# Comparative Detergency of Several Built Polyethenoxy Aliphatic Ethers

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IN a previous article (1) the comparative detergency of built polyethenoxy alkanoates was determined, and the optimum hydrophilic polyethenoxy chain length to various hydrophobic fatty ester radicals was ascertained. It was noted that, in general, two-thirds of one ethenoxy unit was required for each carbon atom in the fatty acid radical to promote optimum detergency. This empirical rule also seemed to hold equally well for a highly condensed molecule, such as a polyethenoxy sitosterol (2). In their comprehensive patent on polyglycol nonionic detergents for use in the textile industry Schoeller and Wittwer (3) reported the successful condensation of various higher alcohols, including octadecyl, with ethylene oxide and indicated that the products possessed good wetting properties. More recently Rossi and Baldacci (4) prepared nonionic detergents from various higher fatty alcohols and ethylene oxide and showed that while surface tension of these substances increased with increasing molecular weight of the hydrophobic portion of the molecule, the washability decreased. The object of the present investigation was to prepare these polyethenoxy ethers and to compare soil removal and whiteness retention values on built mixtures of these nonionic detergents in order to ascertain optimum ethenoxy chain length necessary for each fatty alcohol.

### Preparation of Polyethenoxy Ethers

To the pure fatty alcohol (100 g.) was added 0.5 g. of potassium hydroxide in a tared three-neck flask with a gas disperser inlet, thermometer, and outlet tube. Potassium carbonate was found to be unsatisfactory as a catalyst for the alcohols. The mixture was heated in an atmosphere of nitrogen gas to 160° C., and ethylene oxide gas was added at such a rate as to maintain the temperature between 160-190°C. The apparatus and contents were weighed at various intervals until the desired amount of ethylene oxide was absorbed. Table I indicates the composition of the various nonionic ethers prepared herein as determined by the careful weighing of the initial starting alcohol and the final product.

TABLE I

Composition of Polyethenoxy Ethers

| Alcohol Used | Average Number of Moles of Ethylene Oxide Condensed Per Mole Alcohol | Nature of Product at Room Temperature |
|---|---|---|
| Decyl | 4.2 | Liquid |
| m.p. 5.5-6.5° | 6.1 | Liquid |
| | 7.9 | Liquid |
| | 10.0 | Liquid |
| | 13.9 | Solid |
| Dodecyl | 4.0 | Liquid |
| m.p. 21-22° | 5.9 | Liquid |
| | 8.1 | Liquid |
| | 10.1 | Liquid |
| | 12.2 | Solid |
| | 14.1 | Solid |
| Tetradecyl | 4.4 | Liquid |
| m.p. 36-38° | 6.6 | Liquid |
| | 7.8 | Liquid |
| | 9.8 | Solid |
| | 12.3 | Solid |
| | 14.0 | Solid |
| Octadecyl | 6.5 | Solid |
| m.p. 58-60° | 8.2 | Solid |
| | 10.4 | Solid |
| | 12.5 | Solid |
| | 14.0 | Solid |
| | 16.1 | Solid |

Detergency values, *i.e.*, soil removal and whiteness retention of built mixtures were determined in a Launderometer as in the earlier studies using the method described by Vaughn and Suter (5). The test mixture again consisted of 20% by weight of polyethenoxy ether, 20% tetrasodium pyrophosphate, 20% sodium tripolyphosphate, 39% soda ash, and 1% carboxymethylcellulose. Detergency values were compared to the previously described nonionic arbitrary test standard (1) taken as 100%.

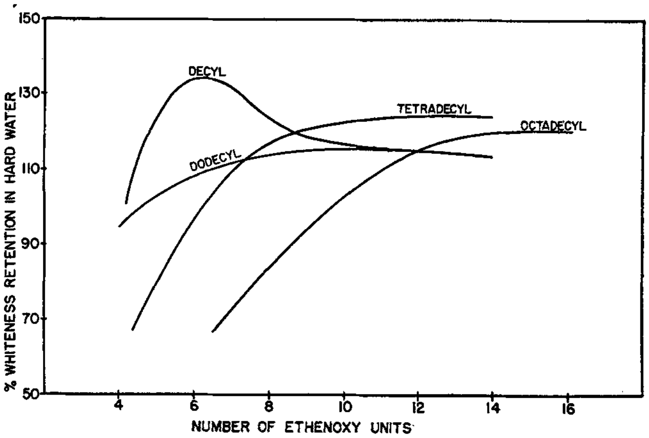

FIG. 1. Variation in whiteness retention in hard water of polyethenoxy aliphatic ethers with ethenoxy chain length.

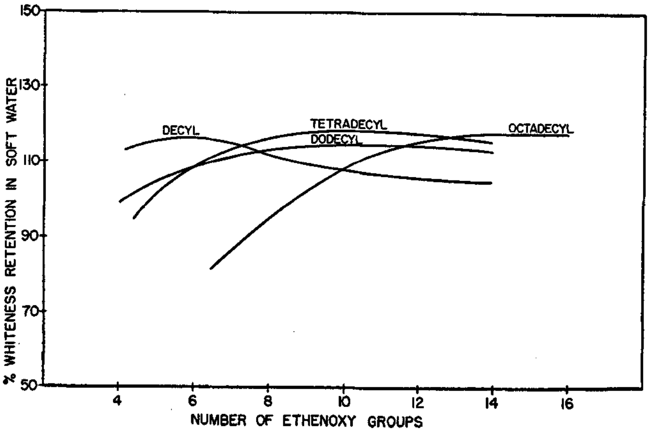

FIG. 2. Variation in whiteness retention in soft water of polyethenoxy aliphatic ethers with ethenoxy chain length.

### Effect of Ethenoxy Chain Length Upon Detergency

From Figures 1 through 4 it may be noted that as in the case of the polyethenoxy alkanoates (1) and the polyethenoxy tallates (6) detergency increases with the number of ethenoxy groups to an optimum

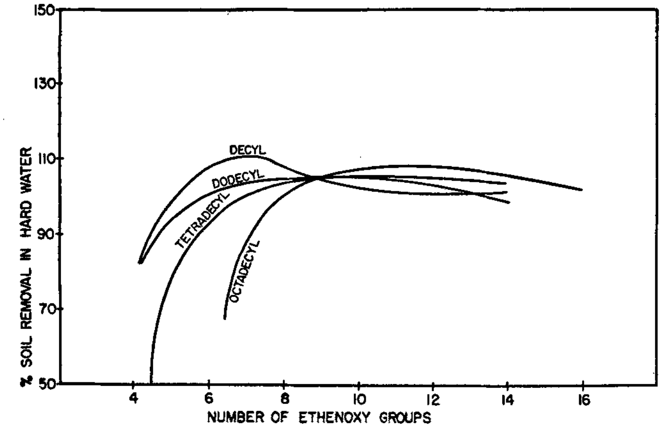

FIG. 3. Variation in soil removal in hard water of polyethenoxy aliphatic ethers with ethenoxy chain length.

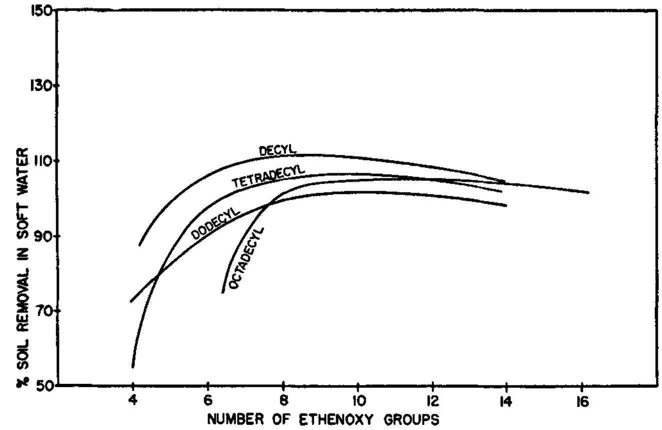

FIG. 4. Variation in soil removal in soft water of polyethenoxy aliphatic ethers with ethenoxy chain length.

point whereupon it levels off or decreases slightly. Here again, the number of ethenoxy groups required for optimum detergency varies with the hydrophobic fatty alcohol chain length and to some extent with each individual detergency test. As in the previously cited experiments (1, 2), two-thirds of an ethenoxy unit for each carbon atom in the hydrophobic unit are required for over-all optimum detergency. In other words, one part by weight of the fatty alcohol or acid should be condensed with two parts by weight of ethylene oxide. It may be also pointed out that the nature of the hydrophobic fatty alcohol portion of the molecule does not greatly influence the detergency values unlike the case of the polyethenoxy alkanoates (1).

TABLE II

Detergency of Polyethenoxy Ethers

| Composition of Alcohol Used | Detergency Values of Condensation Product Containing 16 Moles of Ethylene Oxide | | | |
|---|---|---|---|---|
| | Whiteness Retention | | Soil Removal | |
| | Hard Water | Soft Water | Hard Water | Soft Water |
| I.[a] 3.2% Myristyl<br>28.4% Cetyl<br>19.5% Stearyl<br>45.4% Oleyl<br>3.5% Linoleyl | 129 | 116 | 109 | 107 |
| II.[b] 3.2% Myristyl<br>28.4% Cetyl<br>68.4% Stearyl | 120 | 117 | 105 | 103 |
| Pure Octadecyl Alcohol | 120 | 116 | 103 | 102 |

Sample of [a] Makanol I and [b] Makanol II generously supplied by the Stepan Chemical Company, Chicago, Ill.

## Experiments with Commercial Grade Fatty Alcohols

From the data obtained above, it also seemed desirable to select several commercially available long chain alcohols, condense these with 16 moles of ethylene oxide per mole of alcohol, and determine the detergency values of built mixtures in comparison with the polyethenoxy derivative of a purified octadecyl alcohol. The composition of two such commercially available alcohols and the detergency values of their polyethenoxy derivatives in the built mixture are recorded in Table II.

It would thus appear that the presence of some unsaturated fatty alcohol, such as oleyl, in a polyethenoxy ether gives somewhat improved over-all detergency over those containing saturated alcohols alone.

### REFERENCES

1. Ballun, A. T., Schumacher, J. N., Kapella, G. E., and Karabinos, J. V., J. Am. Oil Chemists' Soc., *31*, 20 (1954).
2. Karabinos, J. V., and Ballun, A. T., J. Am. Oil Chemists' Soc., *31*, 136 (1954).
3. Schoeller, C., and Wittwer, M. (I. G. Farben), U. S. 1,970,578 (1934).
4. Rossi, C., and Baldacci, Ann. chim. (Rome), *41*, 534 (1951).
5. Vaughn, T. H., and Suter, H. R., J. Am. Oil Chemists' Soc., *27*, 249 (1950).
6. Stoltz, E. M., Ballun, A. T., Ferlin, H. J., and Karabinos, J. V., J. Am. Oil Chemists' Soc., *30*, 271 (1953).

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# The Pigments of Crude Cottonseed Oils. I. The Inhibition of Color Reversion in Crude Cottonseed Oils

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PIGMENTS in cottonseed oil have become a serious problem within the past 10 years because of the rapid change from hydraulic to screw-press and prepress-solvent extraction procedures. In the hydraulic mills the cottonseed meats are moistened and cooked at high temperatures, and the oil is extracted at relatively low pressures. Under these conditions nearly all of the pigments remain in the press cake, and there is produced an oil with good refining and bleaching characteristics. In mills which employ low temperature, dry cooking procedures, and high pressures in the presses, a greater percentage of the pigments is extracted and oils more difficult to refine and bleach are produced (1).

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