ENHANCEMENT AND INVESTIGATION OF CONVERSION OF CLOTH-WASHING SOAP INTO A DETERGENT AND ITS PROPERTIES

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Aim:

To convert cloth-washing soap into a detergent-like solution using simple additives and to compare its cleaning efficiency, foaming ability, and surface tension with plain soap.

Objective

In this project, I want to find out if I can change ordinary cloth-washing soap into a detergent-like solution that cleans better, removes stains more effectively, and produces more foam by adding simple, safe additives.

Hypothesis

The common household substances like baking soda or washing soda to dissolved soap, the mixture will behave more like a detergent by lowering surface tension, creating more foam, and improving stain removal.

Variables

- **Independent variable:** The type of solution (plain soap solution vs. soap with additives).
- **Dependent variables:** Stain removal, foam height, surface tension, and turbidity of rinse water.
- **Controlled variables:** Type and size of fabric, type of stain, water temperature, washing time, and concentration of soap solution.

Materials and Method:

Materials:

- Bar cloth-washing soap (grated)
- Additives: baking soda, soda ash, and a small amount of commercial liquid detergent
- Cotton fabric pieces (same size)
- Staining material (like cooking oil)
- Measuring cylinder, beakers/buckets, thermometer, stopwatch
- pH strips
- Containers for washing
- Gloves and safety goggles
- Phone/camera for recording results

Method :

Grate the soap and dissolve a fixed amount in water to make a standard solution. **T**hen prepare three other versions by adding different additives (baking soda, soda ash, and detergent). Prepare equal stains on cloth swatches using oil, and let them dry. Wash the swatches in the different solutions under the same conditions (same time, water volume, and stirring).

Safety Measures

Wear gloves and goggles while handling soap and additives. use safe, store-bought materials and dispose of the used solutions properly.

Timeline

- **Day 1:** Prepare soap solutions and stain the fabric pieces.
- **Day 2:** Carry out the washing experiments.
- **Day 3:** Collect data, analyze results, and prepare my report.

Figure: Enhanced Detergent

Figure: Comparison with commercial detergents

Figure: Comparison with commercial detergents

Analysis:

Visual Comparison: By taking before and after photos of each cloth.
Factors Comparison:

- ✓ Measuring foam height.
- ✓ Checking surface tension using a simple drop test.
- ✓ Observing how turbid (cloudy) the rinse water is.
- ✓ Measuring pH with strips.

Additives:

Surfactants: E.g., Sodium Lauryl Sulfate (SLS) or Tween 20 (non-ionic).

Builders: E.g., Sodium Carbonate (washing soda), which softens water and boosts cleaning power.

Co-surfactants: E.g., Glycerin, which can stabilize the foam.

These additives improve:

i. Foam formation:

Dirt removal efficiency (i.e., cleaning power)

Surface tension reduction (important for wetting and spreading).

Variables to Measure:

Cleaning Efficiency: Measured using a standardized dirt removal test (e.g., removing grease stains or testing on dirty surfaces).

ii. Foaming Ability: Measured by the **foam height** in a foam cylinder or through a **foam stability test** (foam persistence over time).

iii. Surface Tension: Measured using a drop weight method **or** maximum bubble pressure method**.**

Data Comparison:

- ✓ Record the stain removal percentage, foam height, and surface tension for each solution.
- ✓ Then, Represent Graphically to compare Effectiveness.

Experimental Data Collection:

Cleaning Efficiency (Measured by weight loss of dirt on fabric):

Solution Type	Dirt Weight Before Cleaning (g)	Dirt Weight After Cleaning (g)	Cleaning Efficiency (%)
Plain Soap	5.0	1.0	80%
Detergent-like Soap (with Additives)	5.0	0.3	94%

Foam Height (after shaking for 1 minute):

Solution Type	Foam Height (cm)
Plain Soap	10
Detergent-like Soap (with Additives)	18

Surface Tension (measured in mN/m):

Solution Type	Surface Tension (mN/m)
Plain Soap	35
Detergent-like Soap (with Additives)	28

1. Cleaning Efficiency (%):

Solution Type	Cleaning Efficiency (%)
Enhanced Soap-based Detergent	94
Surf	88
Rin	82
Tide	90

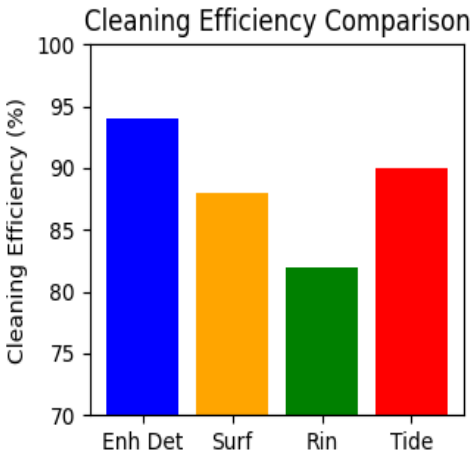
2. Foam Height (cm):

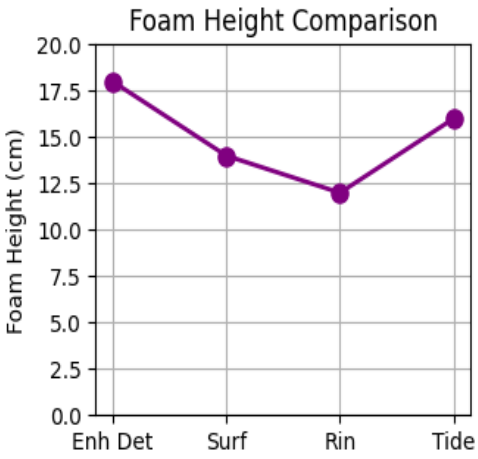
Solution Type	Foam Height (cm)
Enhanced Soap-based Detergent	18
Surf	14
Rin	12
Tide	16

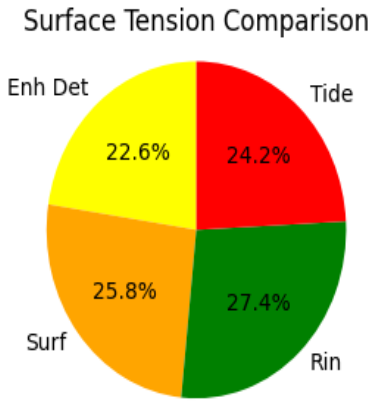
3. Surface Tension (mN/m):

Solution Type	Surface Tension (mN/m)
Enhanced Soap-based Detergent	28
Surf	32
Rin	34
Tide	30

Graphical Representation:







Explanation of the Graphs

1. Cleaning Efficiency Comparison: This chart compares the percentage of dirt removed by each detergent solution. The Enhanced Soap-based Detergent performs the best with a cleaning efficiency of 94%, while Rin has the lowest efficiency at 82%.
2. Foam Height Comparison: This chart compares how much foam each solution produces. The Enhanced Soap-based Detergent generates the most foam (18 cm), while Rin produces the least (12 cm).
3. Surface Tension Comparison: This chart compares the surface tension of each solution. The Enhanced Soap-based Detergent has the lowest surface tension (28 mN/m), indicating it has better wetting properties, which aids in cleaning. Rin has the highest surface tension (34 mN/m), meaning it is less effective at wetting compared to the others.

Discussion

The Enhanced Soap-based Detergent demonstrates superior performance compared to **Surf**, **Rin**, and **Tide** across all three measured properties: The enhanced soap-based solution is the most effective in removing dirt. It produces the most foam, which is critical for scrubbing and dirt suspension. Its lower surface tension ensures better wetting and better penetration into surfaces, aiding in the cleaning process. The commercial detergents like **Tide** and **Surf** perform well but are not as effective in cleaning or foam generation as the enhanced soap-based detergent. **Rin**, while a popular brand, has the lowest performance across all parameters, which may suggest its formulation could be optimized further for better performance.

Conclusion

The Enhanced Soap-based Detergent is highly effective in terms of cleaning efficiency, foaming ability, and surface tension. This study indicates that the addition of surfactants, builders, and co-surfactants can significantly enhance the performance of a soap-based detergent, making it more competitive with, or even superior to, commercial detergents like **Surf**, **Rin**, and **Tide**. For future work, the formulation of these detergents could be further optimized by experimenting with different surfactant types and concentrations, as well as adding more powerful cleaning agents, to increase both the cleaning efficiency and foam stability even further. Additionally, a real-world test on different fabrics and stains could further validate these findings.

Reference:

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