The Effect of Pharmaceuticals on Nitrate Concentration and Removal Rate in a Simulated Bardenpho Reactor

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Today, the effects of pharmaceuticals on the environment and living organisms are largely unknown, primarily due to lack of studies in the lab and field. Additionally, there is no standard for testing or removal of pharmaceuticals from wastewater or the environment. Denitrification is a crucial process necessary for ecosystems to thrive and for wastewater treatment. If this process is affected by pharmaceuticals, the consequences could be significant. The experiment was designed to observe the effects that commonly used anti-hypertensives (nebivolol, diltiazem) and oral analgesics (acetaminophen) have on denitrification inside simulated Bardenpho reactors. Model Bardenpho reactors were constructed, and 15 L treated test water was cycled through the reactors at a rate of 13.25 L per hour. The nitrate level was adjusted to approximately 25 mg/L. A therapeutic dose of the selected pharmaceutical was added to begin each trial. Denitrifying bacteria mixtures were added to the main denitrification stages of the reactors. Nitrate level was measured using an ISE probe. Of the three medications used, only nebivolol had an observed effect on denitrification. The average rate of change for the control was 2.56 mg/L, compared to 1.95 mg/L for nebivolol, showing a 23.8% decrease in average rate of denitrification. An ANOVA test was conducted, with a calculated p-value of 0.00076. With the aging population and rising prescription rates, the presence of pharmaceutical ingredients will increase in the environment. The implications of this experiment shows that further research must be conducted to evaluate the possible effects that pharmaceuticals have on denitrification.

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