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Synthesis and application of ecofriendly liquid detergents of mixed carbohydrates and glycol origin

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ABSTRACT

Various liquid detergents were formulated using ecofriendly polymer of mixed carbohydrate and glycol origin. The samples were showing excellent results in terms of performance like reduction in surface tension of water, foam volume and percent detergency. The samples have shown remarkably good performance at par with conventional samples of petroleum origin.

Key words: Ecofriendly polymer, foam volume, percent detergency.

INTRODUCTION

In the present context there is global trend towards use of liquid detergents because of their convenience, ease of dispensation and dispersion in water, owing to such characteristics liquid detergents are gaining popularity. From manufacturing angle liquid detergents can be manufactured using relatively simple equipments. Liquid detergents are of various types

1. Heavy duty liquid detergents for regular washings
2. Light duty liquid detergents wool, silk etc.
3. Dish washing liquid detergents.

In the present work few green liquid detergents were formulated using sodium hydroxide neutralized polymer and acid slurry. Liquid detergents formulated using sodium hydroxide neutralized carbohydrate polymers and slurry have shown good results in terms of performance like reduction in surface tension of water, foam volume, percent detergency. Neutralization using sodium hydroxide has brought excellent appearance, feel and color to the samples of liquid detergents. In the previous work¹ the synthesis and characterization of biodegradable polymers from starch, glycerol, sorbitol and maleic anhydride was discussed. The synthesis and application of detergent from above source was also discussed². The resin manufactured from starch, sorbitol, glycerol, maleic anhydride is found to be biodegradable in nature³. The various powder detergents were formulated using starch, glycerol, maleic anhydride resin⁴ and used in cleaning of cloth successfully and various liquid detergents were formulated using different resin.^{5,6}

MATERIALS AND METHODS

Table-1.2.1 describes the composition of the green polymer.

Raw Material	Batch 14(%)
Starch	30.76
Sorbitol	26.92
Glycerol	26.92
Maleic Anhydride	15.38
Phthalic Anhydride	Nil

Table 1.2.1 Synthesis of Polymer Based On Starch, Sorbitol, Glycerol, Maleic Anhydride and Phthalic Anhydride

Time in Hrs. min	Temperature (°C)	Remarks
00.00	Room Temperature	600 g water added & batch started
00.30	48	
01.00	75	
01.30	95	
02.00	100	
02.10	101	300 g water added
02.30	103	Thickening of batch started
02.40	105	200 g water added
02.50	106	300 g water added
03.00	108	Batch turned viscous
03.10	108	
03.15	116	Batch terminated

Table 1.2.2 Cooking Schedule of Polymer 14

Sr. No.	Polymer Property	Observation
1	Acid value of the polymer	57.1
2	pH value	2.00
3	Saponification value	385.35
4	Solid (%)	64
5	Color	White
6	Solubility of polymer (i) in water (ii) in Xylene (iii) in alcohol + water (iv) in NaOH solution	Soluble In soluble Partially soluble Soluble
7	Hydrophilic Liphophilic Balance of polymer	11.88
8	BOD TO COD Ratio	0.5967
9	Molecular Weight of the polymer	1863

Table 1.2.3 Physico-Chemical Properties of Polymer 14

1.3 Preparation of Liquid Detergent

Various Raw Materials in liquid detergent like Neutralized Acid Slurry neutralized polymeric resin and conventional ingredients were taken in a glass reactor and homogenized by running the stirrer for about half an hour. Refer. Table 1.2.2

The Solution is cooled in refrigerator at 10°C for 48 hrs. The clear liquid solution was filtered and packed in superior grade air tight plastic containers.

Table 1.3.1 Composition of Liquid Detergents Using Sodium Hydroxide Neutralized Polymer – 14 (By % Weight Method)

Raw Materials	B1	B2	B3	B4	B5
Neutralized Polymer(100)	5	7	8	9	3
Neutralized Slurry(100)	5	3	2	1	3
Sodium. Lauryl Sulfate	3	3	3	3	3
Sodium Lauryl .Ether Sulfate	2	2	2	2	2
Ethylene Di-Amine Tetra Acetic Acid	5	5	5	5	1
Sodium Sulfate	5	5	5	5	9
Water	74	74	74	74	74

Note Sodium hydroxide neutralized polymer was used as a solution in water (37%solid)
Sodium hydroxide neutralized acid slurry was used as a solution in water (40% solid)

Table 1.3.2 Samples prepared from polymer 14

Sr. No.	Sample	Density In G/L	pH Value	Viscosity Time (Seconds)
1	B1	0.992	8	110
2	B2	0.992	8	30
3	B3	0.996	8	80
4	B4	0.997	8	50
5	B5	0.998	8	30

Table 1.3.3 Study of Surface Tension of Water at Various Concentration of Detergent- Polymer 14

Sample	Concentration	Surface Tension In Dyne/Cm	% Reduction In Surface Tension
B ₁	0.1	42.71	39.99
	0.25	41.36	41.89
	0.5	35.88	49.59
	1	31.29	56.04
B ₂	0.1	51.75	27.29
	0.25	41.36	41.89
	0.5	38.44	45.99
	1	34.95	50.89
B ₃	0.1	56.05	21.25
	0.25	47.21	33.67
	0.5	40.24	43.46
	1	33.67	52.69
B ₄	0.1	43.49	38.90
	0.25	37.41	47.44
	0.5	33.67	52.69
	1	30.99	56.46
B ₅	0.1	54.97	22.77
	0.25	45.70	35.79
	0.5	39.04	45.15
	1	32.88	53.79
Surf excel liquid	0.1	16.28	77.13
	0.25	15.95	77.59
	0.5	15.16	78.70
	1	14.86	79.12

1.4 Foam Volume³ Foam volume was determined by using bubble cylinder method

1) **Bubble Cylinder Method:** Foam characteristics are measured in terms of volume and the following steps are carried out for it.

Take 1000 ml cylinder provided with stopper, add to it 100 ml solution of particular concentration whose foam characteristics is to be measured. Give it 30 up-down rotation within time period of 30 seconds. Keep that cylinder on table and observe the foam above liquid level and note down reading at min. The readings were measured after 5, 10, 15 min. respectively. Same procedure is carried out for the solution at different concentration like 0.1%, 0.25%, 0.5% and 1.0%

Table 1.4.1 Study of Foam Volume At 0.1 % Concentration of Detergent

Sr. No.	Sample	Foam Vol. In Cm ³ (Time In Minutes)				
		0	05	10	15	20
1	B ₁	130	130	120	120	120
2	B ₂	70	60	50	50	50
3	B ₃	30	20	20	20	20
4	B ₄	70	70	60	60	60
5	B ₅	70	60	50	40	40
6	Surf Excel Liquid	121	119	111	111	111

Table 1.4.2 Study of Foam Volume At 0.25 % Concentration of Detergent

Sr. No.	Sample	Foam Vol In Cm ³ (Time In Minutes)				
		0	05	10	15	20
1	B ₁	170	150	150	150	150
2	B ₂	130	120	120	120	120
3	B ₃	80	80	80	70	70
4	B ₄	80	80	70	70	70
5	B ₅	150	150	150	150	150
6	Surf excel liquid	142	133	131	118	118

1.5 Percent detergency

a) Soil medium: The soil medium was prepared by mixing Carbon (28.4 %), coconut oil (35.8 %), lauric acid (17.9 %) and mineral oil (17.9 %).

b) Preparation of soil solution: This was prepared by adding 2 g of above soil paste in 500 ml of carbon tetrachloride solution. Mix it well and use for further cloth sample preparation.

The solution was filled in packed bottle.

c) Method of application: The cotton cloths of size 24 cm × 32 cm were prepared. Take 50 ml of soil solution in beaker. Dip this cloth sample in it for 5 min. The same cloth dried in open atmosphere for 2 h. Then this cloth was cut into test sample size of 6 cm × 8 cm and these samples were used for washing purpose. The solutions of different concentration of detergent were prepared and heated to 60 °C temperature. Soiled cloth sample was dipped in it for 5 min and given to and fro 10 hand washes. Washing was carried out in distilled water only. After rinsing these samples in fresh water are kept for drying purpose. The samples which were washed, dried and ironed were used to find out per cent detergency. The %detergency was determined using lamberts and sanders formula. Percent

detergency = $(R_w - R_s) \times \frac{100}{(R_o - R_s)}$ where R_w , R_s and R_o are reflectance measured on washed cloth, soiled

cloth and clean cloth, respectively. The reflectance of the cloth samples were measured by using reflectance meter manufactured by Universal Engineering, Corporation, Ambala Road, Saharanpur. This was standardized by using the magnesium oxide or tile which was provided along with the instrument. This tile having brightness of 81.3 % was adjusted using the knob provided on instrument. After adjustment was done the samples were kept on the instrument

And the readings were noted down and the percent detergency was calculated (Table-1.4.1).

1.5 Method of Application (Tea and Coffee)

The cotton cloth of size 24 x 32 cm² were taken and make checks with the help of size 6 x 8 cm². Then take the above staining solution in a pipette and add in a center or checks one drop and then kept the stain cloth sample in oven at 100-105°C for half an hour. Then this stained cloth is cut into test sample size and these samples were used for washing purpose

R_o =Reflectance measured on white cloth=80.1

R_s =Reflectance measured on soiled cloth=40.1

R_w =Reflectance measured on washed cloth

Table 1.5.1 Study of Percent Detergency at Various Concentration of Detergent on Soiled Stained Cotton Cloth

Sr. No.	Samples	Concentration	% Detergency
1	B ₁	0.25	75.73
		0.5	80.32
2	B ₂	0.25	77.4
		0.5	81.18
3	B ₃	0.25	76.88
		0.5	79.12
4	B ₄	0.25	72.24
		0.5	75.68
5	B ₅	0.25	63.64
		0.5	55.36
6	Surf excel liquid	0.25	75.32
		0.5	78.62

R_o =Reflectance Measured On Clean Cotton Cloth=80.1

R_s = Reflectance Measured On Coffee Cotton Cloth=41.5

R_w =Reflectance Measured On Washed Cotton Cloth

Table 1.5.2 Study of Percent Detergency at Various Concentration of Detergent on Tea Stained Cotton Cloth

Sr. No.	Samples	Concentration	% Detergency
1	B ₁	0.25	50.32
		0.5	66.96
2	B ₂	0.25	49.89
		0.5	64.8
3	B ₃	0.25	49.46
		0.5	64.36
4	B ₄	0.25	47.95
		0.5	63.28
5	B ₅	0.25	32.83
		0.5	60.91
6	SURF EXCEL LIQUID	0.25	76.30
		0.5	77.20

R₀=Reflectance measured on clean cotton cloth=80.1

R_s= reflectance measured on coffee cotton cloth=44.8

R_w=reflectance measured on washed cotton cloth

Table 1.5.3 Study of Percent Detergency at Various Concentration of Detergent on Coffee Stained Cotton Cloth

Sr. No.	Samples	Concentration	% Detergency
1	B ₁	0.25	81.9
		0.5	85.8
2	B ₂	0.25	80.34
		0.5	83.85
3	B ₃	0.25	78.58
		0.5	82.48
4	B ₄	0.25	77.80
		0.5	81.70
5	B ₅	0.25	75.85
		0.5	79.75
6	Surf excel liquid	0.25	72.24
		0.5	75.10

RESULTS AND DISCUSSION

As evident from Table-1.2.1 that a green carbohydrate polymer was synthesized using 30.76% Starch, 26.92% sorbitol, 26.92% glycerol and 15.38% maleic anhydride having BOD to COD ratio 0.5976 showing biodegradability. The carbohydrate polymer having good molecular wt. and has shown HLB ratio 11.88 suggesting its application in detergent formulation.

Various liquid detergents were formulated by varying percentage of various constituents to observe the possible difference in performance characteristics of liquid detergents at changed composition of active components of detergents. The formulations B₁ to B₅ have different proportion of active components of detergency. (Refer Table 1.3.1). In all those formulation the complexing agent EDTA varied from five to zero percentage. EDTA is usually incorporated in premium quality detergents owing to its cost. Percentage of usually incorporated cheap sodium sulfate was varied from 5 to 10. In the formulation B₄ the green polymer percentage has been increased to 9%. As evident from Table 1.3.2 that all detergents have shown pH value 8 and in alkaline medium better detergency is obtained. All samples have shown reasonably good viscosity and density. Every detergents performance is evaluated on the basis of its effects on various functional parameters like effect of detergents on surface tension of water, foam volume of water and percent detergency of cloth.

As seen from Table.1.3.3 that the sample B₄ in which green polymer percentage has been increased to nine percent shows excellent performance in terms of reduction in surface tension of water which helps in the wetting of cloth in minimum of water. As seen from Table 1.4.1 and 1.4.2 that the samples in B series detergents shows moderate performance in terms of foam volume.

The functionally more important property of detergent is percent detergency. As seen from Table 1.5.1 ,the sample B₁ having fifty percent polymer and acid slurry shows 75.73 percent detergency indicating synergetic effect of green polymer and acid slurry and its cumulative effect on cleaning action. The similar kind of performance is seen on tea stained and coffee stained cloth as evident from Table 1.5.2 and 1.5.3

CONCLUSION

The detergent formulation using ecofriendly polymers and acid slurry are giving excellent performance and sometimes better than commercial petroleum based detergents. The effect of sodium hydroxide neutralization of green polymer and acid slurry have shown better results in terms of performance like color, feel, appearance and reduction in surface tension of water, foam volume, percent detergency. In samples like B4 the percentage of green polymer is increased to 9% showing good effects on detergency. Such kind of detergent formulations will prove beneficial in near future as petroleum products availability is shrinking day by day.

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REFERENCES

- [1] J.R.Dontulwar,D.K.Borikar *Asian journal of research in chemistry* , **2011**, 4(7), 1084-1086.
- [2] J.R.Dontulwar, *Asian Journal of research in Chemistry* , **2012**, 23(6), 1186-1189.
- [3] J.R.Dontulwar, D.K.Borikar, *Asian journal of research in chemistry*, **2011**, 5 (2), 197-199.
- [4] J.R.Dontulwar, *soaps, detergents & toiletries review*, **2009**, 12-16.
- [5] J.R.Dontulwar, B.B.Gogte , *Asian Journal of Chemistry*, **2004**, 16, 1385-1390.
- [6] J.R.Dontulwar,D.K.Borikar, *Asian Journal of Chemistry*, **2011**, 236, 2511-2514.