CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Priya Padmanaban

Project Number

S1018

Project Title

The Synthesis of Ferromagnetic Nanoparticles for the Decontamination of Oil-Polluted Water

Abstract

Objectives/Goals

Finding a way to decontaminate oil-polluted water would benefit the health of aquatic organisms as well as the quality of the water. An attempt is made here to use ferromagnetic particles to clean up oil spills.

Methods/Materials

A ferrofluid was synthesized using ferric chloride, ferrous chloride, aqueous ammonia, and tetramethylammonium hydroxide (as a surfactant). Five different concentrations of ferrofluid (0.02, 0.04, 0.06, 0.08, and 0.10) were tested with 100 mL distilled water contaminated with 8.5 mL of oil. The ferromagnetic particles, which were suspended in the ammonia and water solution, mixed with the oil upon contact and made it possible for the oil to be removed with a magnet. The oil was extracted using ferrofluids from all groups at 3 points in time: immediately, after 24 hours, and after 48 hours.

Results

The experiment with 0.08:1 ratio of ferrofluid to water (8 mL of ferrofluid for every 100mL of contaminated water containing 8.5% oil) was the most effective, removing about 94.24% of the oil from the water. The 0.06:1 ratio of ferrofluid to water was very close and removed 92.4% of oil from the polluted water. Highest concentration of magnetite with 0.1:1 ratio of ferrofluid to water consistently removed less oil than the 0.08:1 ratio, even though it contained more ferrofluid. The lowest ratio tested (0.02:1) was least effective, removing just 55.65% of the oil from the water. Extending the exposure time of the magnetite to the oil for 24 and 48 hours did not significantly increase the amount removed.

Conclusions/Discussion

Oil spills, such as the Deepwater Horizon crude oil spill that occurred in the Gulf of Mexico recently, are extremely worrisome. Based on the results, ferrofluids definitely have potential for decontaminating water of oil. While the ratio of 0.08:1 was the most effective, the effectiveness of the ferrofluid increased as the concentration increased, with the exception of the highest concentration used (0.1:1 ratio of ferrofluid to water). This may be due to the fact that such a large amount of ferrofluid was not miscible with the water and oil completely and thus reduced the effectiveness of the ferrofluid. Although it may not be cost effective, a ferrofluid made with harmless chemicals that does not affect the health of aquatic organisms may help decontaminate the water fairly effectively.

Summary Statement

This project tested the effectiveness of a synthesized ferrofluid on the extraction of oil from oil-polluted water.

Help Received

Used labs at Silver Creek High School; Received guidance from Mr. Cervantes.