COMBINED METHOD OF CLEANING OF WASTEWATER FROM ORGANOPHOSPHORUS PESTICIDES

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Abstract. *The article describes the proposed effective method for the combined treatment of wastewater from the production of organophosphorus pesticides. The combination of wastewater ozonation with biological treatment has been shown to provide high efficiency.*
Keywords: *organophosphate pesticides, sludge, wastewater, activated carbon, COD.*

It is most promising to use various methods, in particular biological methods with oxidation methods, to increase the effectiveness of organophosphorus pesticides' wastewater detoxification and treatment. Given the growing scale of pesticide use, one of the most important tasks facing researchers is to develop methods to neutralize pesticides.

The analysis of literature data showed that the combination of methods is the most promising as a basis for creating a universal technology for the neutralization of organophosphorus pesticides in wastewater. For example, combining biological methods with oxidation methods. Currently, the use of activated sludge is a common and universal method of wastewater treatment. The efficiency of the biological treatment method can be increased by using technical oxygen, highly active sludge species, biochemical oxidation stimulators, as well as by improving the structure of aerotanks, aeration equipment and active sludge separation systems [1,2]. Treatment methods based on ozone oxidation are considered to be the most widely used method, because the effluents of the enterprises in question contain low concentrations of stable organic substances with oleophilic properties.

Non-polar (activated carbon) and polar (iron and aluminum hydroxides) sorbents are successfully used in the technology for cleaning natural and wastewater from pesticides. The question of the validity of introducing such a method in relation to organophosphorus compounds remains open. The easy solubility of these elements does not help to quickly remove them from water using coagulants.

Scientists have carefully studied the effect of organophosphorus pesticides (OPP) during active coagulation. The results of the observations did not reveal a decrease in the amount of phosphamide. Thus, changing the dose of coagulant has almost no effect on its removal efficiency. On the contrary, increasing the dose of ferric chloride coagulant to the level of 500 mg/l leads to 80% neutralization of karbofos. DDVP (O,O-dimethyl-O-2,2-dichlorovinylphosphate) formed as a result of its hydrolysis is released when the coagulant is affected by a solution of chlorophos in water. It is reasonable to assume that the reduction of organophosphorus pesticides during coagulation occurs not only due to degradation, but also due to hydrolytic degradation.

In the production of representatives of organophosphorus compounds such as etaphos and heterophos, the process of wastewater treatment occurs when they are saturated with iron salts at pH 2.5-3.0. At the same time, a much higher percentage of cleaning is achieved - 80.5%.

Despite the fact that water purification from pesticides in the process of coagulation has achieved some success, the scientific community has recognized this technology as ineffective.

Tests have shown that using activated carbon filters for water treatment can reduce parathion and malathion content by more than 90%. In addition, adsorption using coal ensures their further chemical changes. The effect of different activated carbons on the removal of phosphamide, carbophos, chlorophos and DDVF from water showed that their similar composition and specific adsorption values can be compared.

Natural sorbents have the ability to remove pesticides from water. Here, thiophosphoric acid and new cations, which replace the natural exchange complex of montmorillonite, come into effect.

Intensive hydrolysis of some organophosphorus pesticides is also noted at standard temperatures. Hydrolysis of trichlorometaphos is carried out in bentonite and other clay rocks. The mineral usually acts as a sorbent for hydrolysis products. An increase in the amount of minerals was noted when switching from Na to Ca and Al samples. Coordination-bonded water is responsible for the hydrolysis of pesticides.

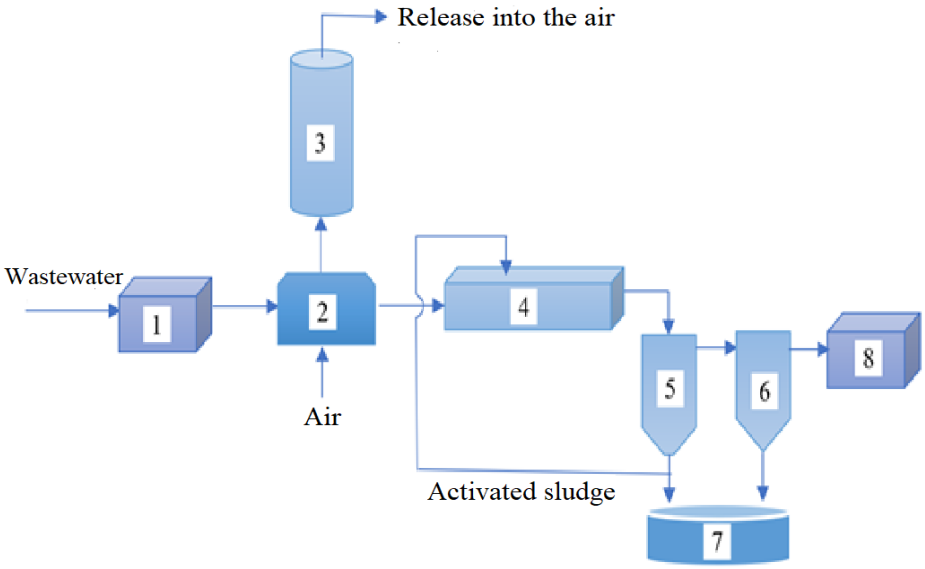
Catalytic activity of minerals can be increased by adding metal ions to the exchange process. After all, it is known that copper ions act as a catalyst for the hydrolysis of many organophosphorus pesticides, and their participation in the exchange process increases the catalytic decomposition of thiophosphoric acid esters. During many experiments, it was found that maximum purification of water from pesticides is carried out using filters working on the principle of reverse osmosis. Such devices are very common today and are used for water purification not only in industrial conditions, but also in residential buildings [4,5].

Based on the existing prototypes, we will combine the ozonation device and the technological scheme of wastewater treatment from pesticides. Initial data: wastewater consumption Q_w=100 m3/h; COD=250 mg/l; ozone demand mole coefficient K_{O3}=10.20 g/g; The conversion factor of K_{COD} to the amount of pollution is K_{COD}=0.20 g/g, on the basis of which we calculate the main dimensions of the ozonation device. Waste water from the production of organophosphorus pesticides - washing water from the production line is collected in tank-collector 1, and then it is sent to the ozonator 2 by means of a pump.

The used ozone-air mixture is sent to the catalytic load filter 3, then the purified air is released into the atmosphere, the generated heat can be used for the household needs of the enterprise. After ozone treatment, water is sent to the sump 4 - for precipitation and separation of organophosphorus compounds, and then the treated water is sent to biological treatment 5 to remove substances not oxidized or partially oxidized by ozone. After biological treatment, the water is cooled again, and the used sludge is returned to the aerotank. The sediment is removed from the water using a centrifuge 6. The sediment from the pipe is fed to the sludge-collector 7, after thickening, it is sent from the collector for suspended matter to the thermal incinerator together with petroleum products and synthetic surfactants. Treated water is collected in the collector 8. Figure 1 shows the technological scheme of wastewater treatment for the production of organophosphorus pesticides.

Figure 1.

Technological scheme of wastewater treatment of organophosphorus pesticides production



1 - collection tank; 2 – ozonation device; 3 – charcoal filter; 4 – airotank; 5 – sump; 6 - centrifuge; 7-sludge collector; 8 - clean water collector.

The proposed device for the combined treatment of organic phosphorus pesticides production wastewater consists of an ozonator with a capacity of 60 m^3/h and an aerotank for complete biological treatment. The efficiency of the device is 93%, the controlled parameters: COD=30 mg/l and glyphosate=0.001 mg/l, do not exceed the agreed LAD (Limit allowable discharge) standards. The category of work at the enterprise is rated as average - IIa. According to the category of explosion and fire hazard, the buildings belong to category D, according to the classification of explosion zones, they have zone B-IIa, fire hazard - P-III. Protective earthing is carried out, it was determined that 21 vertical earthing devices are needed to ensure electrical safety in the workplace of the ozonator.

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