Name(s)

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Project Number

S1102

Project Title

The Effect of Bio-coagulants on the Adsorption of Waste Oil and the Reduction of Turbidity from Oil-Produced Waters

Abstract

Objectives

Through deep sea drilling and hydraulic fracturing, California annually produces about 8 billion gallons of oil and 130 billion gallons of oil-produced waters. Aluminum sulfate is used to treat these produced waters prior to releasing into the environment. This treated water is acidic and damages both aquatic ecosystems and groundwater aquifers. There is a need for an environmentally safe, sustainable, and efficient alternative to aluminum sulfate. As scientific literature on natural alternatives to treat oil-produced water is limited, the goal of this project is to study the efficacy of plant-based coagulants (C. arietinum, S. potatorum, and R. sativus seeds) on oil and suspended solid (turbidity) reduction on oil-produced waters. The hypotheses are that these bio-coagulants will adsorb 75% of waste-oil and reduce turbidity by 50%, as compared to the aluminum sulfate which adsorbs 70% of oil and reduces turbidity by 46%.

Methods

Produced water was simulated using distilled water, clay, and vegetable oil. C. arietinum, S. potatorum, and R.sativus seeds were ground and made into a filtrate. Adsorption experiments were performed in quadruplets by treating the produced water with the filtrates and the control by varying the temperature (15C, 25C, 35C, 45C, 55C), dosage (10g, 20g, 30g, 40g, 50g), and pH (4,5,6,7,8). The supernatant was measured using a novel application of the calcium hydride test and a turbidity meter for each variation.

Results

The removal efficiency (RE%) was calculated and statistical significance established using ANOVA. The results showed that C. arietinum removed 81.5% of oil at pH 6 and R.sativus reduced oil by 88.7% at 35C with 40g dosage. S.potatorum reduced turbidity by 59.9% at pH7, at 35C and dosage of 40g.

Conclusions

The objective was met as the bio-coagulants had a mean oil reduction efficiency of 83.4% and mean turbidity reduction of 56%. The functional groups on the surface of the bio-coagulants helped with coagulation. Flocs formed and settled to the bottom due to gravity. The bio-coagulants destabilized the colloids by neutralizing the forces that keep them apart, thus clarifying water and adsorbing oil from oil-produced waters. This project proves that bio-coagulants are a sustainable and viable alternative to the conventional aluminum sulfate treatments used by oil companies which directly and indirectly harm the environment.

Summary Statement

My experiment studied the adsorptive properties of bio-coagulants on oil and turbidity reduction and proved their efficacies as sustainable alternatives to the commonly-used aluminum sulfate to treat oil produced waters.

Help Received

I designed, experimented, and analyzed the results on my own. I d like to thank Mr. Dan Coltrin, of Forensic Analytics Laboratories for answering my questions on adsorption and using different types of oils, my teacher Dr. Sean Wilmot for his support, and my parents for buying the materials.