Use of Ozone to Remove Soluble Organic Nitrogen and Soluble Organic Phosphorus from Wastewater

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Abstract

Nutrient pollution in surface waters can lead to eutrophication. Since a significant source of nutrients in water comes from wastewater discharges, increasingly stringent limits have been imposed on wastewater treatment plants. To meet these limits, higher-level treatments are needed to remove soluble organic nitrogen (SON) and soluble organic phosphorus (SOP) compounds which are resistant to removal through standard treatment. Other studies have found that these compounds are bioavailable to algae.

One possible way to remove SON and SOP compounds is to use advanced oxidation treatment processes. Previous research studied the impacts of ultraviolet light and hydrogen peroxide on removal and changes in biodegradability of SON and SOP. These treatments did not reduce the concentrations of soluble organic nutrients. Lab-scale investigations were performed on real wastewaters to determine if use of ozone is an effective method for removing SON and SOP. An ozone generating machine was used to make stock solutions of concentrated ozone, which was then added to the wastewaters to achieve desired ozone concentrations. The concentrations of nitrogen and phosphorus species in the wastewater samples were quantified before and after treatment.

The research showed variable results due to uncontrollable contamination in the ozone stock. Unexpected nutrient content and discoloration of ozone stock demonstrated that this procedure was difficult to control in a lab setting. Use of this advanced oxidation treatment at a full scale wastewater treatment facility would be unrealistic. Further research is required in order to identify sustainable methods of treating SON and SOP in wastewater.

Materials and Methods

Nutrient pollution commonly found in wastewater effluent can lead to eutrophication in receiving waters which in turn decreases health of the aquatic ecosystem. As wastewater facilities are required to meet higher standards, more complete forms of nutrient removal is required. The goals of this study were to examine the use of ozone in wastewater effluent on removal of soluble organic nitrogen and soluble organic phosphorus. By finding a sustainable manner of converting phosphorus and nitrogen species into more easily removed species, wastewater treatment facilities may decrease their environmental impacts.

Results

Samples were treated with ozone stock to achieve concentrations of 2.5 mg O₃/L and 5 mg O₃/L.

Ozone Stock Nutrient Contamination

Conclusions

• Highly variable changes in SON, SOP, and SAHP were found with both doses of ozone in Upper Blackstone’s Clearas and Secondary treatment samples and North Attleboro’s samples.

• Changes were variable and likely in part attributed to ozone stock contamination. Ozone stock developed a light pink color, with an undetermined cause, which correlated with high changes in nutrient composition of samples.

• Further research is required to understand sources of contamination when creating ozone stock, the impacts of pure ozone stock on wastewater effluent, and other methods of application of ozone.

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