CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

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Project Number

S0917

Project Title

Phase IV: The Removal of Fuel Oxygenates: Saving the Future from Yesterday

Abstract

Objectives/Goals

The objective of my experiment was to determine an economical and efficient method of MTBE, DIPE, ETBE, and TAME removal in an acute situation of fuel oxygenate contamination by analyzing the chemical or physical removal of MTBE, DIPE, ETBE, and TAME through the use of different adsorbents. The efficiency of each adsorbent in three different matrices of water, groundwater, treated wastewater, and surface water, was analyzed.

Methods/Materials

To prepare the 5-point calibration standard, varying concentrations of the 200g/mL MTBE, DIPE, ETBE, and TAME standard were added to 100mL deionized water to create the .5ppb, 2ppb, 5ppb, 10ppb, and 20ppb standards. Water from various sources with varying degrees of organic content was spiked with the MTBE, DIPE, ETBE, and TAME stock solution to create a concentration of 10ppb. 2g of Bio-Rex 5, coconut carbon, divinylbenzene polymer, granular activated carbon, and high density glass beads were manually packed in separate 6mL cartridges. The efficiency of each adsorbent was determined through the filtration of the three water samples, which represented the three different matrices of water, using a vacuum pump manifold. The Gas Chromatograph/Mass Spectrometer was used for the determination of the remaining MTBE, DIPE, ETBE, and TAME in the filtered water sample. A total of 60 samples were tested.

Results

The Santa Ana River water with the divinylbenzene polymer had no remaining MTBE, DIPE, ETBE, or TAME in the water after filtration, and only trace amounts of the fuel oxygenates remained in the other water matrices, groundwater and treated wastewater. The experimental group Santa Ana River water treated with the high density glass beads had the least amount of MTBE, DIPE, ETBE, and TAME removed after filtration.

Conclusions/Discussion

The level of organic content in the water does not have an effect on the removal of MTBE, DIPE, ETBE, and TAME for no direct, consistent correlation between organic content and adsorbent efficiency was found, and the divinylbenzene polymer proved to be efficient regardless of organic content. Along with acute, irreversible neurotoxic effects, MTBE, DIPE, ETBE, and TAME are potential causes of cancer and tumors at multiple organ sites. Therefore, if our water supplies are contaminated by fuel oxygenates, then the affected water should be filtered using the divinylbenzene polymer for the ensured purification of the water.

Summary Statement

I determined that adsorbents can reduce the amount of fuel oxygenates in the water past the MCG, and the type of water, whether groundwater, treated wastewater, or surface water, does not influence the effeciveness of the adsorbent.

Help Received

I received training on the Gas Chromatograph/Mass Spectrometer for the last two years from supervising chemist Lee J. Yoo at Orange County Water District. During the past three years, I also received training on the Varian Cary 50 UV/Visible Spectrophotometer for the determination of the level of nitrate after