various methods and substances to combat oil pollution. They all have their own advantages and disadvantages[11,12,13,14,15]. When choosing a method for responding to an petroleum spill that has entered the environment, the following principles should be considered:

- Carrying out work in the shortest possible time;
- carrying out an oil spill response operation should not cause greater environmental damage than the accidental spill itself.

Thermal method. It is mainly used for oil spills in the aquatic environment, but in comparison with other methods it is used much less frequently. For its application, it is necessary that the oil layer is more than 3 mm, otherwise it will not burn due to the cooling effect of water. Another problem in the implementation of this method is that the combustible fractions evaporate quickly enough, which also prevents combustion.

Mechanical method. This method is most effective in the first hours after the spill. The reason for this is the sufficient thickness of the oil layer. Over time, the layer becomes thinner, and the area of contamination is larger. In addition, the application of this method is complicated when cleaning the waters of shipyards and ports. The fact is that such water areas are polluted with various debris: boards, wood chips and other objects, which prevents the purification of water from oil products. Various modifications of oil skimmers are used all over the world to eliminate oil spills in the aquatic environment. This technology does not completely solve the problem, since after collection, about 30% of oil products remain on the water surface. Another negative side of this method is that when collecting oil with the help of suction devices, oil skimmers absorb a significant

amount of water, about 40-80%. The withdrawn water contains oil products in various states: from floating to emulsified. Additional purification of these waters is required before returning them back to the reservoir, which carries additional costs. Thus, the cost of cleaning a unit of an area contaminated with oil products increases approximately 2 times. Thus, the use of this technology with an oil film thickness of 1-3 mm is not rational.

Chemical method. This method allows to achieve water purification from oil products up to 95%. This indicator is achieved by adding various reagents to the water that react with oil. Such substances remove oil in the form of sediment. The disadvantage of this method is the possibility of accumulation of oil products at the bottom of the reservoir, which leads to secondary pollution of the aquatic environment. Another variation of this method is the use of adsorbents. With the help of them, water purification up to 98% is achieved. The disadvantage of this method is the impossibility of its use for water purification of water bodies with the flow, for example, in rivers. The fact is that to use this method, the volume of water must be limited. Thus, the source of contamination must be localized.

Microbiological method. This method is based on the use of oil-oxidizing bacteria. With their help, microbiological decomposition of oil occurs. On the basis of these microorganisms, a dry powder is made using a certain technology. In addition to the bacteria themselves, it contains biogenic salts necessary for feeding and activating bacteria. The moisture content of this preparation is about 10%. The application of this method is difficult. The reason for this is the slow progress of the process. In addition, the concentration of oil products must be sufficiently low.

Among the advantages of this method, it is necessary to highlight the high efficiency at low concentrations and environmental safety. In addition, this method is economically feasible. Controlled intensification of hydrocarbon biodegradation through the targeted use of selective oil-oxidizing bacteria is a promising direction for the purification of industrial wastewater from oil impurities. Based on this, for the use of this kind of biological products containing active microorganisms, it is necessary to develop an effective technology for the use of these drugs. The best result will be achieved only if this technology is strictly followed during the cleaning process. With the optimal ratio of the consortium of microorganisms and the concentration of biostimulating substances, it is possible to accelerate the biological oxidation of oil pollution by tens and hundreds of times and to reduce the residual content of oil products to the final oxidation products - CO2 and H2O.

Dams. Various types of dams are used to localize oil pollution on soil and water. In addition to dams, earthen barns, dams, as well as trenches for oil drainage can be used. The use of this or that structure depends on various factors: location on the terrain, time of year, the amount of pollution and other factors.

Physicochemical. Currently, this method is recognized as the most effective and safest. The choice of one or another sorbent depends on a number of factors, including the scale of pollution, the stage of cleaning, the required quality of cleaning, as well as the state of the polluting oil products. In this direction, there is an active search for ways to improve the quality of existing substances and the development of new ones. The most promising are natural sorbents and sorbents from plant residues.

In addition to the above traditional methods, new methods and technologies are currently being developed to effectively combat oil pollution.

Biosorption method, the principle of this method is the combined use of sorbents and microorganisms. It is based on the adsorption of contaminants from water by activated carbon, biomodification of resistant contaminants in the microporous structure of the sorbent into a biodegradable form, followed by their oxidation by a biofilm on the surface of the sorbent.

It should be noted that the most effective result is achieved with staged cleaning using various technologies and materials at different stages. The most promising direction in this area is the research and development of sorption methods of purification. Within this area, special attention is paid to natural materials, since they are environmentally friendly and their use is cost effective. The main problem associated with the use of natural materials as sorbents is the insufficiently pronounced sorption properties of these materials. The solution to this problem can be solved by modifying such a material, as a result of which its sorption properties and, consequently, the efficiency of its use are improved. Some sorbents, both natural and modified, make it possible to simultaneously purify water from various pollutants, for example, from ions of heavy metals and oil products. An example of such a sorbent is the latest development - a modified sorbent obtained using the sol method.

This sorbent is granules of co-precipitated magnesium and aluminum hydroxides with a layered structure. The prospect of using this substance is due to the simplicity of its manufacture, high stability, as well as a lower cost per unit of sorption capacity, in comparison with synthetic resins used for similar purposes.

Distinctive feature of this sorbent is that for the first time in the process of purification from heavy metal ions in concentrations exceeding the maximum permissible standards, it is proposed to use a mixture of two metal hydroxides in a ratio of 70:30 obtained by co-precipitation. The use of this sorbent is possible for the purification of industrial wastewater from heavy metal ions. In addition, it can be used to purify water from oil products. The technology for obtaining the above modified sorbent is quite simple and consists in the following.

Co-precipitated aluminum and magnesium hydroxides were obtained in a continuous way, by simultaneously pouring into a fivefold volume of water from three burettes of solutions of aluminum, magnesium and sodium hydroxide nitrates, while the solution was intensively stirred with a magnetic stirrer, the rate of reagent drainage was 2-3 ml per minute, the pH of precipitation 9.5-10.5 depending on the Mg (II) content, while the concentration of aluminum nitrate remained constant, and the concentration of magnesium nitrate was changed so that the ratio AI (III) Mg (II) was, respectively, 50:50, 70:30 and 30:70 weight percent. The content of aluminum and magnesium in the mixture was monitored by X-ray fluorescence analysis. The precipitate was kept in the mother liquor for 24 hours, washed with distilled water by decantation until a negative reaction to NO3 ions "both in solution and in the precipitate itself, then the precipitate was squeezed out and subjected to granulation, placing the pasty material in molds and drying at 120 ° C.

The groundwater in the construction area is 15 to 120 meters below ground level. This means that the salinity of the topsoil is moderate. 4.9 g / l -10.7 g / l clear, odorless when water mineralization is tested (Table 1).

Table 1. The results of the investigation of the water

Components	**Selected place**		
	NRD	**Relief water**	**Petroleum site**
PM	7.40	7.40	7.80
Q	9.50	9.40	9.15
BMK	2.24	2.80	2.84
HPK	22.4	28.0	28.4
Hangover	64.2	32.4	12.3
Ammonium	0.07	0.03	0.02
Nitrogen nitrate	0.47	0.39	0.50
Fe_2	0.018	0.016	0.019
Cu_2	0.01	0.01	0.02
Tink	0.0008	0.0005	0.0012
Chrome VI	0.0032	0.0044	0.0064
Svinets	0.0	0.0	0.0
Cadmium	0.0	0.0	0.0
Hardness	0.0	0.0	0.0
CA_2	7.20	10.20	15.20
Mg	92.2	136	80.2
Chloride	31.6	41.3	136
Sulucle	124	225	2559
Hydrocarbonate	130	190	94.0

Na	113	14.3	311
Mineralization	20.6	59.3	1537
Phenol	511	795	4717
Petroliumproduct	0.001	0.004	0.005
Spav	0.02	0.03	0.04

This modified sorbent is supposed to be used as a filter loading. In order to effectively use the sorbent in the purpose of the filtering material, it is necessary that it has certain properties, primarily a granular structure. This can be achieved by granulating the sorbent. The choice of the size of the granules depends on the hydraulic resistance of the speed apparatus Thus, the size of the granules is a compromise solution between the desire to reduce the hydraulic resistance of the apparatus and to ensure high rates of mass transfer.There are a fairly large number of ways to obtain grunules of various inorganic sorbents. This or that method depends on the composition of the synthesized sorbent and the raw material used.

The main factors in choosing a method for granulating a modified sorbent based on magnesium and aluminum hydroxides were the strength of the obtained granules and their guaranteed availability for mass transfer processes. Given the fact that magnesium hydroxide has the ability to polycondensate with the formation of mechanically strong structures, a binder should not be added in this case.

Depending on the type of device, its design, type and installation site, it can collect various types of pollutants: garbage, dirt, oil and its processing products. Skimmers of industrial type, for example, are designed to remove petroleum products and crude oil from waste or rounded water in production, as well as to remove such pollutants, including fuel oil and oil oils, from technical water, which is stored in tanks, in order to purify it before repeat.

Fig.1. Skimmer for the purification of petroleum

The use of such devices at the production of the above figure 1 is beneficial from an economic point of view, since it reduces both material and time costs for purification of water from petrolium pollution.

To characterize the structure of the systems under study, an X-ray phase analysis was carried out. The hexagonal lattice of the coprecipitation products of aluminum and magnesium is built of ordered Mg (OH) 2 layers, between which disordered layers of aluminum hydroxide are located, however, this point of view is not shared by all authors of the works under consideration. Therefore, it is impossible to predict in advance the structure of coprecipitation products in the systems of interest to us. Samples of co-precipitated hydroxides, dried at a certain temperature, were ground in an agate mortar and compacted in cuvettes in which the survey was carried out.

The obtained data of X-ray phase analysis allow us to conclude that, in the process of coprecipitation, not magnesium aluminate is formed, but "double layered structures" built of ordered layers of magnesium hydroxide, between which disordered layers of aluminum oxyhydroxide are located.

Results

The solubility product of copper (II), cadmium (II), zinc and Evinz (II) hydroxides is hundreds of times less than the solubility product of magnesium hydroxide; therefore, the equilibrium of the chemical interaction shifts towards the formation of sparingly soluble hydroxides. In addition, magnesium ions additionally diffuse from the adsorbent into the water, which also contributes to an increase in the pH of the medium. Diffusion of

magnesium cations is possible due to the low strength of bonds with the crystal lattice of the cation exchanger. Thus, micelles of heavy metal hydroxides are formed with their further enlargement into aggregates, the formation and growth of a colloidal structure due to the forces of electrostatic interaction between the positively charged surface of the adsorbent grains and negatively charged micelles of heavy metal hydroxides. It follows from this that the absorption of Cu2 +, Sn2 +, Cd2 +, Pb2 + ions occurs not only due to the ion exchange of sorbed cations with magnesium ions, but also due to the formation of hydroxides, aqua and hydroxo complexes formed as a result of the interaction of metals with OH groups on the surface sorbent.

Sorption of copper ions is accompanied by the formation of chemical compounds. The resulting sorbent makes it possible to effectively purify waters contaminated with ions of heavy metals in their joint presence. Its use is also possible for the extraction and subsequent concentration of heavy metal ions from polluted waste waters of various industrial enterprises. This modified sorbent can be used as a component of filters used for the purification of waste and melt water, for example, in snow-melting installations. The modified inorganic sorbent based on magnesium and aluminum hydroxides has a number of distinctive features and advantages over other filter materials. Specifically:

- high sorption capacity, which allows purification of natural and waste waters simultaneously from ions of heavy metals, oil products, phosphates and organochlorine compounds;
- the efficiency of water treatment is not affected by fluctuations in the concentration of one or more pollutants. The modified sorbent allows you to simultaneously extract the entire complex of impurities even at low water temperatures;
- simplicity, reliability, efficiency of production technology;
- regeneration of the load directly in the filter within an hour;
- as a result of the technological process, a small amount of environmentally friendly waste is generated.

The use of this sorbent is cost-effective and is due to the following factors:

- has a lower cost in comparison with sorbents of a similar purpose, which is 5-10 times less than the cost of activated carbon and ion-exchange resins;
- when using a modified sorbent, the amount of chemicals used, such as chlorine, coagulants and flocculants, is reduced;
- the use of a sorbent in wastewater treatment will improve the environmental safety and efficiency of structures;
- wastewater treatment avoids payments and fines for the discharge of untreated wastewater.

Conclusion

Consequently, the sorbent is a promising development and, possibly, in the future will be widely used for wastewater treatment. Such treatment will allow the reuse of water in the production cycle, which will have a significant impact on saving resources. This technology will make possible the transition to sustainable water consumption and the creation of closed production cycles. Currently, the cost of the production process is a very important factor that must be considered when choosing a technology. Economically, it is much more profitable for the enterprise to use a minimum of fresh water in the production process. The use of treated wastewater in repeated production cycles minimizes the consumption of clean water, as well as the amount of wastewater.

There are suggestions that this modified sorbent can be used for water purification from oil pollution, but research in this direction has not been carried out so far. Thus, the study of the interaction of this sorbent with oil products contained in water for pollution control is an urgent scientific task.

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