ANALYSIS OF WASTEWATER AERATION METHODS IN AERATION TANKS

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Annotation: The quality of biological purification largely depends on the operation of aeration systems. This article presents an analysis of the search for the most economical and effective variant of wastewater aeration methods in aeration tanks, provides brief characteristics and conditions of use, and discusses the advantages and disadvantages of mechanical, pneumatic and jet aerators.

Key words: wastewater treatment, aeration system, aeration tank.

Aeration is the process of saturation of a liquid with air through aerators, by means of its forced supply with the help of compressor blowers. Aeration is very widely used in many sectors of the national economy. But most actively, it is used in water treatment and wastewater treatment.

The saturation of water with oxygen in the air is the basis for the biological process of cleaning household wastewater in sewage treatment plants. The tanks in which aeration takes place are called aeration tanks. They create comfortable conditions for the vital activity of microorganisms and bacteria, namely, the optimal concentration of dissolved oxygen and the drain temperature are maintained.

Due to aeration, when effluents enter, a gradual formation of activated sludge flakes from the substrate occurs. In the future, colonies of aerobic bacteria and microorganisms develop on it, which absorb it, that is, they process both complex fats, urea, and other complex pollutants into simpler ones (for example, ammonium compounds – up to molecular nitrogen gas). But all this is impossible without aeration, without dissolved oxygen. If there is no forced, active air supply in the installation, cleaning will be carried out only due to precipitation and rotting processes, which means the presence of odour, and this is unacceptable in most cases. For the aeration process, and ultimately for effective deep biological wastewater treatment, it is very important to understand that it is oxygen in the supplied air that plays a key role. That is, the compressor blower must be provided with the possibility of fresh air intake from the outside. For this purpose, in all autonomous sewage systems, there are either special

holes in the housing or the so-called "fungus" located on the lid of autonomous sewage stations.

The importance of aeration explains the desire of researchers to study this process as deeply as possible, calculate the optimal design of aerators and select the most suitable materials for these devices.

Currently, mechanical aerators, pneumatic aerators and jet aerators are used on an industrial scale.

Pneumatic aeration system.

Aeration of water is carried out by supplying air under the surface of the water. Depending on the type of aerator used, there are:

- fine bubble aeration with the size of air bubbles 1...4 mm. In this case, ceramic, fabric and plastic aerators are used;
- medium bubble aeration, the size of the bubbles is 5...10 mm. For this purpose, perforated pipes, slit aerators, etc. are used;
- large-bubble aeration with a bubble size of more than 10 mm. Pipes and nozzles open from below are used.

Depending on the pressure created at the outlet, aerators of low (up to 10 kPa), normal (10...50 kPa) and high (over 50 kPa) pressure.

Advantages of aerators Pneumatic aeration type:

- Thorough mixing of the waste liquid;
- Any location;
- Uniform aeration and high oxygen mass transfer due to slit perforation;
- Minimum installation costs;
- High resistance to oil, gasoline and chemicals;
- High energy savings compared to porous aerators, much lower pressure losses;
- Extremely long service life;
- Wide range of operation, optimal with adjustable air supply;
- Temperature range -40°C to 90°C

The porous aerators (filter plates), which are the most common in the practice of wastewater treatment to date, have numerous disadvantages.

The most famous of them are:

- increased clogging of pores with dust, lack of effective methods of plate regeneration;
- insufficient strength of the material of the plates, which leads to their frequent destruction;
- significant unevenness of aeration along the length of the aerotanks, due to the inhomogeneous air permeability of the plates;
- the complexity and complexity of performing repair work to replace the destroyed plates.

Mechanical aeration

Mechanical aerators are quite widespread in the practice of wastewater treatment. There are two main types of mechanical aerators - with the vertical and horizontal axis of rotation.

Aerators with a vertical axis of rotation can be surface and buried in a liquid; according to the type of aeration mechanism, they are divided into turbine, impeller and jet. Aerators with a horizontal axis of rotation are surface (rotary) and agitators.

The mechanism of the water aeration process in the cases under consideration can be divided into the following types:

- the suction of air moving in the liquid by the blade through the surface due to a decrease in pressure behind the blade;
- oxygen saturation of numerous jets and liquid droplets formed by the spraying action of a mechanical aerator and having a large contact surface with air;

•mixing of liquid and air in the inter-blade space of aerators under conditions of sharp pressure drops between the zones of high and low pressure, respectively, in front of and behind the moving blades;

•air suction by liquid jets falling or injected into the liquid mass;

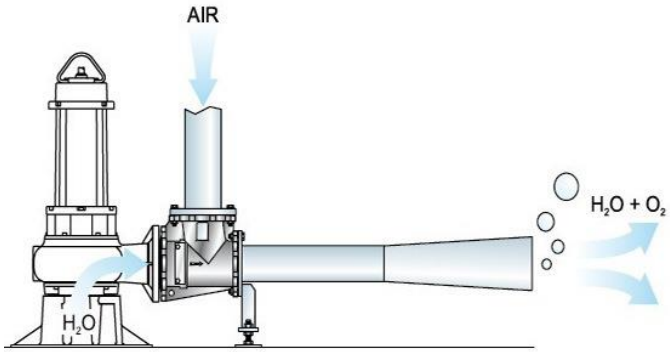
•the dissolution of oxygen through the exchanging layers of the liquid surface during its turbulent mixing.

Mechanical aerators have a number of advantages over pneumatic ones since their installation does not require the construction and operation of blower stations, and air supply communications, they are easy to manufacture and operate and have a high oxidizing ability. Their disadvantages include the need for a large number of aerators to be installed with large structures, the need for scarce equipment (gearboxes, gear motors), as well as insufficiently high reliability of operation.

Jet aeration

The principle of operation of the aerator is based on the ejecting action of the water jet in the narrowing so that the water is saturated with air bubbles.

Studies to improve the technical characteristics of equipment for aerating liquids have led to the emergence of injection static devices that disperse gas with liquid jets created by a pump. Compared with the aerators previously considered, jet machines have the following advantages: a high rate of gas dissolution in liquid and low energy consumption, as well as simplicity of design, ease of operation and reliability of operation. Due to these advantages, jet machines have recently been increasingly used for effective heat and mass transfer in various industries. In particular, they are used in aeration tanks, oxidizing channels and other biological wastewater treatment facilities; in the production of carbonated beverages; medical and microbiological industries



Advantages of aerators (jet) ejector type:

- They are easy to install and do not require regular maintenance, as there are no moving elements.
- The installation of a jet aerator does not require emptying the pool or tank.
- Reduce odours, have a high oxygen efficiency transfer - small bubbles create large contact surfaces between air and water, and high turbulence renews these contact surfaces.
- Economical installation.
- Easy control of oxygen supply, as there is no need for compressed air.
- There is no formation of deposits - an intense jet stream directed to the bottom of the tank prevents the deposition of biomass.
- They work regardless of changes in the water level.
- There is no clogging since the hydraulic ejectors are equipped with an unsaleable impeller (impeller) and a large diameter nozzle to eliminate the possibility of clogging.
- Very low noise level.
- There are no problems with sealing.
- When the unit is inactive, water can enter the air pipeline without negative consequences, and when restarted, the exciting effect of the ejector displaces any liquid from the pipe.

Disadvantages of ejector (jet) aerators: they are used for relatively small treatment facilities since the radius of action of the ejector aerator is small. It is especially effective in small and medium-capacity tanks, or in rectangular pools at wastewater treatment plants.

In conclusion, pretty the use of new materials and modern equipment for air dispersion has made it possible to increase the reliability of well-known aerator designs, but not to fully eliminate their shortcomings.

Aeration systems related to medium-bubble large bubbles have low rates of dissolution of oxygen in the air in the waste liquid. The disadvantage of all pneumatic and airlift aerators is the need to use unreliable, expensive and difficult-to-operate blower equipment. A frequent problem that disables the system of fine-bubbled pneumatic aeration is also the clogging of the pores of the aerators both when the waste fluid enters the aerator when the air supply is turned off, and the ingress of the scale of the air ducts from the inside, leading to siltation and culmination.

The low reliability of mechanical aerators is caused by increased wear of gear motors, strong vibration, and corrosion of the main working elements. Combined neuro mechanical aerators combine the disadvantages of pneumatic and mechanical.

Hydraulic ejector aerators have a limited service area and low aeration efficiency, which leads to high energy consumption for oxygen dissolution and, as a result, can only be used at low-capacity stations.

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