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Impact and Kinetic Analysis of Bioaugmented Activated Sludge in Treatment Process of Pharmaceutical Wastewater

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Extended Abstract

In recent years, concern about occurrence and fate of pharmaceuticals that could be present in water and wastewater has gained increasing attention. During the pharmaceutical production processes, raw materials, solvents, reaction intermediates and products can be released into wastewater. With the public's enhanced awareness of eco-safety and industry's effort to minimize environmental impact, methods based on microorganisms have become more accepted measures of removing pollutants from aquatic systems. Bioremediation technique called bioaugmentation has been gradually considered as a possible solution for the recalcitrance of biorefractory organic compounds in wastewater, where activated sludge is inoculated with specific microorganisms able to produce versatile enzymes to enhance biodegradability. Although microbial processes are very complex, individual processes or group of processes can be described by a kinetic model. Kinetics provides basis for process analysis, can be helpful for understanding the behaviour of biological process and predicting the concentrations of organic matter in the system.

In this study a bioremediation of pharmaceutical wastewater from real industrial stream, using activated sludge and bioaugmented activated sludge with isolated mixed bacterial culture, was investigated. The experiments were conducted in batch conditions, at initial concentration of organic matter in pharmaceutical wastewater, expressed as COD, 5.01 g dm^{-3} and different initial concentrations of activated sludge and bioaugmented activated sludge, which ranged from 1.16 to 3.54 g dm^{-3}. During the experiments COD, pH, concentrations of dissolved oxygen and biomass were monitored. Microscopic analysis was performed to monitor the quality of activated sludge.

Process efficiency of pharmaceutical wastewater treatment was approximately 65 %, where in experiment with bioaugmented activated sludge, the same efficiency was obtained 24 hours earlier. Kinetic analysis was performed using two models. For bioaugmented activated sludge, kinetic parameters μ_{max}, K_S and Y in Monod model were estimated to be 0.86 d^{-1}, 24.50 g dm^{-3}, 0.18 g g^{-1}, while kinetic parameters μ_{max}, K_S, K_i, Y and k_d for Endo-Haldane model were evaluated to be 1.69 d^{-1}, 44.3 g dm^{-3}, 132.0 g dm^{-3}, 0.22 g g^{-1}, 0.001 d^{-1}, respectively. The lowest deviations and very good matches with the experimental data were achieved using the Endo-Haldane model. It indicates that this model best describes the process of biodegradation, because it incorporates the effects both of inhibition and endogenous metabolism. Microscopic examination of activated sludge showed that bioaugmentation does not affect the formation of the flocs, but increases efficiency of the bioremediation in the way that the pharmaceutical wastewater treatment is faster and more efficient with bioaugmented activated sludge.