Effects of Sound Exposure on the Phosphorus Uptake of Polyphosphate-Accumulating Organisms

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Phosphorus is a problematic pollutant; wastewater treatment plants use two methods to remove phosphorus from wastewater: chemical precipitation and biological nutrient removal. In the latter, Polyphosphate-accumulating Organisms (PAOs) are vital and naturally remove phosphorus via uptake. It was hypothesized that sound exposure ranging from 2-8 kHz at 80 decibels would increase phosphorus uptake of PAO over 24 hours. The setup included two sound-resilient chambers, each holding 200 mL of primary clarifier sample; one was exposed to sound frequencies, and the other was not. Orthophosphate and total phosphate measurements were taken initially and after 24 hours; three trials were run for each frequency. Analysis shows the negative percent change of orthophosphate and total phosphate was greater when exposed to 2.5, 5, and 8 kHz. The most significant change was at 8 kHz with a mean change in orthophosphate (mg/L) of 4.358 versus 6.5 when exposed to sound; p-value=0.00569. 2.5 kHz had the most significant change of total phosphate (mg/L), being 1.033 without sound compared to 3.892 with sound; p-value=0.01684. As orthophosphate (free-floating phosphorus) decreases over time, PAOs likely incorporate phosphorus into their bodies. Samples with sound exposure show greater decreases in orthophosphate over time, which is significant for phosphorus absorption. Total phosphate levels show that sound exposure affects phosphate conversion into forms untraceable by normal phosphorus testing. Sound exposure is shown to be an applicable enhancer of biological nutrient removal due to its effects on PAOs and would be an efficient addition to wastewater treatment plants' secondary treatment process.

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Third Award of $1,000