

PROBLEMS OF EFFECTIVE HOMOGENISATION OF CONTENTS OF BIOREACTORS WITH ACTIVATED SLUDGE

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The effectiveness of the wastewater treatment process in bioreactors depends, among other things, on the proper degree of mixing the wastewater with the flocculent suspension of activated sludge. In SBR reactors wastewater treatment is carried out in one chamber in cyclic successive cycle phases, which allow to control of aerobic and anaerobic conditions and ensure homogenization of the bioreactor contents. As activated sludge technology was originally used for carbon organic compound oxidation and nitrification, hence aeration systems were used to mix the volume of bioreactors. Aeration in bioreactors is one of the most energy-intensive processes performed during wastewater treatment. Turbulent mixing by means of aeration is quite beneficial for activated sludge, which should remain in motion, but the stagnant zones that form do not allow a high degree of homogenization to be achieved. For the required combined removal of nitrogen and phosphorus carbon compounds, the need for non-aerated mixing systems has also arisen.

The largest group of bioreactors in which the homogenization of wastewater with the process factor takes place are the systems with mechanical mixing. Depending on the type of mechanical stirrer used in the bioreactor tank there is a complex character of movement in space, which includes circular (along the direction of the stirrer's movement around its circumference), radial (along the tank radius) and axial (parallel to the stirrer's axis of rotation). Circular motion adversely affects the mixing process, so in the tanks are installed special baffles in the form of steering wheels that interfere with this type of movement. When designing mixing systems in bioreactors, a necessary condition that should also be taken into account is to avoid the possibility of destruction of activated sludge flocs due to high shear stress generated by the rotating stirrer and the edges of the baffles.

An analysis of the state of the art has shown that the mixing systems used so far make it possible to achieve a high degree of homogenization of the mixture in the tanks, but the stirrers used do not have elements enabling scraping of falling solid particles from the bottom of the tank and their transport to the level of the liquid table.

Thus, a system for mixing wastewater activated sludge, and the overlying water in SBR bioreactors was developed as a slow-speed helix-shaped ribbon agitator with an integrated sludge transport system from the bottom of the bioreactor to the wastewater table that would provide suitable conditions for floc development while minimizing energy inputs. The transported and dispersed particles can then fall by gravity, and the slow-speed motion of the stirrer will allow them to mix evenly with the liquid ensuring complete homogenization in the reactor volume.

The proposed solution can be used to conduct further research on the energy consumption of the technological process and to isolate species or groups of organisms from activated sludge with particular potential to be used as bioindicators (biomarkers) of improperly conducted mechanical mixing.