Year II: Resistant Electromagnet Propulsion for Petroleum Removal Employing Biocompatible Magnetorheological Fluid in Oil Spill Applications

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Crude oil spills destroy shorelines, imbalance ecosystems, and have detrimental economic impacts. Though damage from these spills has been established in literature, there is limited research on non-visible crude oil separation methods. This research investigated propulsive electromagnetic technology to regulate the removal of non-surface crude oil in oceans using Magnetorheological Fluid (MRF). A novel prototype was developed to investigate separation methods in this study. The system connected an oil/water solution to an electromagnetic field (EMF) separation tube. A propulsive effect was evident when EMF coils were discharged, resulting in the separation of oil and water. A specialized MRF containing Fe_3O_4 microspheres in Oleic Acid was synthesized in this study. The viscoelastic fluid exhibited super lipophilicity and hydrophobicity. The MRF was added to the petroleum/water solution for magnetic properties in EMF removal. The results indicated that the EMF system was most effective at 14 minutes, removing 88.5% of the oil. There was not a significant relation between the type of water used in the experiment (Sea, distilled). The MRF was most effective at high concentrations (1:4) in a distilled water environment ~ 92.8% of the oil was removed. This research has several applications in pollution control, including polyatomic hydrocarbons, micro plastics, and organic pharmaceutical removal. The system can be implemented on the shoreline with a connection tube or at deep sea with a buoy collection mechanism. A deep learning model based on fluorescence imaging is being investigated to quantify pollution levels for targeted use of the system. The device successfully met engineering goals by introducing a novel method of oil spill removal using electromagnetics.

Awards Won:
National Oceanic and Atmospheric Administration - NOAA: Taking the Pulse of the Planet First Award