Alternative Raw Materials for Detergent Industry

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ABSTRACT

In global scenario detergent industry is using conventional active material like soft acid slurry, alfa olefin sulphonate (AOS) and sodium lauryl ether sulphate (SLES) in various detergent compositions. We have synthesized and characterized polymeric surfactants based on malenized oil[1], starch, liquid glucose, polyethylene glycol and sugar. All theses polymers are of vegetable origin and can replace 80 – 100% of conventional active material used in various formulations. Some commercial compositions like liquid and powder detergents[2], floor cleansers, hand washes, dish washing liquids, water thinnable paints[3], electro deposition paints[4] water thinnable primers[5] and printing inks[6] have been prepared based on polymer and tested for performance characteristics. Selected compositions have been compared with commercial products. Our compositions are ecofriendly based mainly on vegetable products and are techno-economically viable products.

Keywords: Ecofriendly, polymeric surfactant, malenized oil, techno-economically.

INTRODUCTION

Surfactants based on renewable resources have experienced increased attention in recent years. Maize starch and sorbitol based polymeric surfactant is our interest as an alternative for petroleum based surfactant [1]. Commercially available detergents mostly contain acid slurry (LABSA) and alpha olefin sulphonate as major ingredient. These are less biodegradable chemicals [2].These are responsible for water pollution. Generally natural origin substances are biodegradable. If we derived polymeric surfactant from starch and sorbitol, it has more chances of showing biodegradable property. It is possible to convert starch and sorbitol into polymeric surfactants. This is basic idea to synthesize such polymers.

In a current work we synthesized starch and sorbitol based polymers by treating it with organic acid [3]. Organic acid used for this purpose are citric acid, oxalic acid, maleic anhydride and pthalic anhydride. Some other chemicals like sodium bisulphate, sodium bisulphite and sodium matabisulphite are also required in small quantity. When starch and sorbitol are treated with organic acid esterification and esterificaton reaction precede. It developed ether and ester linkage in polymer chain. Higher the degree of alcohol , ester, acid and ether group make it more surface active agent[4,5].We formulate some powder and liquid detergents based on starch and sorbitol based polymeric surfactant and compares it with commercially available product. Our results are comparable and sometime it is better than commercial detergents. We are successful to replace acid slurry and alpha olefin sulphonate up to 50 to 70% by our polymer.

Experimental

a) The Reactor

The reactor made up of glass. It consists of two parts. Lower part of reactor is a round bottom flask with very wide mouth. Upper part of reactor is its lid having four necks with standard joint. Out of these central one opening is for inserting mechanical stirrer, second is for charging of raw materials, third is connected to water condenser and four is to fit thermometer. An electric heating mantle having special arrangement for smooth control of the temperature (-/+ 2) has been used. Mechanical stirrer is provided with speed regulator.

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b) Method of synthesis

Initially stoichiometric quantity of sorbitol , maize starch, maleic anhydride, pthalic anhydride, citric acid, oxalic acid, sodium biulphite, sodium bisulphate and sodium metabisulphite were added in the reactor. The temperature was raise slowly and steadily in about two hour to 130^0C. The reaction was continued for three hours at this temperature. The consistency of the reaction mixture was maintained by adding 2 % by weight isopropanol as a solvent. Then heating is stopped and reaction mixer cooled to room temperature. Product is filter and then stored in umber colour glass bottle. Some compositions of raw materials of some polymers are given in table 1.

RESULT AND DISCUSSION

i. We synthesized Maize starch based polymeric surfactants. Starch and sorbitol react with maleic anhydride, pthaleic anhydride, citric acid and oxalic acid. It introduces ester and ether linkage in a chain. Sodium bisulphite, Sodium bisulphate and sodium metabisulphite are used for generation of $–SO_3H$ group. We perform complete physicochemical analysis of all polymers as given in table 2.
ii. The % solid of polymers are in the range of 74 to 77. It is quite good range. It is helpful to handle the polymers and for making detergents formulation. .
iii. Polymers have lower acid value it indicates more acid is reacted with starch and sorbitol [6].
iv. HLB ratios of polymers in between 15-16 [7]. This range is suitable for making detergents. All polymers can be used in preparation of powder and liquid detergents.
v. Polymers have a viscosity in the range of 217 to 270 second [8]. They are easy to handle and can be incorporated in powder very conveniently. If polymers are pale in colour then they are suitable for making of powder detergents as it doesn't impart colour to powder detergents. All polymers are suitable for making powder detergents.

CONCLUSION

i. Starch and sorbitol based polymeric surfactants can successfully used to replace partially petroleum based acid slurry and alpha olefin sulphonates.
ii. Starch and sorbitol are of natural origin so they can be biodegradable
iii. All polymers are useful for the production of eco-friendly powder and liquid detergents.
iv. The polymer has a potential for use in making floor cleansers, hand washes, toilet cleaners, glass cleaners and shampoos.
v. The initial investment cost of plant is 10-15 lakhs and commercial trials are essential for study techno-economic viability of polymers

Table 1. Ingredients for synthesis of Starch based polymers

Ingredients	S-1	S-2	S-3
Sorbitol (70%)	49.1	56.4	57
Starch (70%)	39.2	28.2	28.3
Maleic anhydride	4.9	4.7	2.0
Pthaleic anhydride	2.4	1.9	
Citric acid	2.4	1.4	1.5

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Oxalic acid	-	1.4	1.5
Sodium bisulphate	1.5	3.0	2.0
Sodium bisulphite	0.5	3.0	-
Sodium metabisulphite	-	-	3

Table 2. Physicochemical analysis of different starch based polymers.

Properties	S-1	S-2	S-3
% Solid	77	74	74
pH	3	3.27	4.06
Acid Value	78	75	55
H.L.B. Ratio	15.34	15.64	15.96
Surface tension of neutralized samples	66.64	62	61.20
Colour	Colourless	Colourless	Yellow
Viscosity(by Ford Cup No.4) Seconds at 30^0C	217	245	270

Table 3. Composition of liquid detergents

Ingredients	LD-1	LD-2	LD-3
Acid Slurry(LABSA)	7.0	7.0	7.0
Sodium Lauryl Ether Sulphate (40%)	18.0	18.0	18.0
Sodium Lauryl sulphonate (30%)	2.0	2.0	2.0
Na_2CO_3	2.5	2.5	2.5
Na_2SO_4	1.0	1.0	1.0
Polymer	S1 -8.0	S2-8.0	S3-8.0
fragrance	0.25	0.25	0.25
Water	61.25	61.25	61.25

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Table 4. Analysis of liquid Detergents

Sample	Foam volume(C.C.) by cylinder method	Surface Tension dyne/cm	Viscosity (30^0C) S	pH
LD-1	1000	26.83	290	8
LD-2	1000	26.07	272	8
LD-3	1000	24.37	268	8
Commercial Liquid Detergent	350	27.32	360	9.0

Table 5. Stain removing characteristics of liquid detergents

Sample	Soil stain	Tea stain	Coffee stain	Spinach stain
LD-26	92.3	92.8	93	96.1
LD-27	95.7	93.1	95.4	96.9
LD-28	97.2	94.3	96.8	97.3
Commercial Liquid Detergent	94.9	94.4	95.6	96

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