

Ecofriendly Sugar Polymer based Toilet Cleaners

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Abstract - Sugar based polymers based on sugar, citric acid, Oxalic acid have been synthesized. These polymers were analysed for Physico chemical characteristics and cleaning efficiency of toilet bowl. Sample S2 was selected for formulation of toilet cleaner. Samples of toilet cleaners based mainly on sugar polymer (58-60%) have been prepared and tested in comparison to commercial toilet cleaner. Our samples give excellent cleaning and shine compared to commercial product. Sample T3 is recommended for commercial large scale production.

1. It should quickly or completely remove all organic waste, dust, and stains in the bowl and basin.
2. It should not adversely affect the sanitary materials.
3. It should give a germ free bowl after cleaning.
4. The sample should not be corrosive or irritating to hands.
5. It should incorporate good perfumes so that the bathroom and toilet should provide a pleasant atmosphere.

Key Words - Polymer, Sugar Polymer, Toilet cleaner.

1. INTRODUCTION

Increasing awareness about cleanliness and special "Swatch Bharat Movement" The demand for household cleaners is increasing every year. Conventional toilet cleaners are based on Hydrochloric acid, Sodium bisulphate, Sodium hypo chloride etc. This is a small scale industry and local manufacturer make these products on large scale.

Gary A Devis [5] has studied and surveyed a list of acid Toilet Bowl liquid cleaners to arrive at proper standards and Evaluate the existing formulates from the stand point of environment. Basically Formic, Phosphoric, and Hydrochloric acid are used. All types of non-ionic surfactants and polyethylene Glycol ethers have been used. The powder type bowl cleaners contain mainly Sodium hydrogen sulphate along with salt and carbonates. One of the leading commercial brands uses hydrochloric acid and Non-ionic surfactants. Our laboratory is working on sugar based polymers some of them have a high acid value. Instead of using corrosive Hydrochloric acid we can use these polymers as a base for laundry cleaners. We can avoid the use of any petroleum based surfactant.

The idea is to manufacture basic Toilet cleaner on an organic polymer rather than strong Hydrochloric acid. Our institute is working on Eco-friendly raw materials. [1-4] A specially designed sugar based polymer for this purpose has been used. The idea is to develop eco-friendly vegetable base Household products which does not utilise strong acids like Hydrochloric acid yet it is highly effective in removing organic and other dirt from toilet bowl. The toilet bowl cleaners have been designed with following objectives;

2. EXPERIMENTAL SET UP

Synthesis of Sugar Based Polymer:

The novel polymer was synthesized in a Glass reactor of two-liter capacity. The reactor consists of two parts. Lower part of the reactor is round bottom vessel with very wide mouth. The upper part of the reactor is its lid with 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 third neck and the fourth neck was used for dosing chemicals in the reactor. The reactor was heated by an electric heating mantle having special arrangements for smooth control of temperature of the reactor. A regulator controlled the speed of stirrer. The reaction vessel and its lid were tied together with the help of clamps.

Step 1: Sugar and other ingredients were mixed in a homogenizer to get free flowing slurry this was introduced into the reactor.

Step 2: The mass was slowly heated to 50°C in about 30 minutes. The temp. was then taken to 120°C in about twenty minutes. After attaining the temp., the reactor was continuously monitored for viscosity, cleaning, pH, acid value. In about three hours the desired characteristics are reached.

Now the temp was lowered down to 80° C and sample withdrawn and filtered. The clear material is stored in corked bottles.

Step 3: The sample was analyzed for Acid value, % Solids, pH, Surface tension, and H.L.B., ratio by standard methods (1-4).

Preparations of Toilet Cleaners:

- The composition of toilet cleaners is given in table 4.
- The polymer and other ingredients are mixed in Homogenizer. Borax was dissolved in small amount of water at 90° C then added.
- The contents were kept overnight, filtered and packed in glass bottle.
- The sample were analyzed for pH, foam, viscosity and cleaning performance for toilet bowl and basins. Simultaneously most popular brand of commercial product was analyzed. The idea is to know How our product match with commercial product.

Table No. 1 Acid Toilet Bowl Liquid Cleaners

Sr. No.	Ingredients	Liquid Type			Powder type
		1	2	3	
1	Formic Acid	-	-	5-25	-
2	Phosphoric Acid	-	30-50	-	-
3	HCl	7-15	-	-	-
4	Sodium Hydrogen Sulphate	-	-	-	69-95
5	Nonyl Phenol Polyethylene Glycol Ether	2-4	4-8	-	-
6	OXO Alcohol Polyethylene Glycol Ether	-	-	2-6	-
7	Cetyl Dimethyl Benzyl Alkalamide	-	-	-	-
8	Linear Alkane Benzene Sulphonate	-	1-2	-	0.2-1
9	Xanthene	-	-	0.5-1	
10	Sodium Chloride	-	-	-	5-20
11	Sodium carbonate/Bicarbonate	-	-	-	5-20
12	Water	Balance to get 100%			

- Different Fragrances and Dyestuffs are used.
- Source of information: "Household cleansers Environmental evaluation and proposed" Gary A. Davis and Co-authors University of Tennessee (July 1992)

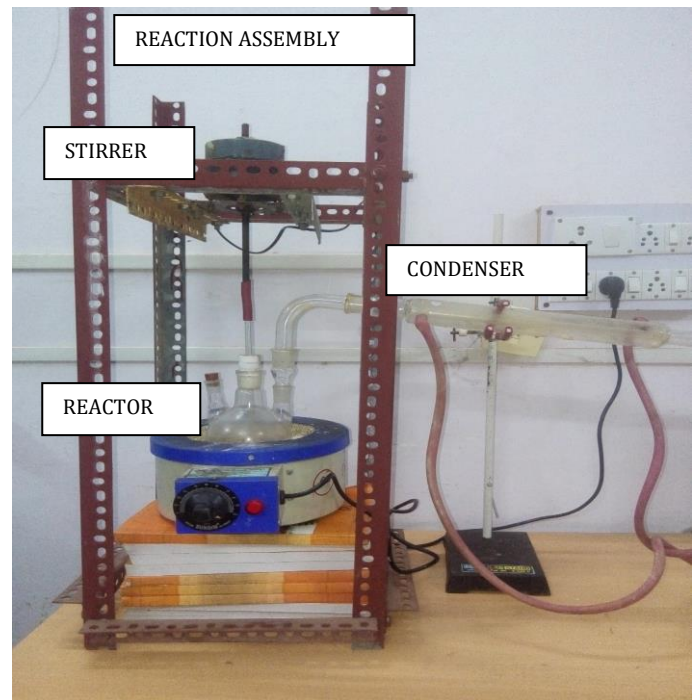


Fig: Photograph of Reactor

Table No. 2: Composition of Sugar Polymer

Name	S1	S2	S3
Sugar	44	44	44
DW	23	23	23
PEG 400	10	10	10
Citric Acid	10	20	-
Oxalic Acid	-	-	20
Maleic Anhydride	10	-	-
Sodium Bisulphate	3	3	3

Abbreviations: DW: Demineralised Water PEG400: Polyethylene Glycol 400

Table 3: Analysis of Sugar Polymers

Batch Name	S1	S2	S3
Viscosity by ford cup no 4 at 30 0 c in sec	235	215	150
% Solid by wt.	77.06	76.70	72.8
Acid Value	127.7	111.2	120.2
Density, gm/cc	1.0092	1.0052	0.998
Surface tension by Stalegmometre	59.74	58.66	57.04
HLB ratio, dynes/cm (based on sap value)	15	16.21	16.68

Table 4: Composition of Toilet Cleaners based on Sugar Polymer

Ingredients % by weight	T1	T2	T3	T4
Polymer	50	58	58	60
SLES 70%	20	30	20	20
30%NaHSO ₄	10	10	20	-
Citric Acid	20	-	02	-
Borax	-	02	-	02
Water	-	-	-	18

Abbreviations: SLES 70% - Sodium laurel ether sulphate

Table 5: Analysis of Toilet Cleaners and Comparison with Commercial Product

Sr. No.	pH	Foam by cylinder method in c.c.			Viscosity (by ford cup at 30°C) in sec	Cleaning Performance for basin and toilet
		1 %	0.5 %	0.25 %		
T1	02	370	280	190	95	Excellent
T2	02	340	280	190	139	Excellent
T3	02	440	280	180	200	Excellent with shine
T4	04	530	440	380	210	Excellent
Commercial	03	260	190	140	62	Excellent with shine

3. RESULT AND DISCUSSION

Table No. 1 give a compressive list of compositions of acid type bowl cleaners, various acids like formic, phosphoric, and hydrochloric acid has been used. Sodium hydrogen sulphate has been used for powder type bowl cleaner. A variety of surfactants and perfumes have been used in commercial samples. Various polyethylene glycol, cationic surfactants, like ethyl dimethyl benzoyl-ammonium chloride and conventional surfactants like linear alkyne benzene sulphonate has been used in toilet cleaners.

The composition of sugar polymers is given in table No. 2. In first sample combination of citric acid and maleic

anhydride is used. In second composition only citric acid is used while in third composition oxalic acid has been used. Standard methods of analysis have been used. The analysis of sugar polymer is given in table No. 3. Oxalic acid based polymer gives highest acid value but it is lower in viscosity and trials in toilet bowl cleaners does not give superior results.

Sample S2 with moderately high acid value, good viscosity and H.L.B ratio is recommended for use in toilet cleaner composition. It gives superior results when tested for bowl cleaning.

The composition of toilet cleaning liquids based mainly on sugar polymer S2 is given in table No. 4. About 20 to 30% S.L.E.S has been used in various compositions. Small amount of Borax has been used in two formulations. 10 to 20% Sodium bisulphate (30%) has been incorporated in three compositions.

Table No. 5 give analysis of Toilet cleaner compositions a commercial sample of toilet cleaner was also tested simultaneously. The pH of prepared sample is between 2 to 4. Commercial sample has a pH of 3. The foaming characteristics are good comparable to commercial sample. The viscosity of our samples are slightly higher than commercial sample. The cleaning performance of all samples is excellent. Sample T3 gives quick and complete cleaning with a little shine in the ceramic bowl. In commercial sample this property is also noted.

Sample T3 is recommended for commercial use. Pilot plant studies can be conducted on this sample.

4. CONCLUSION

1. Three different sugar based polymers have been prepared and analyzed.
2. Sample S2 was selected for use in toilet cleaner based on analysis and initial trials.
3. Four samples of Toilet cleaners were prepared, Sample T3 was adjudge as best on analysis. This is mainly containing Sugar based polymer 58%.
4. Comparison with commercial sample shows that our samples are excellent in cleaning and give shine as desired in commercial product. Pilot scale studies should be under taken for T3 sample.

We have developed a product which is free from strong acids or any surfactants based on petroleum. We are using sugar polymer which is of vegetable origin so the product can be labelled as eco-friendly.

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