Oil Absorbing Polymers

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Background Information

Independent Variable:

Types of polymers (Natural Polymers, Milkweed and Cotton fibers and Synthetic, Sodium Polyacrylate and Envirobond 403).

Dependent Variable:

Amount of oil absorbed.

Controlled Variables:

The volume of oil, the weight of the polymers and duration of trial.

Background Information

Control group:

None

Vocabulary:

Polymer -a substance that has a molecular structure consisting of a large number of similar units bonded together.

Super Absorbent Polymer (SAP)- It is a type of polymer that can absorb more than 25 times its weight.

Background Information

Viscosity- A measure of a liquid's resistance to deformation at a given rate or in otherwards thickness.
Hydrophobicity- It is the physical property of a molecule that in which the molecule is repelled from a mass of water.
Hydrophilic- It is the physical property of a molecule that in which the molecule is attracted to water.
Oleophilicity- It is the physical property of a molecule that in which the molecule is attracted to an oil mass.
Natural Polymers- Polymers that are hollow and repel water, yet absorbs more oil.

Background Information

Sorption- It is a physical and chemical processes by which one substance becomes attached to another.

Nonpolar Molecules- They are molecules that have no positive or negative charges.

Electronegative- A measure of how strongly atoms attract bonding electrons to themselves.

Hydrogen Bond- the attractive force between the hydrogen attached to an electronegative atom of one molecule and an electronegative atom of a different molecule.

Synthetic Polymer- Human-made polymers derived from petroleum oil that absorb less oil than natural polymers.

Background Information

Scientific Processes:

How polymers clean up oil-

-Types of polymers

-Hydrophobic are nonpolar and Hydrophilic have hydrogen bonds

-Hydrocarbon Polymers are Hydrophobic and contains a porous internal structure

Background Information

-sorption of oil also affected by other characteristics such as oleophilicity, high uptake capacity, buoyancy, and retention over time

-hydrophilic polymers form hydrogen bonds

-Oil is a nonpolar molecule, Hydrophilic polymer don’t absorb oil

Background Information

Why this topic was chosen?

-Deepwater Horizon Oil Spill (BP Oil Spill)

-Largest environmental disaster in American history, extensive damage was caused to marine and wildlife habitats

-the process of an oil spill cleanup led to project

Background Information

How will this project help society?

- Cause extensive damage to the environment

-Faster and more efficient way of cleaning the spills will save the environment.

Research Question

Which polymer is best suited for cleaning oil spills?

Hypothesis

If the researcher tests the oil absorbing capacities of four different types of polymers like Milkweed fibers, Cotton fibers, Sodium Polyacrylate and Envirobond 403 then Envirobond 403 will do the best.

According to National Nanotechnology Infrastructure Network (www.nnin.org), a hydrocarbon polymer which has hydrophobic and oleophilic properties attracts and absorbs the oil within its pores, encapsulating it and preventing its from escaping. According to the University of Akron(uakron.edu), Enviro-Bond 403 is a polymer that is very non-polar and this causes it to be hydrophobic (just like oil) thus the polymer attracts and absorbs the oil forming a semi-solid mass that can be handled and disposed off easily.

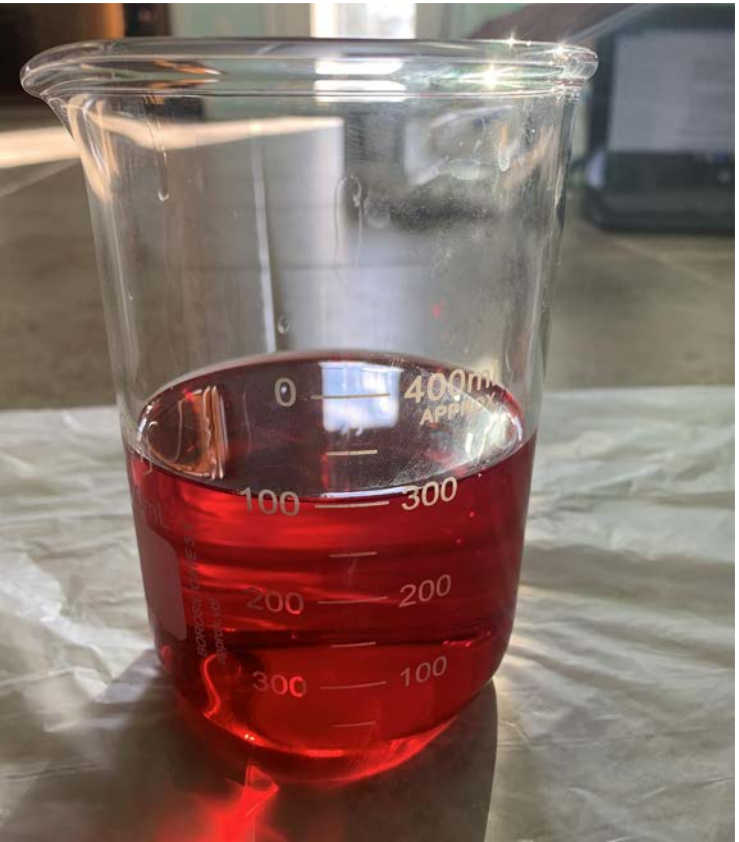
Materials

- A beaker
- Graduated Cylinder
- A measuring scale
- A stopwatch
- 12,000 Marvel Mystery Oil mL
- 30 grams of Envirobond 403
- 30 grams of Milkweed
- 30 grams of Cotton
- 30 grams of Sodium Polyacrylate
- Strainer
- Latex Gloves
- Safety Goggles

Procedure

1. Pour Marvel Mystery Oil into the beaker upto the 300ml mark.
2. Weigh 3 grams of the polymer on the scale
3. Spread the polymer on the top of the oil in the beaker and wait 60 minutes
4. Then separate the oil- polymer mixture from the oil.
5. Pour the rest of the oil into the graduated cylinder to measure the remaining oil.
6. Do 10 trials of steps 1-5
7. Repeat steps 1-6 with the other three polymers

Procedure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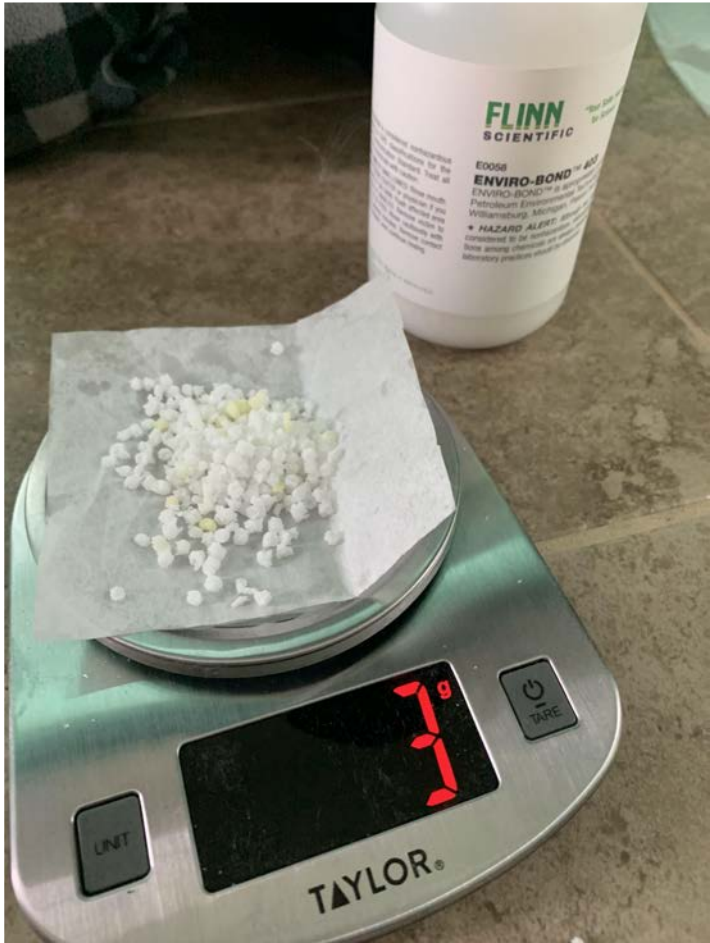

FLINN
SCIENTIFIC
ENVIRO-BOND
UNIT
TARE
TAYLOR

Procedure

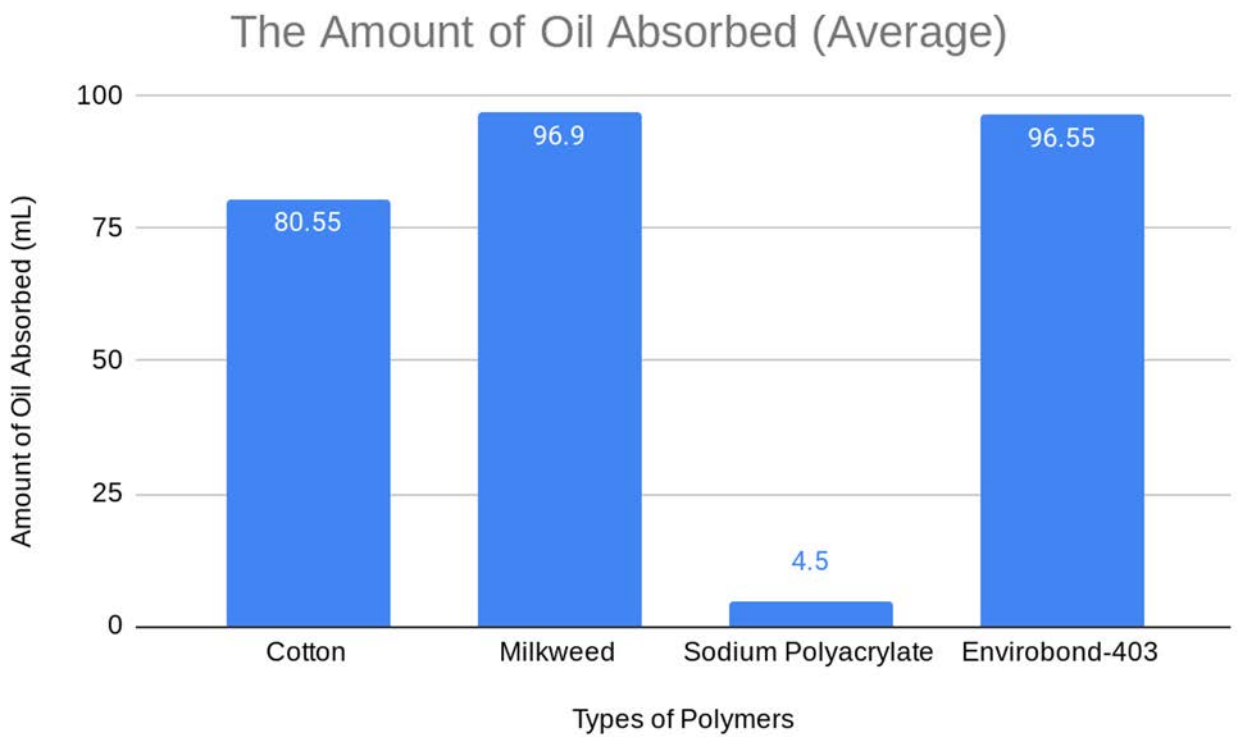

FLINN
SCIENTIFIC
"Your Safer Source for Science"
HYDRO-BOND™ 403
100 g
HOLLISTER

Oil Absorption Trials Chart (mL)

Trials	Cotton	Milkweed	Sodium Polyacrylate	Envirobond-403
Trial 1	71	97.5	3.5	95
Trial 2	90.5	99	6	98
Trial 3	85	96	4.5	92.5
Trial 4	80.5	96.5	3	98.5
Trial 5	72.5	95.5	6.5	92
Trial 6	77	99	4	100.5
Trial 7	78.5	94.5	5	95.5
Trial 8	88.5	98.5	5.5	97.5
Trial 9	74.5	97	2.5	97
Trial 10	87.5	95.5	4.5	99
Average	80.55	96.9	4.5	96.55

mL = milliliters

Average Amount of Oil Absorbed Bar Graph



Data Analysis

Chart: The chart shows data for ten trials of each of the four polymers. Each column represents a polymer: Cotton, Milkweed, Sodium Polyacrylate, and Envirobond-403. The rows show the data (in milliliters) for the ten trials and also average absorption volume for each of the four polymers. The average volume absorbed by Cotton is 80.55 mL, Milkweed is 96.9 mL, Sodium Polyacrylate is 4.5 mL and Envirobond-403 is 96.55 mL.

Data Analysis

Graph: The graph shows that the polymer which performed the best is Milkweed with an average absorption capacity of 96.9 mL and the poorest performer is Sodium Polyacrylate with an average absorption capacity of 4.5 mL. The average absorption capacity of Cotton was 80.55 mL and Envirobond-403's 96.55 mL. The data also shows that of the natural polymers Milkweed and Cotton, Milkweed did better than cotton by 16.35 mL, of the two synthetic polymers Envirobond-403 and Sodium Polyacrylate, Envirobond performed better than Sodium Polyacrylate by 92.05 mL.

Conclusions

-The research question

-My hypothesis

- Envirobond 403 is a hydrocarbon polymer so it is hydrophobic and oleophilic

-The hypothesis is not supported by the evidence

-Milkweed performed better than Envirobond-403 because high wax content and its hollow structure

Conclusions

How polymers clean up oil-

-Types of polymers

-Hydrophobic are nonpolar and Hydrophilic have hydrogen bonds

-Enviro-Bond 403 has hydrophobic and oleophilic properties

-Once the polymers are "full" of oil, they adhere to one another and form a semi-solid mass that can be handled and disposed easier.

Conclusions

-Hydrophilic polymers (Sodium Polyacrylate)

-Oil is a nonpolar molecule, Hydrophilic polymer don’t absorb oil

-Natural polymers are hollow and repel water

-Milkweed is especially absorbs a lot of oil of its high wax content and its hollow structure.

Conclusions

-The experimental error we had was separation of the oil from Milkweed floss

-Transfer of oil from the breaker to the graduated cylinder to measure the amount of oil left was messy

Conclusions

-How is it helpful to society

-Oil spills in oceans cause extensive damage

-A faster and more efficient way of cleaning the spills is used that will save the environment

Conclusions

- Envirobond-403 is way easier to clean up

If researcher had to do this project again, he would like to focus on finding a more cost effective as well as a recyclable polymer.

Thank You

Happy to answer any questions ?

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