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# SOAP FROM MALENISED CASTOR OIL & ITS SPECIFIED END USE FOR CLEANING ALUMINUM COOKWARE

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## ABSTRACT

In India, for household purpose (washing dishes or utensils in kitchen) normally these soaps are used for washing aluminium, stainless steel, glass, crockery utensils. But this soap is not suitable for aluminium utensils because it forms salt with surface of aluminium and deposits there and gives it a blackish appearance. Also, the luster of the utensil is lost. There are many brands of soaps available for dishwashing. But these are suitable for stainless steel, glass, others. But not suitable for aluminum dishes/utensils in which maximum of the food is cooked. These soaps have certain disadvantages, which can be overcome by certain experimental work. The soap creates a salt with the surface of the aluminum metal and deteriorates it. So our main aim is to develop a soap which is most effective especially for aluminum dishes. For these soap is made from castor oil with different formulations. Also the castor oil is malenised to meet with our required criteria and enhance the properties.

**Keywords:** Castor oil, Malenisation, Aluminium vessel, Soap.

# 1. Introduction:

Soap is a combination of animal fat or plant oil and caustic soda. When dissolved in water, it breaks dirt away from surfaces. Soap requires two major raw materials: fat and alkali. The alkali most commonly used today is sodium hydroxide. Potassium hydroxide can also be used. Potassium-based soap creates a more water-soluble product than sodium-based soap, and so it is called "soft soap." Soap can be made from the base hydrolysis of a fat or oil. This hydrolysis is called saponification. Fats and oils are triesters of glycerol and three fatty acids. Esters can be hydrolyzed to their alcohol and carboxylic acid components in the presence of acid or base. Fats, oils, and fatty acids are insoluble in water because their hydrophobic tails are so long. Many vegetable fats, including olive oil, palm kernel oil, and coconut oil, are also used in soap making. Additives are used to enhance the color, texture, and scent of soap. Fragrances and perfumes are added to the soap mixture to cover the odor of dirt and to leave behind a fresh smelling scent. Abrasives to enhance the texture of soap include talc, silica, and marble pumice (volcanic ash). Soap made without dye is a dull grey or brown color, but modern manufacturers color soap to make it more enticing to the consumer.

When used for cleaning, soap allows insoluble particles to become soluble in water, so they can then be rinsed away. For example: oil/fat is insoluble in water, but when a couple of drops of soap solution are added to the mixture, the oil/fat dissolves in the water. The insoluble oil/fat molecules become associated inside micelles, tiny spheres formed from soap molecules with polar hydrophilic (water-attracting) groups on the outside and encasing a lipophilic (fat-attracting) pocket, which shields the oil/fat molecules from the water making it soluble. Anything that is soluble will be washed away with the water.

We tend to think that if a chemical is attacking and dissolving a metal, it must be an acid. And that's generally true. But aluminium is an unusual metal because it is attacked by both acids and alkalis. (It is amphoteric) So the alkaline sodium carbonate in the detergent bar attacks aluminium. The electron-deficient aluminium atoms (aluminium cations) want to regain their normal complement of electrons by reacting with something that has electrons to donate. The surface of the aluminium metal therefore reacts with negative ions (anions) in the solution, forming a dull layer of an aluminium compound (mostly aluminium oxide), at a very slow rate enough to make the surface grey. For this reason, most manufacturers of aluminium cookware advise not to wash it with the commercially available detergent bar.

In the chemical reaction between soap and aluminium, atomic hydrogen is formed. Atomic hydrogen has very weird property of actually being able to move completely through solid aluminium, because it is such a small particle. Atomic hydrogen cannot be contained in an aluminium vessel; it moves right through it as though it were not there. It remains in the atomic state only until it meets another atomic hydrogen atom which then produces the hydrogen molecule, molecular hydrogen, which is a gas, cannot pass through solid aluminium. This process of hydrogen going from the atomic form to the molecular form causes the metal to flake (sometimes even crack) helping produce the powdery residue that you saw. The hot water in the dishwasher greatly accelerated this reaction.

ISTMA (Indian Soaps and Toilet Manufacturer Association) has estimated the Indian detergent bars and powders demand to be in the region of 3.5 million tonnes per annum Per capita consumption of detergent on all India basis is around 2.5 to 3 Kg, which could vary between different regions depending upon the prevailing economic and social conditions.
Likely growth rate in demand 7 to 8% per annum.

Castor oil is a vegetable oil obtained by pressing the seeds of the castor oil plant (*Ricinus communis*). Castor oil is a colorless to very pale yellow liquid with a distinct taste and odor once first ingested. Castor oil is an extremely unique fixed oil. It has a thick and viscous texture and a slight odor. Castor oil feels similar to glycerin with a thick and sticky texture. Castor oil is well known as a source of ricinoleic acid, a monounsaturated, 18-carbon fatty acid. Among fatty acids, ricinoleic acid is unusual in that it has a hydroxyl functional group on the 12th carbon. This functional group causes ricinoleic acid (and castor oil) to be more polar than most fats. The chemical reactivity of the alcohol group also allows chemical derivatization that is not possible with most other seed oils. Because of its ricinoleic acid content, castor oil is a valuable chemical in feed stocks. Castor oil and its derivatives are used in the manufacturing of soaps, lubricants, hydraulic and brake fluids, paints, dyes, coatings, inks, cold-resistant plastics, waxes and polishes, nylon, pharmaceuticals and perfumes.
**Scientific Name** – Ricinus communis
**Origin** – Africa and India

**Other Names** – Arandi Ka Tel (Hindi), Aamudamu (Telugu), Erandela Tela (Marathi), Amanakku Enney (Tamil), Avanakkenna (Malayalam), and Rerira Tela (Bengali).

Malenisation is a method of adding unsaturation compound to the unsaturated part of the oil molecule, thus increasing its complexity and heat reactivity. The compound referred to is maleic anhydride and the oils are known as maleic treated or Malenised oils. Since the maleic is added far or near the unsaturation section of the fatty acid radical, it retards oxidation slightly so that maleic treated oils do not show greatly increased air drying properties. However, they are definitely faster bodying and have better color and at equal viscosity, better water resistance in the dried fillers.

Table 1: Chemical composition of Castor oil

| Average composition of castor seed oil / fatty acid chains | |
|---|---|
| Acid name | Average Percentage Range |
| Ricinoleic acid | 85 – 95% |
| Oleic acid | 2 – 6% |
| Linoleic acid | 1 – 5% |
| α-Linolenic acid | 0.5 – 1% |
| Stearic acid | 0.5 – 1% |
| Palmitic acid | 0.5 – 1% |
| Dihydroxystearic acid | 0.3 – 0.5% |
| Others | 0.2 – 0.5% |

Table 2: Physical properties of Castor oil

| | |
|---|---|
| Boiling Point | 313 °C (595 °F) |
| Density (20°C) | 961 kg/m$^3$ |
| Shelf Life | 1 Year |
| Refraction index n2d | 1.477 -1.479 |
| Unsaponifiable matter | 0.3 -0.5% |
| Hydroxyl Value | 180 |
| Iodine value | 82 – 88 |
| Saponification value | 177- 187 |
| Viscosity (20°C) | 9.5-10.0 dPa.s |

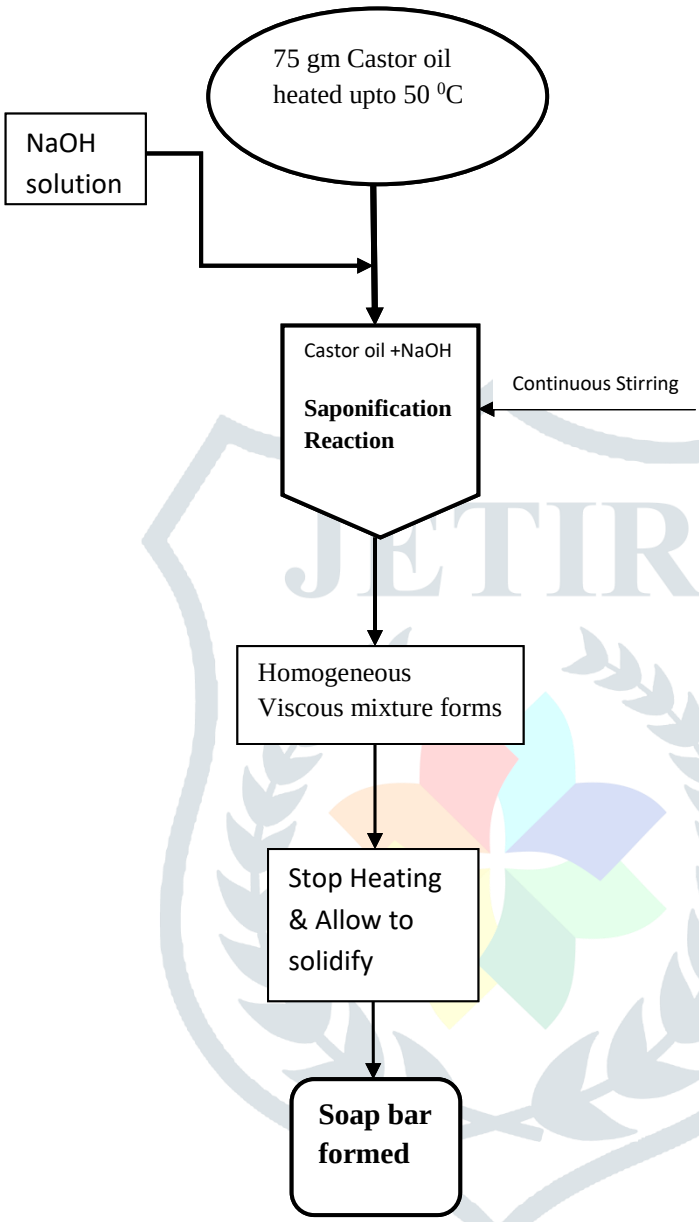
## 2. Experimental Setup

***Preparation of soap from castor oil:***

1) 75gm of castor oil was weighed in a beaker and was heated up to 50 $^oC$.
2) After achieving the temperature of 50 $^oC$ , alkali (as required per sap value of oil) dissolved in distilled water was added with a continuous stirring.

3) The mixture then starts boiling and thickening as saponification reaction proceeds with continuous heating.
4) It should be noted that heating should not be at very high temperature; otherwise the mixture would have poured out of the beaker.
5) As the mixture starts forming a thick semi-solid mixture, it means saponification is completed and product is formed (i.e. soap).
6) Remove the beaker from the heat before the product overflow from the beaker.
7) Then pour the hot semi-solid soap mixture into a mold and allow it to cool for overnight till it completely solidified.


Fig:Flow chart for soap manufacturing




***Malenisation of Castor oil:***

1) 2-3 gm of maleic anhydride was added in 75gm of castor oil and heated up to 75 $^o$C. Then it was cooled up to 45 $^o$C for half an hour.
2) Again the mixture was heated to temperature 75-80 $^o$C and maintained at this temperature for 1hr. Then again it was cooled to 45 $^o$C, maintained for 15 minutes.
3) Finally, it was heated at temperature 80-90 $^o$C for nearly half an hour.
4) From this melanised oil soap was formed in the same way as from pure castor oil.

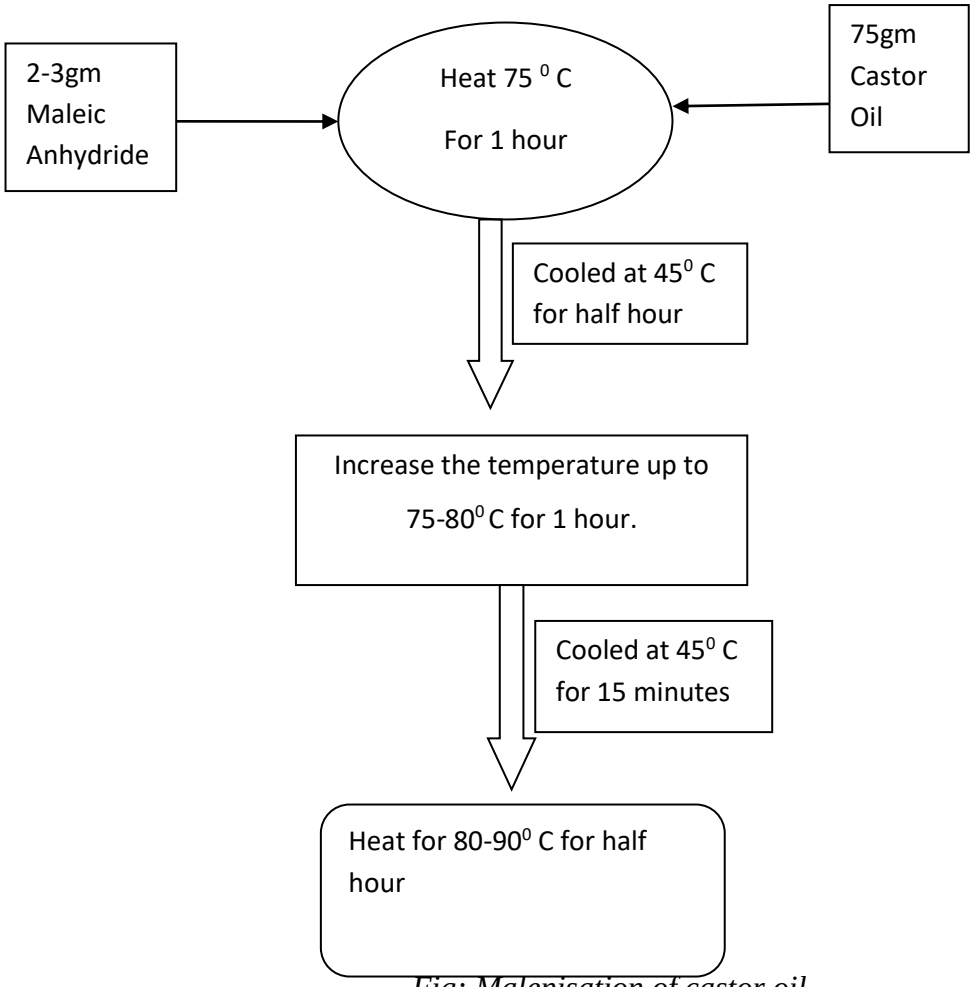



*Fig: Malenisation of castor oil*

## 3. Physio-chemical analysis of oil/soap:

Acid value of castor oil:

The acid value (*AV) is* the number that expresses, in milligrams the quantity of potassium hydroxide required to neutralize the free acids present in 1 g of the substance. Acid value is the measure of hydrolytic rancidity. In general, it gives an indication about edibility of the lipid. The acid valueof castor oil was found to be 2.244

**Table 4.1: Analysis of soap**

| | pH | Foam height % | Moisture content % | Solid content % | Water soluble % | Water insoluble % | Free alkali % | Total Fatty Matter % |
|---|---|---|---|---|---|---|---|---|
| From pure castor oil | | | | | | | | |
| Sample A | 12-13 | 180 | 13.97 | 86.03 | 96.05 | 3.5 | 5.84 | 99 |
| Sample B | 11 | 150 | 12.46 | 87.59 | 96.2 | 3.8 | 5.5 | 95 |
| From melanised castor oil | | | | | | | | |
| Sample C | 10-11 | 200 | 16.66 | 83.34 | 93.9 | 6.1 | 4.8 | 70 |
| Sample D | 9-10 | 180 | 16.66 | 83.34 | 92.7 | 7.3 | 3.5 | 77 |
| Sample E | 11-12 | 230 | 8.33 | 91.67 | 90.8 | 9.2 | 4 | 84 |
| Sample F | 9 | 250 | 16.66 | 83.34 | 91 | 9 | 5.2 | 65 |
| Sample G | 8 | 200 | 16.66 | 83.34 | 91.4 | 8.6 | 6.2 | 80 |

**Table 4.2 : Composition of sample product**

| | Castor oil | Melanised Castor oil | NaOH | Talc | SLS | Optical Brightener | Sodium Silicate | Urea |
|---|---|---|---|---|---|---|---|---|
| Sample A | 80 | - | 13 | - | - | - | - | - |
| Sample B | 80 | - | 13 | 3 | - | - | - | - |
| Sample C | - | 80 | 16 | - | - | - | - | - |
| Sample D | - | 45 | 7 | 1 | 1 | 0.5 | 1.5 | - |
| Sample E | - | 45 | 7 | 2 | 3 | - | 1 | - |
| Sample F | - | 45 | 7 | 2 | 5 | 0.5 | - | - |
| Sample G | - | 45 | 6 | 1 | 2 | 0.5 | 1 | 0.5 |

Note: All quantities are in gram/s

(Ref: All testing are as per "Methods of sampling and test for soaps (second revision) fifth reprint july 2007 (including amendment nos. 1, 2, 3 & 4) udc 661.187 : 620.113.)

## 4. RESULTS, DISCUSSIONS AND CONCLUSIONS

- Soap was made from pure castor oil and it was then tested for different properties such as pH value, foam height, moisture content, free alkali. It was found that the cleaning efficiency of the soap was good for kitchen as well as laundry. Specifically, when it was tested for aluminium vessel which was our main aim it founded to be a good product.

- For further modification the castor oil was malenised by means of maleic anhydride. Then from this malenised oil soap was made in the same way as that from pure castor oil. The soap was also tested for all the physiochemical properties. It was found that the soap formed from melanised castor oil was comparatively better than that of from pure castor oil
- The smell comparatively reduced in melanised oil soap as compared to that of pure one. As well as the dark yellow colour of oil fades after malenisation. Cleaning efficiency of sample A was very good. And that of sample G was much more superior.
- The residue unpleasant smell of the soap can be overcome by means of adding essence. The main problem of aluminium vessel i.e. black residue after washing with other soap was removed. These soap samples all were effective in maintaining the lustre of the vessel and clean it properly. After washing with all the soap samples it leaves the hand moistened and soft as well.

## Conclusions:

Aluminium is an unusual metal in that it is attacked by both acids and alkalis. (It is amphoteric). The surface of the aluminium reacts with negative ions (anions) in the solution, forming a dull layer of an aluminium compound, (mostly aluminium oxide) at a very slow rate enough to make the surface grey. The need to develop a soap for aluminium cookware arise because of this problem associated with the commercially available detergent bar that form salt (i.e. aluminium oxide) with aluminium surface releasing hydrogen. So to eliminate this, we have developed a soap with castor oil & analyzed its after wash effect.

The main reason for castor oil selection is its unique ricinoleic acid which is not used for edible purpose hence available in abundance. Ricinoleic acid has a Hydroxyl group which gives a moisturizing effect after saponification whereas other than oil don't give such result. Taking the advantage of this ricinoleic acid, we used malenisation process to enhance the quality of oil & ultimately the saponified product. The soap thus obtained from this malenised castor oil was much superior in quality & performance which was proved by physio-chemical analysis of soap.

## 5. APPLICATIONS AND USES OF PRODUCT

- The product formed can be used for dishwashing and specifically for aluminium vessel.

- It can also be used for washing clothes.
- White fabrics are easily washed by this soap.
- Any type of stain whether it is of tea/coffee, oil, blood, wine, soil can be easily removed by this soap.
- Just apply the soap over the dirt and left it for 2-3 hours, and then wash it. All stains would be removed.

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