

Biodegradation of Synthetic Detergents

Evaluation by Community Trials

Part 3: Primary Alcohol Sulphates

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ABSTRACT

The biodegradability of primary alcohol sulphates derived from a coconut alcohol and from a synthetic alcohol (Dobanol 25—Shell trademark, known as Neodol in the U.S. and Canada) has been evaluated by field trials with a trickling-filter sewage treatment plant serving a small community. Both these materials showed a high order of biodegradability, average values in the 96-98% region being obtained. On aeration of effluents in the laboratory further degradation to 99% was achieved with both alcohol sulphates. Effluents containing only residues of either alcohol sulphate were practically nonfoaming.

INTRODUCTION

In Parts I and II of this paper (1,2) we described the community trials carried out at Preston to evaluate the biodegradability of a range of sodium alkylbenzene sulphates and nonionic detergents. The present work extends the trials to cover alcohol sulphates derived from both natural and synthetic alcohols. It was considered of interest to compare the biodegradabilities of these two sulphates relative to each other, and relative to the alkylbenzene sulphates previously evaluated.

EXPERIMENTAL PROCEDURE

Conduct of the Trials

The community trials were conducted in the small trickling-filter sewage treatment plant used in the trials described earlier (1,2). The sampling and analysis were done by the Water Pollution Research Laboratory (WPRL) using the same techniques as previously. The alkyl sulphates were determined as methylene blue active substance (MBAS) using the same procedure as that employed for the alkylbenzene sulphates.

Materials Examined

Two alkyl sulphates were tested, one based on a

synthetic alcohol (Dobanol 25) and the other on a natural alcohol (coconut alcohol).

The coconut alcohol consists of a mixture of linear primary alcohols of even carbon number. Dobanol 25 is a synthetic primary alcohol and the process of manufacture leads to the presence of about 75% normal primary alcohols and 25% isomeric primary alcohols (mainly 2-alkyl isomers). Dobanol 25 contains alcohols of both odd and even carbon number (2).

The alkyl sulphates prepared from these alcohols were used in the trials in the form of their sodium or triethanolamine salts.

The clothes washing products were built spray-dried powders based on sodium alcohol sulphates. The formulation contained 15% w alcohol sulphate together with typical builders. It was found necessary to add 1% w rapeseed oil soap to reduce excess foam production which otherwise caused difficulties in operation of washing machines and spin dryers.

The dishwashing liquids were formulated so that the major part of the active material was the alcohol sulphate under test. Triethanolamine salts were used, as the sodium salts were insufficiently soluble. Nonionic detergent (alkyl phenol or alcohol ethoxylate) was generally added to give acceptable dishwashing performance. In one part of the trial we wished to eliminate nonionic detergents from the sewage treatment plant as part of our investigations into the biodegradability of nonionics (2). In this period the dishwashing liquid consisted solely of alcohol sulphate, at higher concentration to obtain acceptable performance. Ethanol or sodium chloride were added to give the desired physical properties.

RESULTS AND DISCUSSION

Biodegradation Results

The results obtained by the WPRL on the alkyl sulphates derived from coconut alcohol and Dobanol 25 are shown in Table I. It is seen that both these materials are highly biodegradable, all the results falling between 95% and 98%.

TABLE I

Summary of Water Pollution Research Laboratory Results

Analysis	Dobanol 25 Nov.-Jan.		Coconut alcohol Jan.-March		Dobanol 25 March-April		Coconut alcohol April-May	
	Settled sewage	Effluent	Settled sewage	Effluent	Settled sewage	Effluent	Settled sewage	Effluent
Sewage temperature (C)	9		8		11		14	
Flow (gal/day)	1692		1541		1710		2070	
Anionic active material ^a (mg/l)	46.4	1.4	53.1	1.3	35.6	1.5	45.4	1.0
Percentage removal of anionic active material	---	97.0 ($\sigma=0.6$)	---	97.8 ($\sigma=0.8$)	---	95.6 ($\sigma=1.1$)	---	97.9 ($\sigma=0.6$)
5 day BOD (mg/l)	391	21.5	437	23	382	23	364	15
Permanganate value (mg/l)	72	22	82	21	73	23	64	20
Ammonia (mg N/l)	67.7	12.3	72.5	12.8	65.8	13.1	62.3	10.2
Oxidized nitrogen (mg N/l)	---	49.5	---	53.6	---	58.4	---	54.4
Nitrite nitrogen (mg N/l)	---	---	---	0.44	---	0.36	---	0.40
Suspended solids (mg/l)	174	32	192	35	177	44	191	42

^aExpressed as "Manoxol" OT (sodium dioetyl sulphosuccinate).

TABLE II
Comparison With Laboratory Test

Product	Biodegradation, %	
	Activated-sludge laboratory test	Community trial
Dobanol 25 sulphate	99	97,96
Coconut alkyl sulphate	99	98,98

They are appreciably more degradable (3-4%) therefore than the best linear alkylbenzene sulphonates previously evaluated.

The average biodegradation (BOD) removal over the whole test period was 94.8% and the degradation of both alkyl sulphates is rather higher therefore than that of the natural sewage. The data also indicate that temperature has little influence on the degree of biodegradation.

Comparison With Laboratory Tests

The laboratory test applied to these two alkyl sulphates was the continuous activated-sludge test prescribed by German law (Husmann test). The results obtained are compared in Table II with those obtained in the community trials.

The laboratory tests indicate both products to be almost completely biodegradable. Slightly lower values were obtained in the community trials. The slight difference between the results obtained on the two products in the

community trials would be insignificant in terms of practical sewage treatment.

Biodegradation on Further Aeration

Periodically samples of effluent were taken to the laboratory and gently aerated over a period of 28 days at 20 C. Determinations of MBAS were made after aeration and the results obtained showed that the alkyl sulphates, based on both synthetic and natural alcohols, degraded to a value of 99% on further aeration.

Foaming Property of Effluents

The foaming tendency of an effluent was evaluated by passing air from a graduated cylinder through the effluent and observing the height of the foam layer produced. This provided a rough comparison of the relative foaming tendency of different effluents. Those containing residual alcohol sulphates were practically nonfoaming except when alkylphenol ethoxylate was also present.

ACKNOWLEDGMENT

The director and staff of the WPRL gave advice and cooperation. R.D. Walker of the Hitchin Urban District Council also assisted.

REFERENCES

1. Mann, A.H., and V.W. Reid, *JAOCS* 48:588 (1971).
2. Mann, A.H., and V.W. Reid, *Ibid.* 48:794 (1971).

[Received May 7, 1971]