# INVESTIGATION OF THE SORPTION PROPERTIES OF THERMAL POWER PLANT SLUDGE

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**Abstract:** The authors suggest using the sludge of chemical water treatment at thermal power plants as a sorbent for treatment of wastewater from oil products in thermal power plants. The results of studies of the basic sorption properties of the sludge are presented.

**Key words:** sludge, sorbent, treatment, wastewater, thermal power plants

The rapid growth of production and increased requirements for water quality require more efficient and environmentally friendly ways of treatment of natural and waste water of enterprises of the energy complex. The waters polluted with oil and oil products occupy a special place. The source of their appearance in wastewater of thermal power plants (TPPs) are fuel oil facilities, electrical equipment, auxiliary services (garages). Oil-containing water is an environmental threat due to the significant excess of maximum permissible concentrations (MPC) compared to natural water. There are many ways to clean wastewater from oil products, but the most effective way to remove them to trace amounts is the method of sorption There are many different types of mineral and organic sorbents of natural and artificial origin, suitable for cleaning water from oil products, the best of which recognized granulated activated carbon (1). At present the problem of finding new sorbents has become urgent. The issue of using cheap mineral sorbents, as well as various kinds of waste for water treatment is relevant because of the low profitability and simultaneously high cost of wastewater treatment systems. When using new sorbents it is necessary to analyze such indicators as efficiency, cost, disposal costs and environmental friendliness. It is proposed to use sludge of chemical water treatment (CWT) TPP as an oil sorbent. At present the slime of chemical water treatment of a thermal power plant (relating to the 5th class of danger, i.e. practically not dangerous) is utilized as a waste. Stockpiling of sludge waste is carried out on sludge dumps, which are open platforms, not equipped with means of environmental protection from filtration waters. Despite the fact that this sludge does not contain highly toxic substances, there are serious problems associated with its storage and subsequent storage. This results in alienation of large areas, the threat of salinization, salinization of groundwater of adjacent areas and deterioration of the hydrochemical regime of the nearest water bodies. Sewage sludge of CHPP clarifiers is a product of liming and coagulation, a natural raw and stable mixture of a certain composition (2). The chemical composition and the ratio of sludge components depend on the chemical composition of raw water under treatment. The chemical composition of the sludge is given in the table. Ash content of the used sludge is 89%, organic carbon - 11%, humic acids - up to 12%.

Approximate chemical composition of the sludge from the water treatment plant

| Концентрация веществ, мг/дм$^3$ | | | | Концентрация веществ, мг-экв/ дм$^3$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $Ca^{2+}$ | $Fe^{3+}$ | $Mg^{2+}$ | $Hg^{2+}$ | $Ni^{2+}$ | $Zn^{2+}$ | $Mn^{2+}$ | $Cr^{3+}$ | $Pb^{2+}$ | $Cd^{2+}$ | $Cu^{2+}$ |
| 276 ± 36 | 1,39 ±0,5 | 36,5 ±7,3 | ≤0,1 | 29 ± 11 | 15,4 ±5,5 | 480 ±163 | 27,3 ±8,7 | 27,3 ±8,7 | 3,2 ±1,0 | 16,3 ±4,6 |

When choosing a sorbent one of the most important performance indicators is its sorption capacity which is determined by the maximum amount of petroleum product absorbed by mass unit of the sorbent. To assess the sorption properties of the sludge were carried out experiments to determine the content of petroleum products in water . Sludge has an average hydrophobicity to different levels of oil absorption under the same conditions. At the same time hydrophobic sorbents are, as a rule, oleophilic, that is easily wetted by oil and oil products. Sludge is a medium-wetted sorbent. The results of the study of the adsorption process kinetics by weight method under the conditions of immersion of the sludge sample in pure samples of petroleum products show that the sorption capacity of the sludge is realized during the first minutes of contact with the waste water. In 25 minutes it reaches 0.5-0.7 g/g for turbine oil, diesel fuel and gasoline and 1.5 g/g for fuel oil, which is 56-78% and 150% correspondingly and it does not increase further. This indicates the onset of sorption equilibrium. The results of the investigation of the sorption capacity of a sludge sample (2 g weight) in relation to oil by the weight method are presented in Fig. 1.

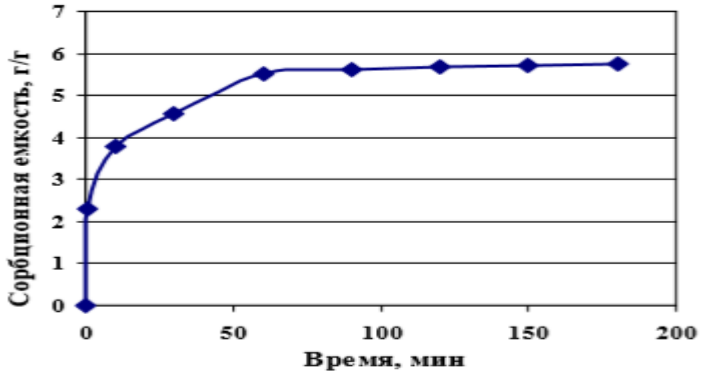


Fig. 1. Sorption capacity of the sludge for oil-containing water

Determination of mass concentration of oil products by infrared spectrometric method was carried out on the AN-1 device. The results of determining the oil content in wastewater, depending on the loading height and mass of the sorbent are shown in Fig. 2.

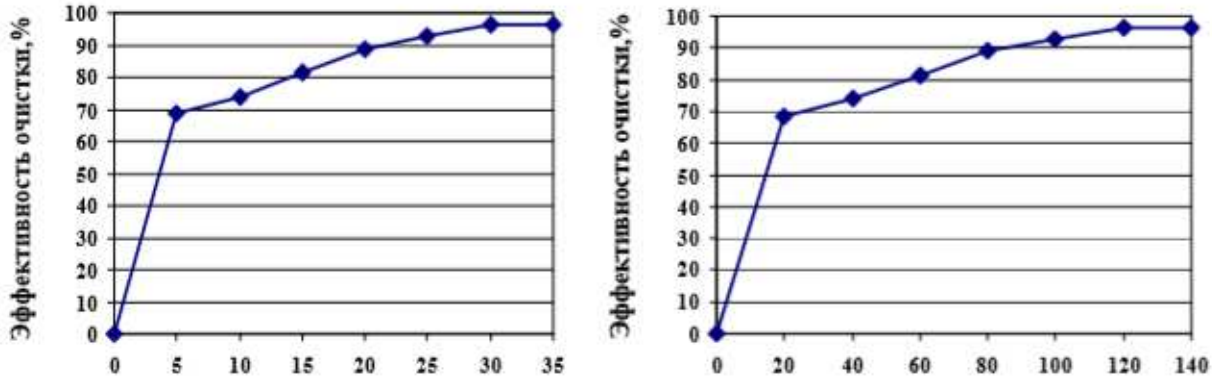


Fig. 2. Dependence of treatment efficiency on the loading height and loading weight

According to the results shown in Fig. 2 we can conclude that the efficiency of TPP wastewater treatment of petroleum products is directly proportional to the height and weight of the load.

Increasing the height of sludge layer more than 30 cm does not increase the efficiency of purification, because there is a sticking of the upper layers, which leads to a decrease in the active surface of the filtering material [3]. The convergence of the results showed that any of the above methods can be used to assess the sorption properties of the sludge. The obtained data can be used for construction of an adsorption isotherm which will allow determining the optimum parameters of industrial purification units.

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