EFFECT OF COMPONENT VARIABLES ON THE QUALITY OF HOUSEHOLD LIQUID DETERGENT PRODUCTION

By

ODUJINRIN JAMES DARE

2007/2/26182EH.

THE DEPARTMENT OF CHEMICAL ENGINEERING,

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF CHEMICAL ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE.

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING IN CHEMICAL ENGINEERING

NOVEMBER, 2011.

DECLARATION

I declare that the work in the project report entitled "EFFECT OF COMPONENT VARIABLES ON THE QUALITY OF HOUSEHOLD LIQUID DETERGENT PRODUCTION" has been performed by me under the supervision of Engr. Aboje.

Name of Student	Signature	Date
ODUJINRIN DARE JAMES		02/12/2011

CERTIFICATION

This is to certify that this report entitled 'EFFECT OF COMPONENT VARIABLES ON THE QUALITY OF HOUSEHOLD LIQUID DETERGENT PRODUCTION' by ODUJINRIN DARE JAMES meets the requirements for the partial fulfillment of the award of Bachelor of Engineering (B.Eng) degree in Chemical Engineering, Federal University of Technology, Minna.

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for Project Supervisor
Engr. A.A Aboje
Date

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Head of Department
Dr. M. O. Edoga
Date

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External Supervisor
Date

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Finally, I acknowledge the grace of God in all my endeavours; it is not by my power or might, but by his guiding spirit. May he take all the glory forever and ever Amen.

ABSTRACT

The project work was carried out to investigate the effects of component variables on the quality of household liquid detergent and as well the general production procedure for House-Hold Liquid detergent. The components that were investigated are: Sodium Tripolyphosphate (S.T.P.P), Sodium hydroxide and Sodium Lauryl Sulphate (SLS). Other materials that were used in the investigation process are Alkyl Benzene Sulphonates, perfume, formaldehyde and water. Four samples of liquid detergent were produced with varying standard components. Sample A contains all the three standard components, Sample B contains; Sodium Lauryl Sulphate, and Sodium Hydroxide except Sodium Tripolyphosphate (S.T.P.P), Sample C contains; Sodium Tripolyphosphate (S.T.P.P) and Sodium Lauryl Sulphate except Sodium Hydroxide (NaOH), while Sample D contains NaOH and S.T.P.P except Sodium Lauryl Sulphate.Their effects were investigated using the quality control tests such as; pH test, Specific Gravity test, percentage Free Alkali, Stable lather test, and Foaming test. The pH values obtained for there Samples are; 9.59, 9.45, 0.97, and 9.63 respectively. The Specific Gravity values obtained for the Samples are; 1.050, 1.044, 1.036 and 1.051. The percentage of free alkali Test of each Sample was found to be; 2.68 % for sample A, 2.00 % for sample B, 0.37 % for sample C and 2.20 % for sample D.

TABLE OF CONTENT

Content **Page**

Cover page	
Title page	i
Declaration	ii
Certification	iii
Acknowledgement	iv
Abstract	v
Table of content	vi
List of tables	vii
CHAPTER ONE	
1.0 Introduction	1
1.1 Aim, Objectives and scopes	2
1.1.1 Objectives	2
1.1.2 Scopes	2
1.2 Justification	2
CHAPTER TWO	
2.0 Literature review	3
2.1 Historical background	3
2.2 Components of detergents	4
2.2.1 Surfactant	4

Content	Page
2.2.1.1 Anionic surfactant	4
2.2.1.2 Cationic surfactant	5
2.2.1.3 Non ion surfactant	6
2.2.1.4 Amphoteric surfactant	6
2.2.1.5 Alkyl Benzene sulfonates	6
2.2.2 Builders (Water softener)	7
2.2.3 Fillers and processing aids	8
2.2.4 Flouresers	8
2.3 Uses of detergent	8
2.4 production of liquid detergent	8
2.5 Properties of liquid detergent	9
2.5.1 Active matter	9
2.5.2 Percentage Free-alkali (NaOH)	10
2.5.3 Density	10
2.5.4 Viscosity and pH values	11
CHAPTER THREE	
3.0 Methodology	12
3.1 Preparation of liquid detergent	13
3.2 Preparation of test samples	14

Content	Page
3.3.pH Test	14
3.3.2 Determination of percentage Free-Alkali	14
3.3.3 Determination of specific Gravity	15
3.3.4 Foaming Test	16
3.3.5 Stable lather test	16
CHAPTER FOUR	
4.0 Results and Discussion of Results	17
4.1 Results of Experiments	17
4.2 Discussion of Results	19
CHAPTER FIVE	
5.0 Conclusion and Recommendation	21
5.1 Conclusion	21
5.2 Recommendation	22
References	23
Appendix	25

List of Tables

Table		Page
Table 3.1	Description of Apparatus and Quantity Required	12
Table 3.2	Basic Composition of Household liquid Detergent	13
Table 4.1	Results Obtained for the Quality Control Test on Sample A	18
Table 4.2	Results Obtained for the Quality Control Test on Sample B	18
Table 4.3	Results Obtained for the Quality Control Test on Sample C	19
Table 4.4	Results Obtained for the Quality Control Test on Sample D	19

Chapter One

1.0 INTRODUCTION

The word detergent means a substance used to enhance the cleansing action of water. Detergents are a familiar sight in homes and industries usually produced in form of tablets, powder and liquid form. The importance of detergent industries and services rendered to the consumers cannot be overemphasized in Nigeria today (Abegunde , 2007).

Generally, detergents fall into two main categories, the first category is the soapy detergent includes house-hold soaps, Toilet soap, Soaps powders, Flakes and Special hard Soaps for use in industries.

The second major category is that of soapless detergents manufactured principally in the form of washing liquid and powders perform similar functions as a soapy powder, and to the casual observer it looks much the same. But its ingredients and the methods of manufacturing are different. The majority of soapless detergents are chiefly based on petrochemicals derived from mineral oils and reacted with sulphuric acid. Others are produced by sulphating tallows, Alcohols and by the reaction of alcohol with ethylene oxide (Bell, 2006).

Soaps are the oldest known detergent before the discovery of soapless detergents. Soap is especially suitable for toilet use and for detergency in soft water, and soap has two demerits, (1) It cannot function properly in a very hard water because of the insoluble calcium and Magnesium soap precipitation, and it cannot function effectively in acid solutions because of conversion to their soluble fatty acid. These effects of soaps have given rise to soapless detergents. For these reasons soapless detergent is widely accepted as a suitable substitute for soap.

Synthetic detergents became successful because of the development of the inexpensive sodium Alkyl benzene sulphonates. Therefore, detergents are also designed that the carbonyl that form scum in soaps is replaced with something else . Detergents contain, Tripoly Phosphate builders, Alkanolamine foam builders, Carboxyl Metyl Cellulose soil suspending agents and optical bleaches which have improved the detergent properties to significant extent.

The introduction of the improved automatic washing machines of detergent types is yet another factor in the success of synthetic house- hold detergents.

The production of built synthetic detergents is greater than that of soaps in the United State of America (USA). Some African countries manufacture soaps and detergents on the basis of self sufficiency level. Among the leading producers of soaps and detergents in Africa are the South Africa, Nigeria, Zimbabwe (Walsh *et al*, 2003)

Synthetic detergents are produced principally from petroleum products and to a lesser extent from coconut oil. Now petroleum based detergents represent over 70 % of the United States house-hold Market and over 50 % of the Nigeria house- hold Market.

Among all the surfactants obtained from petroleum sources, Sodium dodecyl benzene Sulphonate and Oxy-ethylated octyl or Nonyl Phenol, are of major importance in terms of volume of production as present (Robert *et al*, 1992)

1.1 Aims , Objective and Scope

The aim of the study is to study the effect of component variables on the quality of production of household liquid detergents through the objectives below:

1.1.1 Objectives

The main objectives of this project work is to give,

- Detail explanation on the preparation of Liquid Detergents
- And as well consider some of the components used with their effects on samples of Detergent on variation.

1.1.2 Scopes

The scope of this project focuses on the following,

- Literature Review for Detergents.
- Liquid Detergent and highlighting its manufacture properties.
- Investigating the effects of each of the standard ingredient on the quality of the Liquid Detergent and this was achieved by varying the standard components. The following tests were carried out on them i.e The various samples obtained by Variation of standard ingredient, pH Test , Foaming Test, Stable Lather, Free Alkali, Viscosity Measurement and Gravity Measurement.

1.2 Justification

The justification for the project are outlined below:

- It will encourage small scale industries
- It will encourage indigenous design of plants for the production of household liquid detergents
- The production of liquid detergent improves on the quality of washing action of soap which is not effective in hard water
- Self employment opportunities.

Chapter Two

2.0 LITERATURE REVIEW

The washing industry, usually known as soap industry, has root over 2000 years in the past, a soap factory having been found in the Pompeii excavation. However, among the many chemical process industries, none has experienced such a fundamental change in chemical raw materials as have the washing industries. It has been generally accepted that the per capital use of toilet soap is a reliable guide to the standard of living for any country (George. 1984).

2.1 Historical Background

Soap itself was never actually "discovered'', but instead gradually evolved from crude mixture of both Alkaline and fatty materials. Pliny the Elder described the manufacture of both hard and soft soap in the first century, but it was not until the thirteenth century that soap was produced in sufficient quantity to call it an industry. Up to early 1800s soap was believed to be a mechanical mixture of fat and Alkali, then chevreul, a French chemist showed that soap formation was actually a chemical reaction . Domeier completed his research on the recovery of glycerine from saponification mixtures in this period. Until Le blanc's important discovery producing lower- priced sodium carbonate from sodium chloride , the Alkali required was obtained by crude Leaching of wood ashes or from the evaporation of naturally occuring Alkaline water e.g The Nile River (George. 1984).

The raw material shortages of World War 1 led the Germans to develop "synthetic soaps" or detergents. These were composed of short- chain Alkylnaphthalene sulphonates, which were good wetting agents but only fair detergent action. This sparked the interest world wide in developing detergents, and new development has progressed through long chain alcohol Sulphates in the 1920s and 1930s, through Alkyl – aryl long chain Sulphonates in the 1940s, to branched chain compounds in the 1950s and 1960s. During the 1960s the requirement of biodegradability became important and caused the return to linear long chains, because only the linear chains can be easily biodegraded (George. 1984).

2.2 Components of Detergent

Detergent used for both institutional and House-hold needs comprises of substances categorised into the following groups;

(1) Surfactant

(2) Builders

(3) Blending Agents

(4) Auxiliary Agents.

A large volume of active organic compounds, or surfactants, for both detergents and soap are manufactured in final form by soap and detergent companies. Examples are; linear Alkyl benzene sulphonates (LAS) and fatty alcohol sulphates, which these companies manufactured hundreds of millions of pounds . The same is true for fatty acids, the basic materials for soap. Most of the inorganic materials, such as oleum, caustic soda and various sodium phosphate and a large number of additives the last mentioned amounting to 3% or less of the product weight are purchased (Madu, 2007).

2.2.1 Surfactant;

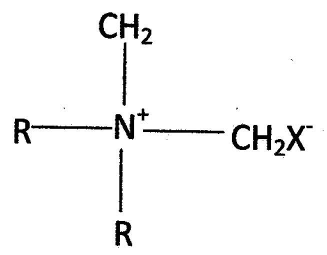
These constitute the most important group of detergent components and are present in all types of detergent components and are present in all types of detergents; surfactant generally are water-soluble surface action agent comprising of a hydrophobic portion (usually a long alkyl chain) attached to hydrophilic or solubility enhancing functional group (Madu, 2007).
Thus, type of charge present on the chain-carrying portion of the molecule after dissociation in acqeous solution is used to place surfactant in one of four classes viz;

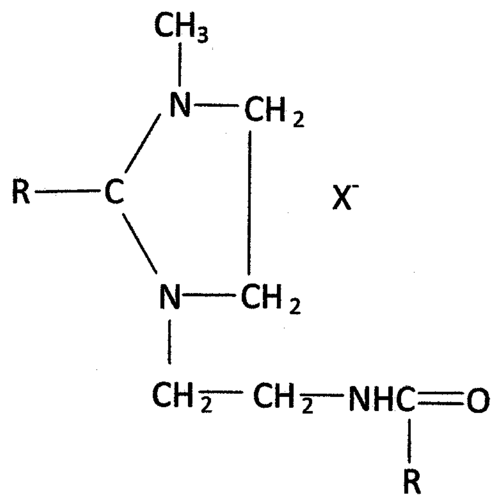
2.2.1.1 *Anionic Surfactants*

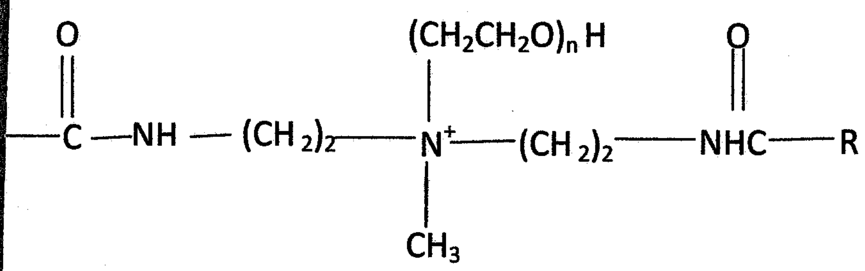
Anionic surfactants from the largest group of surfactants used for house-hold cleaners, personal care products and industrial detergents. These products have a lipophilic oil soluble "Tail" and a hydrophilic water soluble "head", Anionic surfactants are good wetting and emulsifying agents. Examples of anionic surfactants are; Linear Alkyl Benzene Sulphonic Acid, Sodium Laureth Sulphate, etc.

2.2.1.2 *Cationic Surfactants*

Cationic surfactants have a positive ion and are used for fabric conditioning and manufacture of quaternary compounds. The quaternary ammonium compounds comprise the cationic class. Type A is a dialkyl dimethyl quaternary ammonium compound.







The X^- is either Cl^- or $CH_3SO_4^-$ Type B is a diamido alkoxylated quaternary ammonium compound, where X^- is $CH_3SO_4^-$. The C^7 is an amido imidazolinium compound where X^- is $CH_3SO_4^-$ (Bajah *et al*, 1995)

Being generally weak in detergent power, although they have good lubricating antistatic and germicide properties, they are not usually used as household detergents. Anionics and cationics are not compatible with soap.

2.2.1.3 *Non-Ionic Surfactants*

Non-Ionic surfactants do not have collarity charge. These products have excellent wetting properties and are generally used in combination with other surfactants for enhancing their performance properties. Alcohol Ethoxylates and Alcohol Phenol condensates are examples of Non- Ionic Surfactant. Non Ionics are effective than anionics in removing soil at the lower temperatures necessary for laundering synthetic fibers. They are also more effective at removing body oils.

2.2.1.4 *Amphoteric Surfactants*

Amphoteric Surfactants exhibits large collarities depending on the pH of the solution. Betaines are an example of an Amphoteric surfactants.

The Surfactant suited for detergent is essentially expected to demonstrate the following characteristics ;

1. Specific Adsorption,
2. Soil removal,
3. Low Sensitivity to water hardness,
4. Dispersion Properties,
5. High Solubility,
6. Wetting Power,
7. Desirable foam characteristics,
8. Neutral odour,
9. Storage stability,
10. Favourable handling characteristics,
11. Minimal toxicity to human etc.

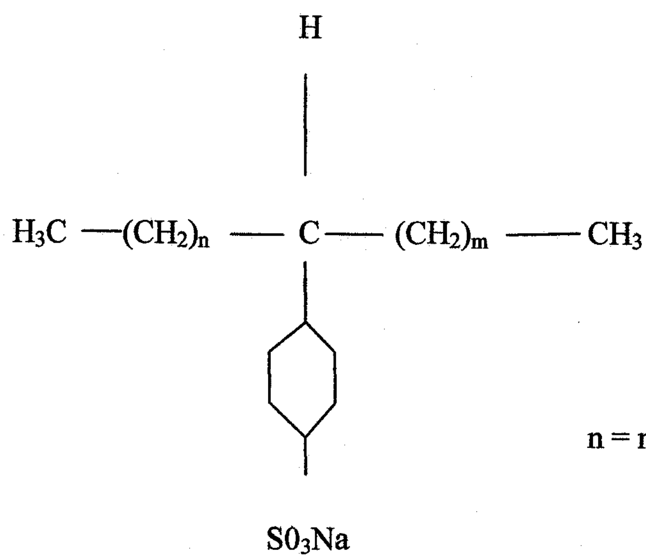
2.2.1.5 Alkyl Benzene Sulphonate

Alkyl benzene sulphonate which is the active matter/ component of the household liquid detergent includes the following perculiar properties

- Effective performance

- Very interesting foaming characteristics
- High foaming ability and foam produced is readily stabilized by foam stabilizer.
- Linear Alkyl benzene sulphonic acid's high solubility makes it very suitable for use in foam agents for liquid detergent.

However, Linear Akyl Benzene Sulphonate is sensitive to water hardness.



n = m = 7 - 10

2.2.2 Builders (Water Softeners)

Detergent builders play a central role in the course of the washing process. Their function is mainly that of supporting detergent action and of eliminating calcium and magnesium ions, which arise partly from the water and sometimes also from the soil and cutleries. This category of builders is comprised of several types of materials, specific alkaline substances such as sodium carbonate and sodium silicate; complexing agents like sodium tripolyphosphate (STPP) etc. Builders are thus water softeners and they work by complexetion, precipitation or ion exchange. The use of STPP has been curtailed because of contribution of the waste phosphate to eutrophication. The most common builders used in most detergent factories today are; synthetic zeolite which are solids ion exchangers which trap the divalent ions inside the solid particles. Most of the builders also produce alkaline solution which helps the cleaning and most detergents work effectively around pH 10 – 11 (Madu, 2007).

2.2.3 Fillers and Processing Aids

There are materials added to alter the physical properties of the detergent. Alcohol are added to liquid detergents to keep everything in solution and also to lower the free zing point. Filler impose the following properties on the detergent;

1. flowability
2. high solubility

processing aids however, are substances required in the preparation of liquid detergents. The most important of these have the assignment of ensuring through their own hydrotropic characters that the other detergent components can be combined in a stable way in an aqueous environment. Above all there ingredients must prevent phase separation and precipitation occurring as a result of shifts in temperature. Commonly used materials include short chain alkyl benzene sulphonate (e.g Toluene sulphonate and cumeine sulphonate), as well as low molecular mass alcohol (Ethanol, 2 – propanol) and poly glycoethers (Ethylene Glycol).

2.2.4 Flourescers

Organic molecules are added to detergent because of their fluorescent properties. They absorb on the washed material e.g cutleries, or kitchen utensils like dye but they absorb ultra – violet (UV) light and re – emit white light, thus brightening the material. They are also known as optical brightness e.g tinopal, glycerine

2.3 Uses of Detergents

1. It is used for both institutional and house-hold needs of enhancing wash effectiveness.

2.4 Production of Liquid Detergent.

Liquid detergent can be produced by weighing the required quantity of clean water into a clean beaker keeping back a small amount for variation in actives and for use during addition of colour. The formula quantity of sodium EDTMP or Briquest was weighed and added to the water in the beaker until fully dissolved by continuous stirring or mixing. 95% of the formula quantity of 47%w/w sodium EDTMP or briquest was weighed and added to the water in the beaker until fully dissolved by continuous stirring or mixing. 95% of the formula quantity of 47%w/w sodium Hydroxide solution (Low Grade) was added and mixing was ensured continuous.

Furthermore, the required formula amount of the Linear alkylbenzene sulphonic acid was added and mixed until all the acid has reacted and there were no lumps of undisperse acid in the liquid, on the side of the beaker and the stirrer. The formula quantities of propylene Glycol and Magnesium sulphate were at the same time added to the solution in the beaker and well mixed until fully dissolved.

7 % w/w sodium Hydroxide solution (Low Grade) was added and mixing was ensured continuous. Furthermore, the required formula amount of the Linear Alkyl Benzene Sulphonic acid was added and mixed until all the acid has reacted and there were no lumps of undispersed acid in the liquid, on the side of the stirrer. The formula quantities of propylene Glycol and Magnesium Sulphates were at the same time added to the solution in the beaker and well mixed until fully dissolved (Madu, 2007).

The temperature of the batch was then brought below 40 ^{0}C before continuing. Formula quantity of sodium lauryl sulphate (70 % w/w active) was added after variation in active level had been taken into account.

In a suitable clean container, the dye was pre-mixed with small amount of clean water and was rinsed with more water as required. To the main mixing beaker the formula quantity of 'Day Fresh' perfume was added, together with the required amount or quantity of formaldehyde (37 %w/w active). The remaining portion of water added originally was then added to make up to full water weight (Madu, 2007).

The pH of the solution produced was adjusted to 6.0-7.0 with sodium Hydroxide (to increase pH) as required with the adequate consideration of precautions. The batch was then left mixing for few minutes after each addition before measuring pH. After all the materials had been charged into the beaker the batch was thoroughly mixed for few minutes (say 60minutes).

2.5 Properties of Liquid Detergent

2.5.1 Active Matter

During usage, liquid detergent may have some bad effects on washing the domestic materials and clothes, that is , the compositions used may not have to remove the dirts or grease from the materials. Also, there are some products in which the reaction does not proceed fast enough in removing the dirt. Therefore, determination of this active detergent is then carried out in order to know the degree of effectiveness of the detergent. Usually this depends on the raw materials used as well as the proportion of the components used. The standard range for the active matter of liquid detergent 21 – 23.0 % (Bell, 2006).

2.5.2 Percentage Free Alkali (Na_2O)

When using soaps, it is important that the solution should be Alkaline. The soap and detergent must contain sufficient Alkaline to neutralise the acidity invariably present to maintain the pH of the soap solution above its hydrolysis point. Generally, soapless detergents are not hydrolysed as easily as soaps, but it is still necessary to have sufficient Alkali present in it to neutralise the materials, and the presence of builders – tends to reduce both surface and interfacial tensions of the solutions. The most ideal detergent builder is one that releases its Alkalinity only on reaction, but alkalinity will still be available at a relatively high level. The advantage of the test is to control the presence of free Alkali because caustic soda is corrosive. The tolerable Ph range for Na_2O is expected to be between pH of 8 – 9. The percentage free alkali ranges from 2.0 to 3.2 (Bell,2006).

The Physical Properties of the liquid detergent these includes, (i) Density (ii) pH value (iii) Viscosity.

2.5.3 Density

The Specific Gravity and density are general physical characteristics used in the classification and identification of the detergent produced. This depends on the types of materials used for production and the chemicals used as builders and additives. When using Sodium Hydroxides (NaoH) solution, the specific Graviity varies from 1.007 to 1.543 but when potassium hydroxide is used, the specific Gravity Varies from 1.0088 to 1.5382 at various temperatures.

2.5.4 pH Values

It is often essential to know the acidity level of detergents. These are several good ways to determine directly the pH of a solution. Electronic instruments rely on electrodes dipped into a solution to give immediate accurate reading of the pH value.

Paper stripes impregnated with mixture of dye will give instantaneous pH when they are wet with a solution, these are improved versions of the old method and litmus paper was introduced in which the litmus paper turns to pink in indicate acidity and blue indicate basicity. The tolerable range for pH in detergent is expected to fall between pH of 8.5 to 10 (Madu, 2007).

2.5.5 Viscosity

Viscosity is a measure of the internal fluid friction which tends to oppose any dynamic change in the fluid motion that is, if friction between layers of fluid is small (low viscosity) and applied shearing force will result in a large velocity gradient. As the velocity increases, each fluid layers exert a large frictional drag on the other layer and velocity gradient decreases. The coefficient of viscosity is expressed in poise. The viscosity of detergent can be measured by using ford cup or rising bubbles viscometer. The viscosity of a detergent is expected to fall within the range of 369-461 seconds; here the viscosity is measured in relation to time of flow of the liquid from the ford cup (Madu, 2007).

Chapter Three

3.0 METHODOLOGY

Table 3.1 Showing the description of the apparatus and the quantity required

S/N	APPARATUS	QTY REQUIRED
1	BEAKER(1000mls)	2
2	STIRRING ROD	1
3	CONICAL FLASK(250mls,PYREX)	1
4	MEASURING CYLINDER(500mls)	1
5	pH METER(DIGITAL)	1
6	CHEMICAL BALANCE	1
7	BURETTE(50 ml)	1
8	PIPETTE(25 ml)	1

Table 3.2: Basic Composition of House-hold Liquid Detergent

Ingredient	Function	Wt% composition of ingredient in product
Water (distilled)	For dissolution of solid ingredients	60.43
Sodium hydroxide (NaOH)	Active ingredient in the neutralization reaction	3.60
Linear Alkyl Benzene Sulphonic Acid	Active matter of the detergent as foaming agent	14.60
Sodium Tri Poly Phosphate (STPP)	Removal of inorganic soil, detergent building	1.5
Sodium Lauryl Sulphate	An example of anionic surfactant as LABS, it is a good wetting and emulsifying agents i.e removal of oil	11.43
Water for mixing dye	For dissolution of dye solute	3.34
Fresh Green Dye Powder	Gives the detergent the greenish colouration	0.0036
Fragrance (Day fresh)	Extremely complex mixture, added in little concentrate to the detergent to give its sweet smell.	0.250
Formaldehyde	Used as preservative	0.250
Making up water	For making up the detergent solution to the required quantity or capacity	3.34

Basis = 500 g of finished product of Liquid Detergent.

3.1 Preparation of Liquid Detergent

500 grams of distilled water at room temperature was weighed into a clean beaker from this, 302.0 g of the distilled water was measured into another clean beaker keeping back the rest for variation in actives and for use during addition of colour. There after 0.65 g of glycerine was added to the 302.0 g clean water in the beaker until fully dissolved by continuous stirring or mixing. Furthermore, 18.0 g of the anhydrous NaOH salt was added to the mixture of glycerine and water in the beaker and mixing was ensured continuous. 73.0 g of Linear Alkyl Benzene Sulphonic acid was weighed and added cum mixed continuously until all the acid has reacted and there were no lumps of undispersed acid in the mixture, on the side of the beaker or the stirrer. Then 7.50 g of Sodium Tri poly phosphate, 57.15 g of Sodium Lauryl Sulphate were added at the same time to the solution after variation in active level had been taken into account and temperature of mixture was ensured brought below 40 °C before continuing.

In a suitable clean container, 0.018 g of dye was pre-mixed with 16.7 g of distilled water taken from the original left over, no mess of the dye was allowed lost but was ensured rinsed into the solution by more water. Then 1.25 g of day fresh (super fragrance) was weighed and added into the detergent mixture together with 1.250 g of formaldehyde. The remaining portion of the water reserved originally was then added to make up to full water weight. The pH of the solution produced was adjusted to 6.0 – 7.0 with NaOH (to increase pH) as required with the adequate consideration of precaution.

3.2 Preparation of Test Samples

Using the same method as described in 3.3.1, four samples of detergents were produced, these consist of:-

SAMPLE A:- This is the standard formulation of detergents incorporating all the standard components as described in 3.1

SAMPLE B:- All the standard components are present except Sodium Tripoly Phoshate (S.T.PP)

SAMPLE C:- All the standard components are present except Sodium Hydroxide.

SAMPLE D:- All the standard components are present except Sodium Lauryl Sulphate (SLS)

3.3 Quality Control Test

For the samples of detergent produced, the following Tests were carried out:

3.3.1 pH Test

This was carried out by Neat Method, which involves obtaining the pH of sample by direct insertion of the electrode of the pH meter into the sample.

3.3.2 Determination of Free Alkali

20 g of detergent sample was weighed and dissolved in 150 ml of neutralised Ethanol, followed by adding 10m/s of 10% Barium Chloride solution. Then 3 drops of phenolphthalein indicator was added. This solution was then titrated against 0.1 M solution of Tetraoxosulphate VI (H_2SO_4). The end-point was colourless. Using the formular below the free Alkali in percentage was calculated:-

$$\text{Free Alkali} = \frac{End\ point\ x\ Factor}{Weight\ of\ Sample} \qquad \text{Equation 3.1}$$

The factor is 3.1 (from Literature)

3.3.3 Determination of Specific Gravity

This was carried out by using Specific Gravity bottle. Initially the bottle was ensured cleaned and dried, then its weight measured using a digital weighing balance with its cork in position.

Furthermore, the empty bottle was then filled with distilled water to the brim and the bottle properly covered with the cork. The water which spilled on the body of the bottle was carefully dried up using a dry hand towel, and the weight of the bottle and the distilled water was taken and recorded. The same bottle was emptied of the water and dried, which was again filled up to the brim but now with the sample under test.

The overflown sample material on the body of the bottle was ensured dried while the cork was in proper position. The cork was kept in position to ensure the bottle is air-tight, and the weight of the bottle together with the sample in it was measured and recorded.

Finally, the following readings were obtained and the Specific Gravity calculated as shown below;

W_1 = Initial weight in grams of bottle when empty, with the cork in place.

W_2 = Weight of bottle when filled with distilled water (Also with cork in place)

W_3 = Weight of bottle when filled with sample with cork in position.

W_4 = Weight of distilled water that filled the bottle to capacity. This was obtained by subtracting the weight of the empty bottle 'W_1' from the weight of bottle and water 'W_2'

Therefore, the Specific Gravity of sample was calculated for using relation below,

$$\text{Specific Gravity of sample} = \frac{\text{Weight of Sample that filled the Specific Gravity bottle}}{\text{Weight of water that filled equal capacity of the bottle}}$$

$$\text{Specific Gravity} = \frac{W5}{w4} = \frac{W3-W1}{W2-W1} \qquad \text{Equation 3.2}$$

The specification of Specific Gravity for standard Liquid detergent varies from 1.007 to 1.543 using NaOH solution.

3.3.4 Foaming Test

This was determined by dissolving 2 grams of detergent in 60 ml of water. The solution was then stirred together for 30 seconds to allow for formation of foam.

3.3.5 Stable Lather Test

This was carried out to know whether the detergent will form stable lather when dissolved in water and was done by rubbing the detergent on the surface of the palm.

Chapter Four

4.0 RESULTS AND DISCUSSION OF RESULT

4.1 Results of Experiments.

Table 4.1: Showing the results obtained for the Quality Control Tests carried out on Sample A (Contains all ingredients)

Quality Control Test	Specification	Result of Test Obtained	Remarks
Specific Gravity	1.007-1.543	1.050	Meets required standard
pH	8.5-10.0	9.59	Falls within required specification
% Free Alkali	2.0-3.2	2.68	Falls within specification
Colour	Green	Greenish colour	Specification met
Foam Formation	Continuous formation	Good foam formation	Specification met
Stable Lather	Stable lather with water	Stable La ther	Stable lather was formed with water
Odour	Sweet Fragrance	Sweet fragrance	Specification met

Table 4.2: Showing the results obtained for the Quality Control Test carried out on Sample B (Containing other ingredients except S.T.P.P)

Quality Control	Specification	Results of Test Obtained	Remarks
Specific Gravity	1.007-1.543	1.044	Meets required specification
pH	8.5-10.0	9.45	Meets required specification
Percentage Free Alkali	2.0-3.2	2.00	Meets required specification
Colour	Green	Green	Meets required specification
Foam Formation	Continuous formation	Formation of foam was continuous	Meets required specification
Stable Lather	Stable lather with water	Lather with water was stable	Meets required specification
Odour	Sweet fragrance	Sweet fragrance perceived	Meets required specification

Table 4.3: Showing the results obtained for the Quality Control Test carried out on Sample C (Containing other ingredients except NaOH)

Quality Control Test	Specification	Results of Tests Obtained	Remarks
Specification Gravity	1.007-1.543	1.036	Meets required specification
pH	8.5-10.0	0.97	Falls below required specification
Percentage Free Alkali	2.0-3.2	0.37	Falls below required specification
Colour	Green	Greenish colouration	Specification met
Foam Formation	Continuous formation of foam	Continuous formation of foam	Specification met
Stable Lather	Stable lather with water	Stable lather with water	Specification met
Odour	Sweet fragrance	Sweet fragrance perceived	Specification met

Table 4.4: Showing the results obtained for the Quality Control Test carried out on Sample D (Containing other ingredients except S.L.S)

Quality Control Test	Specification	Results of Tests Obtained	Remarks
Specification Gravity	1.007-1.543	1.051	Meets required specification
pH	8.5-10.0	9.63	Meets required specification
Percentage Free Alkali	2.0-3.2	2.20	Meets required specification
Colour	Green	Greenish colouration	Meets required specification
Foam Formation	Continuous formation of foam	Continuous formation of foam	Meets required specification
Stable Lather	Stable lather with water	Stable lather formed with water	Meets required specification
Odour	Sweet fragrance	Sweet fragrance perceived	Meets required specification

Note: from table 4.3, the percentage free alkali value for sample C i.e 0.37 % which is below the range required was as a result of the absence of NaOH in the Liquid-detergent which accounted for the unreacted NaOH known as the free alkali. Generally, the presence of excess unreacted alkali in the liquid detergent beyond the specified one may be very corrosive on the user when washing, since NaOH is corrosive in nature.

4.3 Discussion of Results

The results obtained for the analysis carried out on both the physical and chemical properties of each of the samples A,B,C and D of the liquid detergent obtained via variation of the standard components showed clearly the component, that if absent in the formulation will affect the quality of the liquid detergent. From table 4.1, 4.2, 4.3 and 4.4 which showed that the specific Gravities of Sample A(containing all ingredients), Sample B (containing all ingredients except Sodium Tri polyphosphase), Sample C(containing all ingredients except NaOH) and Sample D (containing all ingredients except Sodium Lauryl Sulphate) were; 1.050, 1.044, 1.036 and 1.051 respectively, it was obvious that the specific gravity of each of the sample met the required specification which ranges from 1.007 – 1.543. But for the fact that each of the samples A,B,C and D passed the specific gravity test does not mean all met demanded quality, this was clearly shown by the pH test carried out on each of the liquid detergent samples A,B,C and D where the pH value of the sample were obtained as; 9.59, 9.45, 0.97 and 9.63 respectively as shown in tables 4.1, 4.2, 4.3 and 4.4 respectively.

Hence, 0.97 pH value obtained for sample C which has no NaOH showed an acidic pH of the liquid detergent, since there was no alkali i.e (NaOH) to neutralize the Linear Alkylbenzene Sulphonic acid thereby turning the bulk solution to acidic. Hence it could be deduced that the effect of absence of NaOH in the liquid detergent solution will be corrosive on the user's hand. Whereas, for samples A, B, and D with pH of 9.59, 9.45 and 9.63 showed that the specification was met by each of the sample, and hence they are accounted for as being users friendly.

In conclusion, for the free alkali test, which involved knowing the amount of unreacted NaOH present in the liquid detergent solution. For samples A,B and D containing NaOH solution with percentage free alkali as shown in the tables 4.1, 4.2 and 4.4 as 2.68 %, 2.00 %, and 2.20 % respectively indicated that samples passed the percentage free alkali test with the specification of 2.0 % $\leq Na_2O \leq$ 3.20 %. But for sample C which contained no alkali i.e NaOH, had a percentage free alkali of 0.37 % (as shown in table 4.3) far below the range of specification which was undoubtedly as a result of the absence of NaOH solution from which percentage of the unreacted NaOH with the LABSA known as the free alkali in the liquid detergent is obtained. Although, the low value of the percentage free alkali i.e 0.37 % obtained for sample C may have resulted from side reactions of other components which are sodium compound present in the sample C, with water. Example of such compound is Sodium tripolyphosphate and Sodium Lauryl Sulphate. Now, since the effect of the presence of free alkali in excess in the liquid detergent is its corrosiveness to the hand when used, sample C may not cause more danger to user as the pH has indicated before, since it contains low percentage of free alkali. Also, since sample A, B and D still have their percentage free alkali falling within the acceptable limit i.e 2.0 % - 3.2 %, hence they are considered users friendly.

Chapter Five

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The liquid detergent produced with the absence of Sodium Tripoly Phosphate, but containing other standard components known as Sample B, and the other called Sample D containing all other standard components except Sodium Lauryl Sulphate, having passed the pH test, Specific Gravity Test and percentage free-Alkali Test i.e having results for there tests fallen within acceptable limit as indicated before, as also did the Sample A which contained all the standard components, it could be concluded that any of the formulation used for preparing Sample A, B and D is suggested suitable for preparing good quality liquid detergent, since those components absent have no significant negative effect on the overall quality of the detergent produced respectively.

Whereas, for Sample C, which indicated the liquid detergent produced with the absence of NaOH but containing other components, The formulation used here is suggested not suitable as NaOH which has large effect on adjusting the pH of the liquid detergent to fall within the required specification to make it users friendly, is absent and which resulted in the 0-97 pH value, and of course indicating high corrosiveness.

5.2 Recommendation

* Future research should focus on design of Liquid Detergent pilot plant and test run.

* Variation of other components such as Linear Alkyl benzene Sulphonic Acid, Glycerin, etc to Investigate their effect on the quality of liquid detergent produced should be carried out.

* As washing industry among the chemical process industries in experiencing a fundamental change in chemical raw materials, I recommend that future research should focus on cost effectiveness of raw material to produce high quality product.

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APPENDIX

Calculations

Specific Gravity for Each of theTest Samples

SAMPLE A

Let W_1 = weight of empty bottle

W_2 = weight of empty bottle + H_2O

W_3 = weight of sample

W_4 = weight of sample + empty bottle = $W_1 + W_3$

Now the above weight were obtained as follows:

$W_1 = 25.07$ g

$W_2 = 74.379$ g

$W_4 = W_1 + W_3 = 76.744$ g

:. $W_3 = 76.744 - W_1 = (76.744 - 25.07)\text{g} = 51.674$ g

Wt of water equal volume of water = 74.379 – 25.079 = 49.309 g

Specific Gravity of Sample A = $\frac{51.674}{49.309} = 1.047963$

:. S.G of Sample A ≈ 1.050

SAMPLE B

$W_1 = 25.07$ g, $W_2 = 74.379$, $W_4 = W_1 + W_3 = 76.551$ g

W_3 = Wt of sample B = (76.551 – 25.07) g = 51.481 g

Weight of water = 49.309 g

S.G of Sample B = 51.481 = 1.044

49.309

SAMPLE C

$W_1 = 25.25$ g = Wt of empty bottle

W_2 = weight of bottle + H_2O = 74.31 g

$W_3 = W_2 - W_1 = (74.31 - 25.25)$ g

Where W_3 = Wt of water

$W_3 = 49.06$ g

W_4 = Wt of sample + bottle

$W_4 = 76.09$ g

$W_5 = W_4 - W_1 = 76.09 - 25.25 = 50.84$ g

$$\text{S.G of Sample C} = \frac{50.84}{49.06} = 1.036$$

SAMPLE D

$W_1 = 25.25$ g, W_2 = weight of bottle + H_2O = 74.31 g

W_3 = Wt of water = 49.06 g, W_5 = (Wt of sample + bottle) – (Wt of empty bottle)

$W_5 = (76.83 - 25.25)$ g = 51.58 g

$$\text{S.G of Sample D} = \frac{51.58}{49.06} = \underline{1.051}$$

Percentage Free – Alkali for Each of the Test Samples

SAMPLE A (Containing all the standard components)

Wt of sample A measured = 20 g

Volume of neutralized Ethanol used = 150 ml

Sample A solution = 150 ml of Ethanol + 10 ml of 10% $BaCl_2$ + 20 g of sample A

Concentration of Acid (dil H_2SO_4) in the burette = 0.1 mol/dm^3

Indicator used = Phenolphthalein Indicator (3 drops)

:. Titre value obtained (colourless End point was obtained) = 17.30 cm^3

:. % free Alkali = End point × factor

Weight of sample

The value of factor is 3.1 (from literature)

$$\% \text{ free Alkali} = \frac{17.30 \times 3.1}{20} = 2.68\ \%$$

SAMPLE B(Containing other components except Sodium Tripolyphosphate (STPP)).

End-point obtained after following similar procedure as carried out for sample A is 12.90 cm^3

$$\therefore \quad \% \text{ free-Alkali} = \frac{\text{End point} \times \text{factor}}{\text{Weight of sample}} = \frac{12.90 \times 3.1}{20}$$

$$= 2.0\ \%$$

Percentage free Alkali for Sample C (Containing all standard components except NaOH)

Titre value or end point obtained after titration = 2.39 cm^3

$$\therefore \quad \% \text{ Free Alkali of Sample C} = \frac{\text{End point} \times \text{factor}}{\text{Wt of sample}} = \frac{2.39 \times 3.1}{20}$$

$$= 0.37\ \%$$

Percentage Free Alkali for Sample D (Containing all standard components exceptSodium Lauryl Sulphate (S.L.S))

Titre value obtained after titration = 14.19 cm^3

$$\therefore \quad \text{Percentage free Alkali of Sample D} = \frac{\text{End point} \times \text{factor}}{\text{Wt of sample}} = \frac{14.19 \times 3.1}{20}$$

$$= 2.20\ \%$$