CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Robert E. Bilodeau

Project Number

38732

Project Title

Comparison of Oxidizers in the Removal of NDMA in the UV Advanced Oxidation Process of Treating Drinking Water

Abstract

Objectives/Goals

This project determines which oxidant is the most effective at removing N-nitrosodimethylamine (NDMA) when added to the ultra violet advanced oxidative process (UV-AOP) during the treatment of drinking water. The two oxidants looked at in this project are hydrogen peroxide (H2O2) and chlorine (Cl2). My hypothesis is that H2O2 added during the stage of the UV-AOP will be more effective than free Cl2 in removing NDMA present in drinking water.

Methods/Materials

The Orange County Water District provided the laboratory support for running this experiment. During each experiment water which had previously treated with both reverse osmosis and microfiltration was siphoned off into a test pilot. This water was then subjected to ultra violet light along with the addition of a specific oxidizer. Levels of NDMA were tested before and after each pilot run using a liquid chromatograph. After each sample was analyzed the percent of NDMA removed was calculated, and the contamination level differences were subsequently graphed.

Results

Hydrogen peroxide (H2O2) saw the largest percent reduction of NDMA of any oxidant with an average of 99% removal. Most of the water with added hydrogen peroxide removed all NDMA present to ND. Chlorine (Cl2) saw the next largest reduction of NDMA with an average total removal of 74%. When chlorine is added at 0.99 mg/L, it effectively removed NDMA at 74% more reliably. During the UV process with no oxidants, NDMA was significantly removed from the water. The dark control, no UV, yielded an overall increase in NDMA levels.

Conclusions/Discussion

The hypothesis for this project proved to be correct, hydrogen peroxide (H2O2) was the most effective oxidant at removing NDMA during the UV-AOP. Although photolysis itself is the largest remover of NDMA the added oxidants helped to lower the NDMA concentrations to levels that could not be achieved through photolysis alone. This is extremely important as the Environmental Protection Agency has determined NDMA is toxic at levels as low as 0.7 ng/L and the California State Drinking Water standard is set at 10 ng/L. It was also determined that although less effective than H2O2, the addition of free chlorine did remove a significant amount of NDMA and since it is a much cheaper oxidant it could be implemented in smaller and rural water districts which have monetary restraints.

Summary Statement

I analyzed which oxidizer, hydrogen peroxide or chlorine, was more effective in the removal of NDMA in the UV advanced oxidative process of treating drinking water.

Help Received

The Orange County Water District provided the laboratory support for running this experiment, specifically Dr. Shannon Roback.