CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)

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Project Number

J0810

Project Title

Nitrate, Nitrite, Nitrogen: A Study on the Removal of Nitrate in Groundwater and Treated Wastewater

Abstract

Objectives/Goals

The objective of my experiment was to determine an economical and efficient method of nitrate removal in an acute situation of nitrate intrusion by analyzing the chemical or physical removal of nitrate through the use of different adsorbents. Also, the efficiency of each adsorbent in groundwater or treated wastewater was analyzed.

Methods/Materials

A calibration standard was created using different concentrations of a 1,000 ppm nitrate stock solution to create a 2, 5, 10, 20, 50, 100, and 500 ppm calibration standard. Water from various sources with different levels of organic content was spiked with 50 ppm of the stock solution. 2g of Bio-Rex 5, coconut carbon, IMAC HP555, Ambersorb 572, and Ambersorb 563 were manually packed in separate 6 mL cartridges. The efficiency of each adsorbent was filtered with eight different water samples using a vacuum pump manifold. The Varian Cary 50 Ultra-Violet/Visible Spectrophotometer was used for the UV determination of the remaining nitrate in the filtered water sample. A total of 80 samples were tested, and the effectiveness of the various filters at different pH levels of 4, 7, and 11 was also determined.

Results

Mesa Consolidated Water District water, which represented colored or treated wastewater, filtered with Bio-Rex 5 had the most amount of nitrate removed, but coconut carbon was most effective in removing nitrate from groundwater, or water without a high organic content. The experimental group Orange County Water District water treated with Ambersorb 563 had the least amount of nitrate removed after filtration.

Conclusions/Discussion

The level of organic content in the water can have an effect on nitrate removal. A high organic content negatively affects the effectiveness of adsorbents that physically removes nitrate, though a high organic content has a positive effect on adsorbents that chemically remove nitrate, such as the Bio-Rex 5. Infants under six months of age are susceptible to nitrate poisoning - methemoglobinemia, also known as the "blue baby syndrome," and they could die from the oxygen deficiency caused by the methemoglobin. Therefore, if there was a nitrate intrusion in our water supplies, then the affected water should be filtered using the Bio-Rex 5 or coconut carbon, depending on the level of organic content in the water.

Summary Statement

I determined that certain adsorbents can considerably reduce the amount of nitrate in the water, and the type of water, whether it is groundwater or treated wastewater, can drastically influence the effectiveness of these adsorbents.

Help Received

I received prior training on the Varian Cary 50 UV/Visible Spectrophotometer from supervising chemist Lee J. Yoo during the past three years. Lab work for the detection and removal of nitrate was done in the inorganic laboratory of OCWD under the supervision of Lee J. Yoo.