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Environmental biotechnological processes for 4-nitrophenol removal from water with pre-catalytic ozonation

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Abstract

The dependence of 4-nitrophenol biodegradation rate from its concentration in the aqueous phase was studied. The concentration of 4-nitrophenol in water at which this substance stops biodegradation (500 mg/l) was determined and it was shown that biotechnological purification of such water became impossible. In order to solve this problem a two-stage water purification process from 4-nitrophenol with an initial concentration corresponding to complete inhibition of biodegradation was proposed. First step of this process is catalytic ozonation to reduce the xenobiotic concentration to level which is acceptable for biodegradation. Second stage of this process is mineralization during biotechnological process using a mixed culture of microorganisms isolated from activated sludge of biological treatment plant. To determine quantitative regularities for effective control of 4-nitrophenol biodegradation rate, description of this process using Haldane's and Luong's biokinetic models was carried out. The parameters of these models were calculated. Adequacy of these models was analyzed. It was found that Luong's model can be used for more accurate prediction of 4-nitrophenol biodegradation rate at different conditions of the process. To determine the optimal conditions of catalytic ozonation of water containing 4-nitrophenol dependence of mineralization rate on the content of the composite magnetically separable catalyst containing amorphized titanium dioxide and magnetite was studied. It was shown that optimal catalyst concentration for ozonation process was 1.2 g/l, because further enhancing of its content did not increase mineralization rate.

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