



### RESEARCH ARTICLE

## WHITENING AND COLOR IMPROVING IN TOILET SOAP MANUFACTURE WITH THE STUDY OF SOME PHYSICOCHEMICAL PROPERTIES

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#### Abstract

Soap is one of the most effectual cleaning agents in water. Soaps are prepared by the process of saponification reaction. Sodium and potassium salts soap is used for both laundry and antiseptic purposes. Toilet soap is the perfumery and cosmetic product and serves for personal hygiene, so it should have the broadest possible range of specific characteristics. This study was undertaken to address the raw material in soap and method of saponification and manufacturing usage. The study was also conducted some of the physical and chemical properties such as: (pH, Total dissolved solids (TDS), free alkali, saponification value of toilet soaps). The study revealed that soap bleaching is usually done to improve color, remove impurities and improve taste. Sodium chloride and sodium silicate were used as bleaching chemicals as well as improving the color of the toilet soap manufacture.

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#### Introduction:-

Soap is integral to our society today, and we find it hard to imagine a time when people were kept sweat smelling by the action of perfume rather than soap. However, the current widespread use of soap is only a very recent occurrence, despite the fact that it has been made for more than 2500 years. The first recorded manufacture of soap was in 600BC, when Pliny the Elder described its manufacture by the Phoenicians from goats tallow and ash, and it was known among the British Celts and throughout the Roman Empire. However, these people used their soap medicinally. The manufacture of soap for cleaning has been known for the second century AD that it was used for cleaning, and not until the nineteenth century that it began to be commonly used in the Western world. Until the end of the nineteenth century as soap bar was the only product available for laundering. In areas where laundry was conducted at elevated temperatures, it was soon discovered that soap dissolves more readily as particles are smaller than a solid bar. Consumers therefore shaved the bars and dissolved the shaving in hot water. From the standpoint of laundering, since Second World War, the use of soap has markedly decreased when compared with the correspondent increasing in detergents. Nevertheless the laundry soap has maintained a proper market area, which is more or less in every country, depending on usage, habits, local economic situation, raw materials availability, water hardness and eutrophication problem (Hardy & Snell, 1957).

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**Manufacture of soap**

The word soap (Latin *sapo*, which is cognate with Latin *sebum*, tallow) appears to have been originally applied to the product obtained by treating tallow with ashes (Maotsela, Danha, & Muzenda, 2019). In its strictly chemical sense, it refers to combinations of fatty acids with metallic bases, a definition which includes not only sodium stearate, oleate and palmitate, which form the bulk of the soaps of commerce, but also the linoleates of lead manganese, etc, used as driers, and various pharmaceutical preparations, e.g mercury oleate (*Hydrargyrioleatum*), zinc oleate and lead plaster, together with several other metallic salts of fatty acids. Technically speaking, however, the meaning of the term soap is considerably restricted, and limited to the combinations of fatty acids and alkalis, obtained by treating various animal or vegetable fatty matters, or the fatty acids derived there from, with soda or potash, the former giving hard soaps, the latter soft soaps. The use of ammonia as an alkali for soap-making purposes has often been attempted, but owing to the ease with which the resultant soap is decomposed, it can scarcely be looked upon as a product of much commercial value (Salihu, 2007; Thomssen, 1922).

**Raw material used in production soap****Fats and Oils. -**

All animal and vegetable oils and fats intended for soap-making should be as free as possible from unsaponifiable matter, of a good color and appearance, and in a sweet, fresh condition. The unsaponifiable matter naturally present as cholesterol, or phytosterol ranges in the various oils and fats from 0.2 to 2.0 per cent. All oils and fats contain free acidity; but excess of acidity, though it may be due to the decomposition of the glyceride, and does not always denote rancidity, is undesirable in soap-making material. Rancidity of fats and oils is entirely due to oxidation, in addition to free acid aldehydes and ketenes being formed, and it has been proposed to estimate rancidity by determining the amount of these latter produced. It is scarcely necessary to observe how very important it is that the sampling of fats and oils should be efficiently performed, so that the sample submitted to the chemist may be a representative average of the parcel. In the following short description of the materials used, we give, under each heading, figures for typical samples of the qualities most suitable for soap-making (El Maghraby & Tolba, 2015).

**Tallows.**

Most of the imported tallow comes from America, Australia, and New Zealand. South American mutton tallow is usually of good quality; South American beef tallow is possessed of a deep yellow color and rather strong odor but makes a bright soap of a good body and texture. North American tallows are, as a rule, much paler in color than those of South America, but do not compare with them in consistence. Most of the Australasian tallows are of very uniform quality and much in demand. Great Britain produces large quantities of tallow which comes into the market as town and country tallow, or home melt. Owing to the increasing demand for edible fat, much of the rough fat is carefully selected, rendered separately, and the product sold for margarine-making. Consequently the melted tallow for soap-making is of secondary importance to the tallow Melter (El Maghraby & Tolba, 2015).

**Cocoa-nut Oil.**

The best-known qualities are Cochin and Ceylon oils, which are prepared in Cochin (Malabar) or the Philippine Islands and Ceylon respectively. The dried kernels of the cocoanut are exported to various ports in Europe, and the oil obtained comes on the market as Continental Coprah Oil, with the prefix of the country or port where it has been crushed, e.g., Belgian, French and Marseilles Coprah Oil. Coprah is also imported into England, and the oil expressed from it is termed English Pressed Coprah. Cocoa-nut oil should absorb 8.9 to 9.3 per cent. iodine. (El Maghraby & Tolba, 2015)

**Palm-nut Oil.**

The kernels of the palm-tree fruit are exported from the west coast of Africa to Europe, and this oil obtained from them. Palm-nut oil should absorb 10 to 13 per cent. iodine.

**Olive Oil.**

The olive is extensively grown in Southern Europe and in portions of Asia and Africa bordering the Mediterranean Sea. The fruit of this tree yields the oil. The free fatty acid content of olive oil varies very considerably. Very fine oils contain less than 1 per cent. acidity: commercial oils may be graded according to their free acidity, e.g., under 5 percent., under 10 per cent., etc., and it entirely depends upon the desired price of the resultant soap as to what grade would be used. The aim of this study is to bleach and improve the color of the toilet soap manufacture and investigate the side effect of the bleaching materials.

### Manufacture toilet soap bar

The production syndet bars is more difficult than the manufacture of conventional toilet soap, the main problem being the plasticity of the syndet base. soap plasticity stays rather constant in the normal 30 to 45 c temperature operating range, whereas syndet plasticity changes from very hard to very soft in some processing range. standard toilet soap finishing lines are used for syndet bar manufacture but product appearance and line productivity are seldom satisfactory, the best syndet bar line is the "dual function fishing line" with predefining (Hollstein & Spitz, 1982).

Toilet bar line over the last decade, toilet soap finishing lines have been standardized into a few well defined types, unfortunately toilet soap bar lines have not received the same attention and there are many types, mostly based on toilet soap finishing method. the "dual function predefining syndet bar line" illustrates two manufacturing routes using the same processing steps and the same machinery. the difference is in the possibility of using either a twin worm simplex refiner and/or the three roll mill for the predefining and refining steps. the predefining concept, the dual function manufacture flexibility and some specialized equipment should be part of any well-functioning toilet bar line (Hardy & Snell, 1957; Hollstein & Spitz, 1982).

Twin-worm plodders have superior conveying, palletizing and extruding capabilities. the superior performance of the twin-worm vs single-worm plodders is achieved with the two counter-rotating touching but not intermeshing, special profile worms. the toilet bar worms are of different design than the normal soap worm. toilet bars with a limited number and small quantity of additives can be produced with single worm plodders, but it is always recommended to use the special worms to facilitate processing (Hardy & Snell, 1957).

### Materials And Methods:-

The materials were obtained from a local Manufacture called Towfiq manufacture of soap which placed in Khartoum, Sudan.

#### Formulas:-

A formula with some manufacturing descriptions of specific remarkable procedure are below reported

Fatty acids (80/20 tallow/coconut oil)	62%
Caustic soda 38% Na <sub>2</sub> O	16.1%
Deionised water	8.2%
Glycerine	6.2%
Sodium chloride(20% solution)	1%
Caustic potash(30% solution)	6.5%

### Processing Step

#### Predefining

A predefining step is the best assurance for trouble-free toilet bar processing. the low moisture content, cold toilet base material is usually very hard, but when it is subjected to mechanical work with a refiner or a roll mill, it is easily plasticized into a there soft and same what sticky consistency. the plasticized base mixed easier with the soled and liquid additives in the mixing stage than a non-plasticized base. the subsequent refining and extruding steps are also performed better (Ogoshi & Miyawaki, 1985).

#### Maxing

The predefined solid syndet base is mixed with all the other additives in a standard batch-type soap amalgamator (mixer) the optimal mixing time depends on the product formulation and batch size used, over mixing should be avoided since it will cause product discharge difficulties from the amalgamator and conveying problems to the refining stage (Maotsele et al., 2019).

#### Refining

Refining the entire product mixture into a homogeneous, uniform optimal quality finished product is performed with a roll mill or a simplex refiner and with the first stage of the duplex vacuum plodder, which is always a refining stage. The operating variable from the refining units are cooling. Water temperature for the refiner and/or roll mill. and refining screen size for the refiners. The cooling water temperature is very critical, depending largely on the water content of the product and to a lesser degree on the line capacity, type and size of refining equipment used. In

the refiners refining screen of European mesh number 18,22, 30, or in certain cases even 55 (U. S mesh number 16, 20, 28 or 50) can be used . the proper size depends on the product formulation , i.e. the quantity and type of additives (Maotsela et al., 2019; Ogoshi & Miyawaki, 1985).

### **Extruding**

All modern finishing lines have a duplex vacuum plodder for the final refining, compacting and air free extrusion of the product these units consist of two plidders mounted in the them and connected by a vacuum chamber . twin worm duplex vacuum plidders are the best for toilet bar lines. it is very important to note that the preliminary stage of the duplex vacuum plidders is a refining stage whereas the final stage is for extrusion head temperature ensures a smooth surface finish to the extruded slug ( billet ) the optimal temperature , anywhere between 60 and 90 c depends on the line output and product formula(Ogoshi& Miyawaki, 1985)(Maotsela et al., 2019).

### **Cutting**

The continuous extrude slug which leaves the duplex vacuum plodder is cut into individual slugs of predetermined length. standard sap chain cutters with the chain movement assisted by an air motor are most suitable (Maotsela et al., 2019; Ogoshi & Miyawaki, 1985).

### **Conditioning**

The purpose of conditioning is to harden slug surface before stamping. since most toilet bar formulations are somewhat soft and stick. even the use refrigerated (chilled) stamping dies does not always help to achieve acceptable stamping rates.Due to the cost and size of conditioning tunnels ,they should be considered only for 200 bars/min and faster lines and for very difficult to stamp products since conditioning tunnels ,are seldom used(Maotsela et al., 2019; Ogoshi & Miyawaki, 1985).

### **Stamping**

The use of refrigerated chilled stamping dies in the automatic soap presses has become standard practice for soap and toilet product alike. the optimal temperature at which the toilet bars best release from the dies depends on the product formula and line speed, as well as. on the bar shape and the humidity in the operating area. the temperature range varies from 30°C to 10 °C.Die releasing agents are also used, they are applied to surface of the slugs or sprayed directly on to stamping dies. the silicon based product zs 2945 is a very effective die releasing agent(Maotsela et al., 2019; Ogoshi & Miyawaki, 1985) .

### **Product reprocessing**

Extruded unstamped slugs (billets), stamp bars (tablets) and all trimmings and flashing from the stamping operation must be reprocessed immediately because toilet products regarded very quickly .just like toilet soap finishing lines , all syndet lines must be provided with a continuous product rework recycle conveying system . with high speed lines and very difficult products , it is best to repalletize all the rework material through a small plodder before recycling it to the preliminary stage of the duplex vacuum plodder (Maotsela et al., 2019; Ogoshi & Miyawaki, 1985).

## **Material and Methods:-**

### **Materials**

Ethanol alcohol 95%,Normality (0.1), solution Ph-Ph (1%) in alcohol 95% , soap, distilled water, solution of calcium nitrate 20% orange methyl of 0.1g in 100ml distilled water, Sulphuric acid (1.0) , potassium chromate 5g in 100ml of distilled water, AgNO<sub>3</sub> (0.1N), HCl , orange methyl, anhydrous sodium sulphate, petroleum ether, soap, solution of potassium iodide, sulfuric acid, sodium sulfate.

### **Methods:-**

#### **Determination of percentage of sodium hydroxide in soap**

10g of the sample was taken and used to heat 100 ml of ethanol for 5min to get rid carbon dioxide. heating was continued while shaking until 70 °C. then 4drops of Ph .Ph indicator was added to neutralize the solution with sodium hydroxide until the color changed to light red pink , and also heat until the sample completely dissolve in the alcohol then titration against HCl(0.1N) was done until the appearance of light red pink color resembling on neutralizing alcohol then calculation was done to find free alkali in the soap(Adane, 2020).

**Determination of NaCl in soap**

10g of the sample was taken and added 100ml of distilled water to it. then heat until the sample completely dissolved in water. 20ml of calcium nitrate was then added then the sample was filtered using a beaker then 100ml took from the filtrate and added to it of drops of methyl orange. Neutralize the solution by adding H<sub>2</sub>SO<sub>4</sub> (1.0) to it then added potassium chromate and titrate against AgNO<sub>3</sub> (0.1N) after that calculations was done to find the concentration of NaCl in the Soap(Bennett, 1910).

**Determination of percentage of silicate in soap**

10g from the sample wa taken and 100 ml of alcohol pure was added to it then heated until the sample completely dissolve then the dissolved sample was filtered using tunnel, the filter paper was washed several times with hot alcohol then wash the filter paper with hot distilled water several times, until the dissolving of all the suspended silicates in filter paper with hot water then titrate against hydrochloric acid (0.1N) using methyl orange after that calculations was done to determine the percentage of silicate in the Soap(Edeler, 1925; Vivian, Nathan, Osano, Mesopirr, & Omwoyo, 2014).

**Total dissolved fatty acid in soap**

10g of the sample was taken and added 100ml of water then heated until dissolve the soap then the sample was transferred in the separating tunnel of 500 ml then added props of methyl orange and little of HCl (0.1N) until the color changes to red color then leave the sample to cool use the solvent separate the formed oil layer then repeat the separation several times than drop the fatty acids from the separating tunnel to the filter paper containing sodium sulphate anhydrase then put the solvent then to in beaker machine than to the furnace at 100c for 24hrs draw, after that calculations was done(Chen & Ng, 1984; Jenkins & Palmquist, 1984).

**Titer point**

Fill the water through with cold water at 20-1<sup>o</sup>c, then put the sample of fatty acid, in the test tube containing thermometer and red stirred, mix the sample with glass rod and observe the temperature decrease of the sample. Decrease in temperature contains until the specific temperaturewithin 30 seconds than raise slowly than continuous decrease. degree of hardness is the highest degree at when tats melt with the slow decrease in temperature(Forestell, Böhnlein, & Rigg, 1995; Jennings, 1931).

**Determination of the PH**

Ten (10) grams of the powdered bar soaps were weighed and dissolved in distilled water and made up to 100 cm<sup>3</sup> (10%) soap solution. The solutions were allowed to stand and settle for 24h before determinations. The pH of the soap solution was determined using a pH meter.

**Results And Discussion:-**

To perceiving the physical and chemical characteristics of commercially available toilet soap prepared from Tawfik soap manufacture, the research was supervised by analyzing thesamples as shown in Table 1.

**Table 1:-** Some properties of fatty materials used in the samples of soap.

pH	10.2
Free alkali	1.31%
TDS (mg/L)	48
NaOH (%)	0.04
NaCl(%)	0.51
Saponification value	200
Titer point	53
Sodium silicate	5.3*0.14

The table 1 shows that the pH values was 10.2 and its acceptable. The results compared with results (10.4) reported by Warra et al. (2011) and Tarun et al., (2014). The results of soaps ranged between 9.20 and 10.2 with mean and standard errors of 10.2 and 0.02 respectively. There are some relationships between the results of this study and those reported in Kenya (Vivian et al., 2014). TDS results provided in Table 1 was 48, it is acceptable and compared with the results released in the gardenweb by Alice (2013). TDS is known to give water at a low concentration a flat taste, which is acceptable to the users. In the other way round, increased concentrations of

dissolved solids may likewise give undesirable effects. TDS can produce hard water, which produces deposits and films on fixtures, pipes and boilers (Kamel, 2017). Infarct, washings in hard water using soaps and detergents can be said to be a fruitless effort because it cannot be used to clean anything, more soap will be needed which eventually turns to waste. Saponification value (S.V) is used to estimate the quantity of sodium hydroxide required to saponify the fat, and the results obtained are within acceptable range (193-206), those found by the other authors [Ahmed et al, 2016]. Titer of soap bar from palm base ranged from 39-47°C with an average of 45°C. The increase in titer of palm-based soaps was due to incorporation of a palm fraction, stearin, which had a higher solidification point. In the earlier survey, the titer was only 39-42°C. Tallow-based soaps still maintain a titer of 34-39°C and an average of 37°C. However, titer was not a requirement in most soap specification (Ahmed et al, 2016). Free caustic alkali is one of the parameters that specifies the abrasiveness of any given soaps. The free caustic alkali is the amount of alkali free to counter and avert the soap from becoming oily. From the current analysis, the obtained results for free caustic alkali were 1.31%. Excess free alkali causes skin itching.

Industrial sodium chloride is usually contained by impurities consisting mostly of magnesium carbonate. When the sodium chloride solution is added to the corrected sodium silicate solution, magnesium hydrate or magnesium silicate precipitates, making the solution dark, milky or even paste like. So, we suggest purifying the industrial sodium chloride solution before mixing it with the sodium silicate solution. Sodium silicate is a composition where sodium oxide ( $\text{Na}_2\text{O}$ ) and silica ( $\text{SiO}_2$ ) are combined in varying proportions, usually with some water. A wide range in useful properties is possible by vary the proportions of these components. Moreover, low cost contributes to make sodium silicate desirable for many widespread applications. Based on many practical trials and laboratory tests, it was found that the best weight ratio ( $\text{Na}_2\text{O}:\text{SiO}_2$ ) for sodium silicate solution in soap industry is 2.0-2.4 that is  $\text{Na}_2\text{O}:2.0-2.4\text{SiO}_2$ . Through sometimes it is possible to buy some products almost ready for use (for instance Diamond-sharrock grade 52, that is offered under form of a solution at 52Be concentration at 20C or 68F, and with 2.40 weight ratio), in most cases sodium silicate is available in different weight ratios, generally 3.0, 3.2 or more. For this reason, it is necessary to correct the  $\text{Na}_2\text{O}:\text{SiO}_2$  ratio. To add whiteness and opacity to soaps, titanium dioxide ( $\text{TiO}_2$ ) is used. Titanium dioxide is effective when used in concentrations from 0.03 to 0.05% on weight basis, that is 0.3 to 0.5 Kg of titanium dioxide per 1000 Kg of soap. Titanium dioxide can be added to the neat soap in a Crutcher (before drying) or to the dry soap pellets in an amalgamator (Mazzoni model MS) or mixer-refiner (Mazzoni model MC). In both cases a 1 to 1 ratio water slurry can be prepared using water at 60C (140F) or more to facilitate dilution. For toilet soap bar production, the titanium dioxide amount may be increased up to 0.5% on weight basis.

Sodium hydrosulphite is commonly used as a bleaching agent. Commercial sodium hydrosulphite is a white powder. It is stable when dry, but decomposes if moisture is present, so it is necessary to keep it in air proof containers. Depending on soap color, 1 to 3 Kg of sodium hydrosulphite are employed for 1000 kg of soap. The bleaching is carried out before the last salting out. The mass must be in a smooth homogeneous condition with a closed grain. The free caustic is to be about 0.4%. The required amount of sodium hydrosulphite is dissolved in 10 times its weight of water, previously made slightly alkaline by addition of 0.1 part of caustic soda solution at 36 Be. After boiling the mass for 30-40 minutes, the bleaching is completed, and the soap mass may be salted out. To obtain good results, it is most important that the soap is alkaline.

### **Conclusion:-**

Present study solved bleaching and improving the color ( $\text{TiO}_2 + \text{CMC}$ ) and considered some practical experiments in soap industry. The study was also conducted to find the physicochemical properties of Towfiq soap manufacture. The obtained results revealed that most of the parameters are acceptable. The study recommends that the results may be useful in the future to be used as a reference for young researchers who are interested in the field of industrial chemistry. That is to certify this research will give a good view of toilet soap is manufactured and how some improvement was done during the study.

### **Conflict Of Interest Statement**

All authors of the manuscript declare that they do not have financial/commercial conflicts of interest.

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