Wat-A-Soap!

Lathery Lavender

100% Natural Lavender-Scented Handcrafted Soap

Enriched with natural oils

Includes five bars of soap

NET WT: 13.52 oz (393.3 g)

UNIVERSITY OF WATERLOO | FACULTY OF ENGINEERING
Department of Chemical Engineering

Ingredients: Cocos nucifera (coconut oil), Ghee, Brassica napus (canola oil), Helianthus annuus (sunflower oil), Zea mays (Corn Oil), Lavandula (Lavender Oil)

A **sustainable** soap product infused with **lavender** fragrance and **all natural** oils that keeps skin clean and conditioned. Packaged in a completely **biodegradable** and **environmentally-friendly** multi-use bag.

Packaging

- REUSABLE ORGANIC MESH BAG - In order to create a way to reduce the use of plastic and make a positive impact on our environment, we used a reusable natural cotton biodegradable bag.
- The mesh allows customers to be able to get a scent of what our product smells like and also allows for air circulation.
- ECO-FRIENDLY MATERIAL - Our natural cotton mesh bags consist of a convenient drawstring with wooden closure which is all 100% natural, sustainable, polyester-free, nylon-free, unbleach biodegradable, zero-Waste.
- Not only is the packaging meant for our soap product, but once the soap is fully used, the mesh bags can be easily washed out for other common household uses. Common alternative uses could include: an eco-friendly storage for fruits and vegetables, kids toys, travel items, snacks, crafts, etc.
- Additionally, our organic mesh bag provides a high level of protection to the elements, unlike most handmade soap packages that expose the majority of the soap to its environment.

Green Chemistry In Our Product

- Throughout this assignment, we focused on incorporating as many of the green chemistry principles as possible into our final product by:
  - Using chemicals from renewable sources (plants oils)
  - Ensuring the use of non-toxic, non-bioaccumulative and environmentally-friendly materials and chemicals.
  - Creating a completely reusable way to package our product to mitigate waste production.

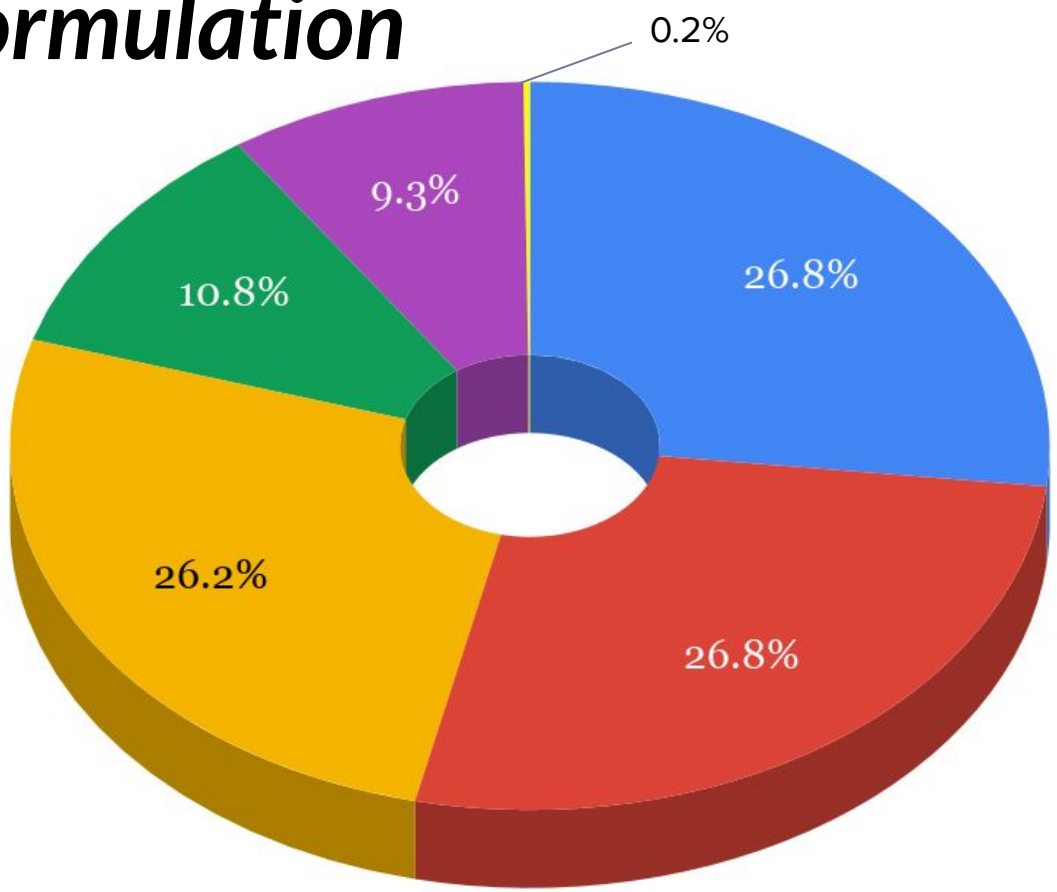
Design Criteria

- The task was to design and create hand soap, using 500 grams of oils, water and lye.
- Each of the oils have their own unique properties, therefore a soap calculator was necessary in formulating an ingredient list which optimizes for specific desirable effects such as lather, cleansing, conditioning, and so on. For our particular soap we wanted to optimise cleansing and conditioning while having a relatively hard bar of soap that is able to produce bubbly lather.
- Given limited time and materials we opted to use the cold process as it is very easy to follow, especially for beginners. The cold process soap takes longer to cure but it creates a much nicer bar of soap and allows for customization which the hot process does not.

Mold Selection

The pringles can was the best selection for the mold of our soap since it provided a cheap, recyclable and convenient alternative to traditional wooden box molds. Also, it allowed for our soap to have a nice round shape making it more appealing to consumers.

Formulation



- Coconut Oil
- Canola Oil
- Ghee
- Sunflower Oil
- Corn Oil
- Lavender Essential Oil

Oil	Percentage	Mass (g)
Coconut Oil	26.8%	134.10
Ghee	26.2%	131.24
Corn Oil	9.3%	46.48
Sunflower Oil	10.8%	53.96
Canola Oil	26.8%	134.21
Lavender Essential Oil	0.02%	1

Benefits

- Coconut Oil
  - Helps prevent / reduce acne
  - Provides hardness to soap
  - Allows the soap to have bubbly lather
- Canola Oil
  - Inexpensive
  - Provides the soap with low, dense, creamy lather
- Sunflower Oil
  - Provides skin conditioning for dry skin
  - Works synergistically with corn oil to provide a nice, rich, moisturizing creamy lather attribute in the soap

Benefits Continued

- Ghee
  - Source of hardness within the soap
  - contains essential fatty acids that induce hydration in the skin cells, thus moisturizing dry skin
- Corn Oil
  - Protects against Free Radicals
  - Creates a strong cleansing and moisturizing Properties for soap.
  - Cost effective
- Our product is also 100% vegan

Vitamin E

- Every Oil contains a source of vitamin E
- Vitamin E can :
  - fight free radicals from pollutants and toxins in environment and foods
  - encourages healing of skin and reduces scarring from injury
  - vitamin E shields skin from damage due to its protective properties, also boosts the immune system

NaOH vs. KOH

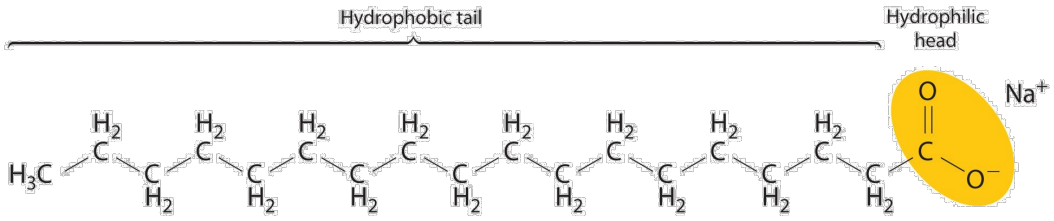
The main chemistry behind the soap making process is known as saponification, where the fats in the oil change into soap in the presence of a strong base. For this particular soap we included sodium hydroxide (NaOH) in the recipe over potassium hydroxide (KOH). Although both get the job done, the main difference is in the consistency of the soap. NaOH creates a smooth hard bar of soap while KOH creates a grainy softer bar. Also, another factor is that KOH is more expensive than NaOH to produce.

Soap Using NaOH:

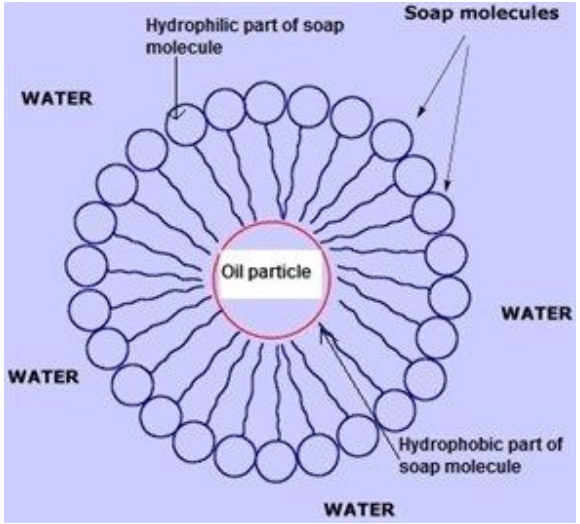
Soap Using KOH:

What Is Soap?

- Soap is a cleansing agent created by the chemical reaction of a fatty acid with an alkali metal hydroxide
- The cleansing action of soap comes from its unique ability to surround oil particles, causing them to be dispersed in water and easily rinsed away



Sodium stearate: a soap



The Chemistry Behind the Process of Soap Making

- Soap is made by mixing fats and oils that react with a base. Sodium hydroxide is the most commonly used base for a hard soap bar. Triglycerides are reacted with sodium hydroxide to produce glycerol and soap molecules.
- There are two main types of fatty acids: saturated and unsaturated. Soaps containing more saturated oils tend to be more firm and better at cleaning. Unsaturated fatty acids or oils are liquid at room temperature and have a lower melting point than saturated fatty acids. Unsaturated fatty acids that are common in these oils are Oleic and Linoleic Acid which contributes to a fluffier finished product.

The Chemistry Behind the Function of Soap

- Soap cleans by acting as a surfactant and emulsifier. Surfactants are compounds that lower the surface tension between two liquids, between a gas and a liquid, or between a liquid and a solid. Soap molecules are long and thin with one end being hydrophilic and the other hydrophobic.
- This makes it possible for water and oil to become finely diffused in each other, creating a stable, homogenous, smooth compound.
- The hydrophobic ends of the molecules are attracted to dirt and oil, and does not interact with water molecules. When soap and soiling oils are mixed, the nonpolar hydrocarbon portion of the micelles break up the nonpolar oil molecules. The hydrophilic ends stick out into the water, and these drops of oil are washed away with water. Thus, these two processes work together to clean surfaces.

Price of oils	**$5.15**
Price of NaOH ($14.93 per 500g)	**$2.31**
Price per gram	**$0.013**
Packaging	**$2.30**
5 bars (384g) of soap & packaging	**$7.25**
Selling Cost	**$12.00**

The Soap Calculator

- The soap calculator utilizes the data of the properties of 10 specific oils to calculate the characteristics of the soap
- Our soap calculator is used to construct a theoretical soap with the following properties:
  - Hardness : 40
  - Cleansing : 22
  - Bubbly Lather : 22
  - Creamy Lather : 18
  - Conditioning : 50
  - Coconut Oil - 134.09g
  - Ghee - 131.24g
  - Corn Oil - 46.48g
  - Sunflower Oil - 53.96g
  - Canola Oil - 134.21g
  - NaOH - 77.30g
  - H2O - 190g
- The total mass of the soap should be 767.3g

The Soap Calculator

- During the making of the soap, the scale was accurate to one decimal place
- Our actual soap ended up using:
  - Coconut Oil - 134.1g
  - Ghee - 131.2g
  - Corn Oil - 46.5g
  - Sunflower Oil - 54g
  - Canola Oil - 134.2g
  - NaOH - 73.3g
  - H20 - 190g

- The total mass of the actual soap is 682.4g

Soap Calculator

- In the Soap making, we used 5% less NaOH to account for the superfat in the soap to account for any oils that were not turned into soap by the NaOH
- In addition, the mass of the actual soap is less than the mass of the soap due to the soap making. Mass is lost from the mixing of the water lye solution to the fume hood.