Engineering and Testing of Metakaolin Al2Si2O7 and Calcium Bentonite Al2H2O12Si4 Concretion-Spheres: A Novel Composite for the Remediation of Hydrocarbons and Heavy Metals

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The purpose of this project is to develop a versatile, environmentally sustainable, low cost, clay-based sorbent to extract oil and metallic pollutants in various natural environments. To meet these requirements, the clay based sorbent was made from: Calcium Bentonite, Metakaolin, Calcium Hydroxide, and Quartz-silica sand. Then molded into Concretion-Spheres. The mixture was crafted to remain neutrally buoyant, with a net buoyancy of 1.33 grams. The effectiveness of the sorbent was determined by measuring both the oil absorbency and conductivity. Samples were exposed to oil for 3 hours, and the mass of oil in the simulated environment decreased by 19% in both the organic and synthetic oil treatments. Conductivity measurements indicated a 72.7% decline in TDS after 7 days. A decrease in TDS is indicative of a decrease in metallic pollutants. The novel mixture of Calcium Bentonite and Metakaolin clay demonstrated the ability to be poured and molded similar to concrete, as well as remaining neutrally buoyant. Hereby enabling an external floatation device to hold it above the water's surface with ease; allowing the sample to target oil spills and other forms of pollution on the water’s surface. This material can be used in a vast number of applications and can be used in a large variety of environments to extract metallic and oil pollutants in different environments.

Awards Won:

Second Award of $2,000