Removing Aqueous Phosphate with Sand Adsorption Columns

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Nutrient pollution is a widespread and serious contamination issue that occurs when excess aqueous phosphate causes severe algal growth, which curtails dissolved oxygen in freshwater bodies through eutrophication. My five years of data from monthly water monitoring demonstrate that there is an alarming level of nutrient pollution in the Logan River, as visual observation and turbidity readings indicate abnormally large amounts of algae. My observations were validated by the Utah Division of Water Quality, as it recently found the downstream Logan River to be environmentally impaired due to its lack of dissolved oxygen. Logan City's wastewater treatment plant releases 12.3 million gallons of wastewater effluent daily into the Logan River, and phosphate concentrations in the effluent are regularly above 2.0 mg/L. Thus, Logan City's wastewater treatment plant is a possible source of nutrient pollution. I resolved to research a method for alleviating the impacts of nutrient pollution by developing an approach for significantly decreasing phosphate in wastewater effluent. I decided to focus my investigations on adsorption columns, as they were economical and effective at filtering water in literature. Ultimately, I found that locally-sourced silica sand is the most effective filter medium, with 10 mL sand removing 98% phosphate from the first 60 mL of 2.30 mg/L phosphate solution. Assuming an effluent flow rate of 12.3 million gallons/day, it would require 6.22 * 10^2 kg silica sand to remove all phosphate from effluent for 24 hours (based on experimental findings). My investigations highlighted a potential low-cost treatment for phosphate contamination in water, as locally-sourced silica sand proved to be effective at removing aqueous phosphate.

Awards Won: