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# LIQUID DETERGENT BASED ON ECO FRIENDLY NOVEL POLYMERS CONTAINS GLYCEROL, POLYETHYLENE GLYCOL AND PHTHALIC ANHYDRIDE

Suraj R. Mathane*, P.D Gawande, B. B Gogte, M. K. N. Yenkie

Laxminarayan Institute of Technology R.T.M. Nagpur University Nagpur, Maharashtra, India.

**Keywords:**

Glycerol, Polyethylene glycol, Phthalic anhydride, Detergent. Ecofriendly polymers

**For Correspondence:**

**B. B Gogte**

**Suraj R. Mathane**

Laxminarayan Institute of Technology R.T.M. Nagpur University Nagpur, Maharashtra, India

**E-mail:**

dr.gogte_chem@rediffmail.com

surajmathane@gmail.com

## ABSTRACT

Novel polymers based on glycerol, polyethylene glycol(400) and phthalic anhydride have been synthesized. The variation in mole ratios, reaction temperature, type of catalyst and the time of heating has been studied. The idea of the present work is to develop a novel polymer based mainly on vegetable sources and use it as an active ingredient in detergent compositions. The ecofriendly polymers has been used along with sodium lauryl ether sulphate and sodium lauryl sulphate for formulation of liquid laundry detergents. The physicochemical characteristic and detergency of our product was compared with commercial product, our samples are equivalent or some time better than commercial samples. The effort will made liquid detergent ecofriendly and free from petroleum origin products like acid slurry.

## INTRODUCTION

A large number of industrial products like powder and liquid detergents, shampoos and cosmetics were based on petroleum based surfactants. As we know the price and availability of petroleum surfactants is fluctuating every year, we must think of alternative vegetable products as substitute of acid slurry. In our laboratory we prepared novel polymeric surfactant mainly based on vegetable origin glycerol. Glycerol[(1)] is by product of biodiesel industry and fat spitting industry. In the present peace of research work we synthesized novel polymer mainly based on glycerol, polyethylene glycol(400)[(2)] and phthalic anhydride[(3)] with small amount of sorbitol, sodium bisulphate and sodium bisulphite. The synthesized polymers were analyzed for % solids, viscosity, H.L.B ratio and pH value by standards laboratory methods [(4-9)]. Novel polymers used in formulation of liquid detergents.

The liquid detergents have been analyzed for foam, surface tension and % detergency [(10)] at different concentrations of liquid detergent solutions.

## MATERIAL AND METHODS

### A) Reaction programming and Synthesis of polymers

The preparation of Novel polymers was carried out in a glass reactor. The reactor consists of two parts. Lower part of the reactor is a round bottom vessel of 2 L capacity with very wide mouth. The upper port of the reactor is its lid, having four necks with standard joints. A motor driven stirrer was inserted in the reactor through the central neck, while another neck was used for thermometer. A condenser was fitted with the reactor through the third neck and the fourth neck was used for dropping the chemicals in to the reactor. The Reactor was heated by an electric heating mantle having special arrangements for smooth control of the temperature ($\pm 2^0$c) of the reactor. A regulator controlled the speed of the stirrer. The reaction vessel and its lid were tied together with help of clamps.

All the ingredients (as given in Table1) were heated to $130^0$C for three hours in glass reactor.

After three hours heating was stop and mass cooled to room temperature.

### Analysis and Testing:

The novel polymers were analyzed for % solids, viscosity, pH and H.L.B ratio by standard laboratory methods .FT- I.R[(11)] spectra was analyzed to confirm ether , ester , acids and free OH groups present in our polymers.

**Preparation of Liquid Detergent:**

All the ingredients are weighed in required amount and kept separately. Now the sulphonates such as sodium lauryl sulphate(S.L.S), sodium lauryl ether sulphate (S.L.E.S) and alpha olefin sulphonate are mixed in half the portion of water required to from a homogenous white paste. Remaining ingredients are added to the rest part of water one by one with proper stirring. Finally the above prepared paste is added to this second solution slowly with moderate stirring. After total addition stirring was continue for 20min and resultant sample is allowed to settle in lower compartment of refrigerator. On next day it is taken out and filtered at room temperature. After these samples are analyzed for various parameters mentioned.

***TABLE NO 1: COMPOSITION OF POLYMERS***

| Sr.No. | Polymer (Ingredients in %) | S17 | S25 |
|---|---|---|---|
| 1 | Glycerol | 75 | 45 |
| 2 | Polyethylene Glycol (400) | 5 | 20 |
| 3 | Sorbitol(70% solids) | 10 | 10 |
| 4 | Phthalic anhydride | 5 | 20 |
| 5 | $NaHSO_4$ | 2.5 | 2.5 |
| 6 | $NaHSO_3$ | 2.5 | 2.5 |

***TABLE NO 2 : PHYSICOCHEMICAL ANALYSIS OF POLYMERS***

| Sr.No. | Polymer Properties | S17 | S25 |
|---|---|---|---|
| 1 | % Solids | 93.20 | 89.18 |
| 2 | pH(1% solution)by Digital pH meter | 3.80 | 3.05 |
| 3 | Viscosity In Seconds (ford cup no4. At $30^0$C) | 185 | 225 |
| 4 | H.L.B Ratio | 17.7 | 16.50 |

***TABLE NO 3: LIQUID DETERGENTS BASED ON POLYMER S25***

| Sr.No | %Ingredient | LD1 | LD2 |
|---|---|---|---|
| 1 | Polymer(S25) | 9 | 12.5 |
| 2 | Acid slurry | 8 | 4.5 |
| 3 | Sodium lauryl sulphate (40% Solids) | 3 | 3 |
| 4 | Sodium lauryl ether sulphate | 17 | 17 |
| 5 | Sodium Carbonate | 2.5 | 2.5 |
| 6 | Sodium sulphate | 2.5 | 2.5 |
| 7 | Urea | 0.5 | 0.5 |
| 8 | Poly vinyl alcohol (20% Solids) | 2.5 | 2.5 |
| 9 | Distilled Water | 55 | 55 |

***TABLE NO:4 ANALYSIS OF LIQUID DETERGENTS***

| Concentration | Sample | Foam Volume ($cm^3$) ( by Glass cylinder method ) | | | | Surface Tension In dyne/cm (Stalagnometer method) |
|---|---|---|---|---|---|---|
| | | 0min | 5min | 10min | 15 min | |
| 1% | LD1 | 1000 | 940 | 900 | 890 | 27.92 |
| | LD2 | 1000 | 950 | 900 | 900 | 26.56 |
| | CLD1 | 1000 | 990 | 980 | 960 | 25.04 |
| | CLD2 | 1000 | 980 | 960 | 960 | 27.65 |
| 0.5% | LD1 | 980 | 700 | 680 | 670 | 30.77 |
| | LD2 | 970 | 900 | 870 | 850 | 27.55 |
| | CLD1 | 1000 | 980 | 980 | 950 | 26.01 |
| | CLD2 | 970 | 940 | 910 | 870 | 29.04 |

Note- CLD1- Commercial Liquid detergent-1, CLD2- Commercial Liquid detergent-2.

***TABLE NO: 5 ANALYSIS OF SOIL STAIN REMOVING CAPACITY ON COTTON CLOTH OF LIQUID DETERGENTS BASED ON POLYMER S25***

$R_0$=Reflectance measured on clean cloth =100, Rs= Reflectance measured on Stained cloth=31

| Sr.no | Concentration | Sample | Rw (by Reflectance meter) | %Detergency |
|---|---|---|---|---|
| 1 | 1% | LD1 | 93 | 89.85 |
| 2 | | LD2 | 93 | 89.85 |
| 3 | | CLD1 | 95 | 92.75 |
| 4 | | CLD2 | 93 | 89.85 |
| 5 | 0.5% | LD1 | 89 | 84.05 |
| 6 | | LD2 | 88 | 82.60 |
| 7 | | CLD1 | 92 | 88.40 |
| 8 | | CLD2 | 90 | 85.50 |

***Fig no : 1 FT-IR SPECTRA OF POLYMER S25***

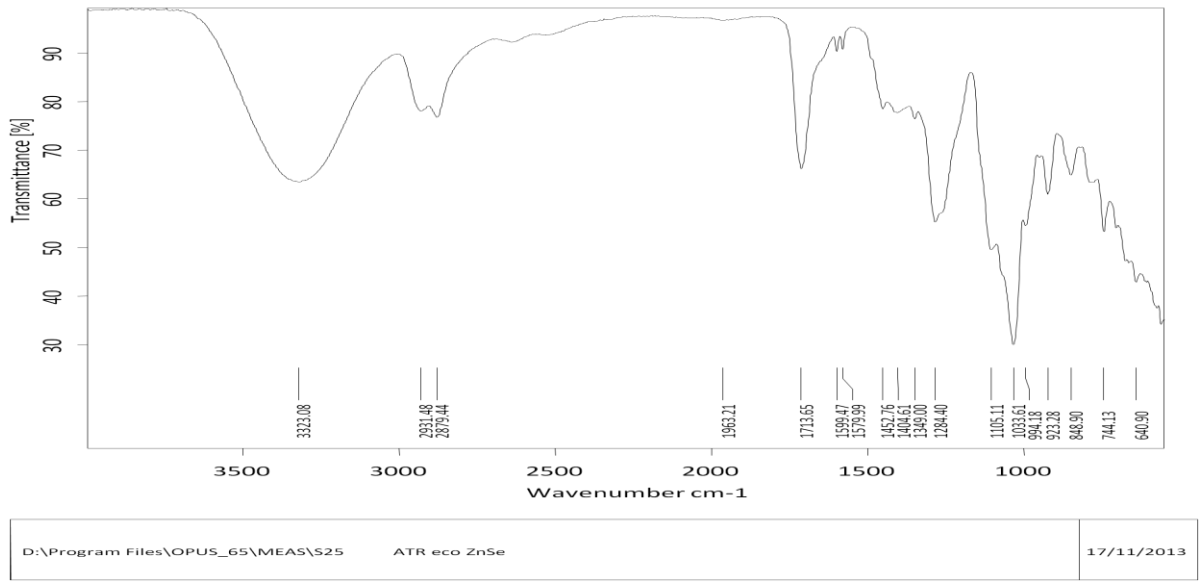

***TABLE NO: 6 FT-IR SPECTROSCOPIC ANALYSIS OF POLYMER S25***

| Sr.No | Groups Expect S25 | FT-I.R range | FT-I.R rang Observed |
|---|---|---|---|
| 1 | Hydroxyl group( OH stretch) | 3200-3700 | 3323.08 |
| 2 | Free carboxylic group(C-H stretch) | 2500-3000 | 2879.44 |
| 3 | Ester group( C=O stretch) | 1700-1750 | 1713.65 |
| 4 | Ether group(C-O stretching) | 1070-1250 | 1105.11 |

## RESULTS AND DISCUSSION

1) Composition of novel polymers is given in Table 1. Polymers were synthesized using glycerol, polyethylene glycol (400) and phthalic anhydride as main ingredient with small amount of sorbitol, sodium bisulphate and sodium bisulphite.

2) Physicochemical analysis of polymers given in Table 2. Polymers have 89.18 to 93.20 % solids. Polymers are in liquid state and have pH range 3.05 to 3.8 (pH of 1% solution of polymer). Both polymers have good viscosity rang 185 to 225. The H.L.B ratio suggest that their use in detergents compositions as given in Table 2.

3) The detergency of polymer S25 was better than polymer S17 so it was selected for preparation of liquid laundry detergent.

4) Liquid detergents based on polymer S25 and commercial liquid detergent were analyzed by standard methods for foam, surface tension and soil stain removing capacity on cotton cloth .% detergency was tested at 0.5% and 1% concentrated solution of liquid detergent given in Table 4 and 5.

5) FT-IR Spectroscopic analysis is given in Table 6 . Analysis of FT-IR spectroscopy shows presence of ester group (1713.65), ether group (1105.11), free-OH groups (3323.08) and free acid groups (2879.44)

## CONCLUSION

The following concussions stand confirm in the light of above research work.

1) Polymers mainly based on glycerol , polyethylene glycol(400) and phthalic anhydride have been successfully synthesis and mol ratio , temperature and concentration of sodium bisulphate and bisulphate were standardized to get desired viscosity, pH ,acid value and cleaning characteristic.

2) Polymer S25 was selected for liquid detergent composition and it gives better detergency. These liquid detergents analyzed for surface tension, foam, % detergency and compared with commercial liquid detergent available in market. Our products were equivalent or some time better than commercial samples available in market.

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