Oil Spill Cleanup
Testing the Effectiveness of Oil Absorbing Materials

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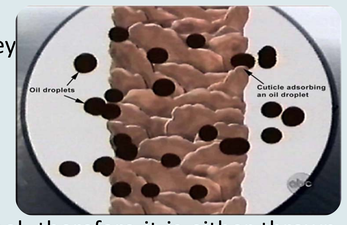
Introduction

On April 20, 2010 the Deepwater Horizon drilling rig exploded. Since then, approximately 210,000 gallons of oil a day were released into the Gulf of Mexico. On July 15, 2010 the gushing oil well was finally capped. Scientists estimate that a total of 205,800,000 gallons of crude oil leaked into the Gulf. The blowout is at a depth of one mile below the surface of the ocean. Most of the oil rises to the surface of the ocean due to density differences, but some oil gets trapped in underwater currents and travels throughout the ocean. Surface oil cleanup is the focus of this experiment. Currently, BP is using a variety of cleanup methods including:

1. **Skimming:** removal of surface oil with specially designed boats
2. **Dispersants**: chemicals which break up the oil into small droplets, the dispersant Corexit is currently being used
3. **Booms:** usually used to protect shoreline, these long tubes float in the water to contain oil
4. **Absorbents:** materials which soak up oil from the water's surface

Materials

Willamette Valley Wool:



Farmers in the Oregon Willamette Valley have a huge surplus of wool. The wool produced by sheep in this region is of a low quality not suitable for textiles. The processing techniques currently available make it economically unfeasible to use the wool, therefore it is either thrown out or stored in warehouses.

Non-woven wool pads:

Specifically designed for oil spill clean up by Northwest Woolen Mills, these dense, non-woven blankets made from recycled wool and yarn absorb a lot of oil and very little water.

Cellulose:

A natural, recycled product made from plant cellulose. This material is hydrophobic and relatively low in cost (less than $1/lb.)

Polymer:

Envirobond 403 is a super absorbent polymer which comes in powdered form. It is formulated to bond with liquid hydrocarbons and trap them in a gel-like, semi-solid matrix.

Methods

1. Wearing gloves, fill the bottom of a Petri dish halfway with water.
2. Add crude oil to the water to create a simulated oil spill. (In this case 5 mL of crude oil was used.)
3. Weigh a small amount of wool (approximately 1 gram) and record the actual mass.
4. Place the wool in the Petri dish of oil and water and swirl it around.
5. Using tweezers or other utensil remove oil-soaked wool and place it in a tared Petri dish bottom.
6. Weigh and record data for the oil soaked wool (which also contains some water). If time allows, let the wool sit for 24 hrs to allow water to evaporate. Or dry the wool in an oven.
7. Repeat steps 1-6 with the other chosen materials (in this case polymer, cellulose, and non-woven wool blanket.)
8. To test reusability of the wool, after step 6 is complete, squeeze oil out of wool sample with gloved hands, and measure the amount of recovered oil.
9. Repeat steps 1-6 with the squeezed wool sample (2nd pass).

Material	Density (g/cm^3)
Raw Wool	0.253
Woolen Blanket	1.48
Crude Oil	0.84

Figure 1. Densities of materials used.

Tar balls washed ashore on a Mississippi Gulf coast beach.

Bioremediation (Oil-eating Bacteria):

Soil samples were collected from outside of Gleeson Hall. Three repetitions of 1 gram soil samples were placed in shake flasks. To these flasks 100mL of sterilized water, 1mL of motor oil, and 10mL of nutrient solution was added. The nutrient solution contained Calcium Chloride, Magnesium Sulfate, Diammonium Phosphate, Ferric Chloride Hexahydrate and Dipotassium Phosphate. They were then incubated at 27.6 degrees Celsius for 5 days. After incubation, bacteria plating techniques were used to culture oil eating bacteria. Oil eating bacteria were found to be visible but quantitative measurements were not obtained.

Conclusions

After five repeat experiments, it was concluded that the non-woven wool pad outperformed the raw wool in oil absorbency. The absorbency ratio of the non-woven wool pad was 14.08 ml oil/g wool pad. In contrast, the absorbency ratio of raw wool was only 11.58 ml oil/g wool. And when the raw wool was squeezed and reused, there was only a 22% decrease in oil adsorption, showing that wool reuse is both possible and practical. **Both raw wool and non-woven wool pads would make excellent oil spill clean-up materials in the Gulf of Mexico oil disaster.**

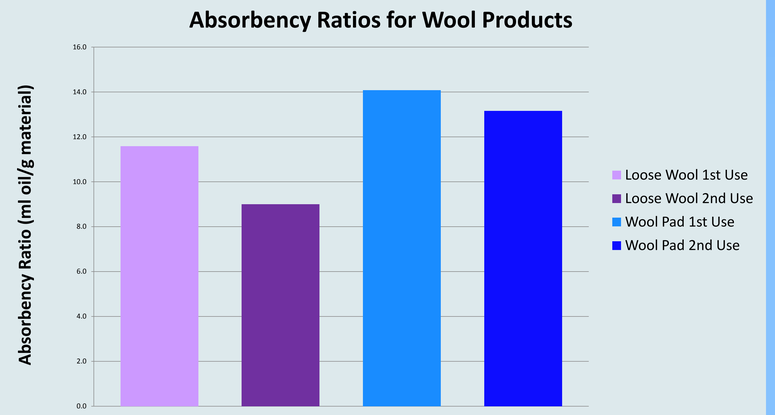


Figure 2. Data obtained with triplicate trials of crude oil absorbed by various forms of wool. The nonwoven wool blanket has the highest absorbency ratio.

Acknowledgements

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Outreach

The Oil Spill Clean Up Lab Procedure has been developed for a wide variety of student audiences including:

1. COSEY: Center for Outreach in Engineering and Science for Youth Camps (200 middle school students)
2. SESEY: Summer Experience in Science and Engineering Camp (4 high school students)
3. SMILE: Science and Math Investigative Learning Experiences Teacher Workshop (21 high school teachers serving 220 high school students)
4. OSU E-camp (20 middle school students)
5. OSU ExxonMobil Bernard Harris Science Camp (30 middle school students)
6. International Baccalaureate Conference @ OSU (300 high school students)