



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

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| Name(s) Amelie Leviant | Project Number J1121 |
| Project Title Petrochemical Waste Clean-up Using Polymers: A Proof of Concept | |
| <p style="text-align: center;">Abstract</p> <p>Objectives Petrochemical waste cleanup is expensive but important. This project began with the hypothesis that polymers could be used to capture both oil and waste water. Following research on new techniques for cleanup, such as the use of polymer sponges to collect oil, the goal of this project was to demonstrate capture of oil and waste water with polyvinyl alcohol (PVA) while controlling viscosity to allow for polymer fluid extraction.</p> <p>Methods The contamination test model consisted of 100 ml of water, colored with food coloring to simulate contaminants, and 50 ml of mineral oil. In Phase 1, using multiple trials, I mixed PVA powder into hot water to create my own PVA solutions and then injected PVA solutions of 4%, 6%, and 8% into the model. Next, 10 ml of a 4% sodium tetraborate solution was added. After mixing, I examined the visible percentage of oil and water captured in the polymer fluid and its viscosity. Not satisfied with the results, I later conducted a Phase 2 test, where, using the same model, I injected PVA solutions of 4.5%, 5%, and 5.5%, in multiple trials, to identify where most of the test model contents were captured in the polymer fluid but viscosity remained manageable. For Phase 3, conducted for my own scientific satisfaction, I examined whether PVA powder, added directly to the oil in the model, could capture just the oil from the model.</p> <p>Results Phase 1: Trials with 8% and 6% PVA solutions resulted in full incorporation of oil and contaminant-filled water, but the polymer fluid was highly viscous. Trials with 4% PVA solution resulted in almost no incorporation of oil and water. Phase 2: Trials at 5.5% PVA solution showed a very high degree of incorporation, estimated at 98%, but viscosity was still too high to extract with a syringe. Trials at 4.5% PVA solution were poorly incorporated (under 5%). Trials with 5% PVA solution showed a high degree of incorporation (estimated at 95%), but viscosity was low enough that some polymer fluid was successfully extracted with a syringe. Phase 3: After adding 20gm of PVA powder onto 50 mL of oil, 40 mL of oil was absorbed (an 80% sorption rate).</p> <p>Conclusions After Phase 1 suggested a PVA solution range needing more study, Phase 2 indicated that, at a solution strength between 6% and 4%, there exists a concentration(s) that could incorporate most of the oil and water while remaining at a manageable viscosity level that could be pumped. Phase 3, conducted to examine PVA behavior in oil, shows further evaluation of polymer-based remediation ideas is warranted.</p> | |
| Summary Statement This project examines whether oil and waste water can be captured in a polymer fluid and then feasibly extracted by controlling viscosity with an ideal polymer solution concentration. | |
| Help Received My father assisted me with research and with the safe handling of hot water and the chemicals used in this project. | |