Design of a Fe3O4/Bentonite/Graphite Coated Polyurethane Sponge for Economical and Eco-Friendly Oil Spill Recovery

Kim, Autumn (School: Greenwich High School)

Annually, ~1.3 million gallons of crude oil spill into the ocean. Traditional methods of oil cleanup are difficult, costly, non-efficient, and environmentally harmful, all highlighting the need for a simple and effective means for oil in water remediation. Both bentonite (an inexpensive clay) and magnetite Fe3O4) have demonstrated oil-absorbing properties, with the latter remaining magnetic for facile retrieval of oil pollutants, however neither has been applied in a simple and effective way. In this research, bentonite, Fe3O4, and graphite were embedded into a polyurethane sponge, to create an oil-in-water remediation tool that can remove both high levels (insoluble/visible) oil contamination in water, as well as soluble, undetectable contaminants. In use, the Fe3O4/Bentonite/Graphite-Coated Polyurethane (FBG) sponge was first placed atop a simulated, contaminated solution of floating, insoluble oil (with a gasoline model contaminant). After 10 minutes, the soaked FBG-sponge was removed and squeezed for ~100% oil recovery (via measure of oil's luminescence at 335nm (with a 235nm excitation). For phase-1 remediation, 37.4 g-insoluble oil/cm2 of insoluble oil was removed from water, and recovered for its original, intended use. In phase-2 of remediation, a second, new FBG-sponge was inserted into the now soluble oil-in-water resource. Within 4 days of floatation, 25.7 microgram/cm2 oil was removed, and the water was free of oil or other contaminants from the sponge remediation device. In phase-2, ~57% of the soluble hydrocarbons were recovered via a similar squeezing method. SEM analyses of the used FBG-sponges highlight their prolonged integrity, and verify the presence of oil within its active ingredients.

Awards Won:

Second Award of $2,000