

Environmental aspects of textile chemical processing — Part-II

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SURFACTANTS FOR PRETREATMENT

THE consumption of surfactants in West Germany was around 430,000 Tons in 1985, of which 10% (43,000) were used by the textile industry and 70% of the used surfactants go in waste water (30,000 tons). In India, the total consumption of surfactants in textile was around 50,000 tons in 1989 and thus similar large amounts of surfactants find their way into waste water. Of the total surfactants produced in Germany, 59% belong to anion-active type, (25% soaps and 34% synthetic detergents), 33% are non-ionics, 7% cationics and 1% amphoteric. The ethylene oxide/propylene oxide condensates of fatty alcohols and alkyl phenols thus formed a substantial part of surfactant consumption and were preferred to anionics due to better compatibility and emulsifying power. Even in India, these non-ionics form about 40% of total consumption of sur-

phenol ethoxylates, metabolates are produced which are toxic to fishes. The chemical industry in Germany decided in 1986 to replace these products in 3 years by other products which are less harmful.

COMPOSITION AND PROPERTIES OF ETHOXYLATES

In contrast to alkane sulphonates, non-ionic surfactants are not homogeneous but mixtures of molecules having varying number of ethylene oxide units. Alkyl phenols have high reactivity towards ethylene oxide and thus lead to complete conversion into the desired end products. Lauryl alcohol has lower reactivity and products always contain appreciable fraction of unreacted alcohol which reduced their alkali stability. Fatty alcohol ethoxylates also have a wider distribution of products with varying degree of ethoxyla-

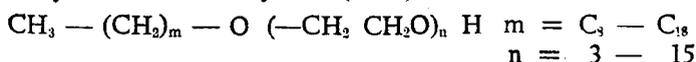
tion. Fatty alcohol ethoxylates increase with degree of ethoxylation and reach a maximum while foaming and alkali stability decreases. Thus, it is not possible to have a universal surfactant to have all above properties at optimum level.

Emulsifying power: The fat emulsifying power of Lauryl Alcohol Ethoxylates (LAE) is of importance in pretreatment of fabrics as chlorinated products are discouraged from ecological considerations. In an aqueous solution, the surfactant and water molecules form a mix phase whose nature is continuously varying with temperature. Due to the heterogeneous composition of LAE, we have a cloud point which is not sharp as for NPE. The mechanism of removal of fats from textiles involves the following steps: I — Surfactant gets uniformly distributed on textiles in water soluble form, II — on increasing temperature the product becomes insoluble promoting penetration in fatty matters, III. On cooling or adding anion active surfactants, the water soluble state is again achieved causing removal of fat by emulsification.

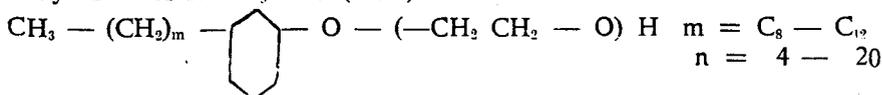
The LAE surfactants, however, have low stability to electrolytes reducing their activity in the presence of alkalis. In order to remove fatty stains, the emulsifying agent has to be higher than 10% of fat quantity. The LAE also have a higher foaming tendency than NPE and the foams are more stable. These problems are aggravated in the presence of sizing polymers which have a foam stabilising effect.

The ethoxylates are not chemically destroyed by even higher

Fatty Alcohol Ethoxylates (FAE)



Alkyl Phenol Ethoxylates (APE)



factants (20,000 tons) in the textile industry in India. The alkyl phenol ethylene-oxide condensates are given preference due to lower foaming tendency and overall good performance.

However, during the last few years, it has been shown that during biological degradation of alkyl

The main useful properties of surfactants are emulsifying power, detergency, alkali stability, and foaming tendency. These properties are however affected in diverse pattern as the degree of ethoxylation of fatty alcohol increases. In general, wetting power, detergency, and alkali stability in-

concentrations of mercerising alkali (300 g/l), but these non-ionic surfactants have a reduced stability in the presence of electrolytes, whether they are caustic soad, sodium silicate or glauber salt. At high concentration of electrolyte and high temperature, the surfactants separate as an oil phase floating on surface along with unreacted fatty alcohol. In the presence of peroxide this can be aggravated by escape of decomposing oxygen and the surface concentration can increase due to evaporation. The detergency of FAE is superior to APE in acidic and neutral pH; in alkaline medium at boil it is only slightly less, which is more than compensated by their better soil carrying capacity.

NEW SURFACTANTS FOR PRETREATMENT

A series of new products have been developed by Chemische Fabrik Tübingen for pretreatment which are free from the above problems and are equally or more efficient. They are synergistic formulations of many components which are completely biodegradable.

Felosan APF	Kier boiling additive upto 50 g/l NaOH
Felosan RG	Removal of oil stains.
Cotoblanco NAC	Stable to NaOH — 50 g/l
Lavotan DSU	For long liquors with mere turbulence
Rewettin VM	Silicate dispersing power.

CONSTITUENTS OF PRETREATMENT WASTE WATER

Pretreatment stage is known to cause considerable pollution problems as it aims at removal of natural and added impurities. Table 1 gives the amount of vari-

TABLE 1 — POLLUTION LOADS IN PRETREATMENT WASTE WATER

Material	COD mgO ₂ /g	Waste water 15 l/kg.		
		Maximum possible %	g/l	COD g/l
Cotton impurities	1,110	12	8	8,800
Fibre residues	1,045	10	6.7	7,061
Starch size	1,160	15	1	11,600
PVA size	420	5	3.3	1,386
Polyacrylate size	270	5	3.3	891
Mineral oil	2,520	5	3.3	8,316
Paraffin	880	3	2.0	1,760
Fatty esters	1,550	2	1.3	2,015
Polyglycols	1,930	3	2.0	3,860
Felason APF	1,475	3	2.0	2,950
Lavoton DSU	1,170	1	0.7	819

ous impurities likely in waste water as well as the resulting pollution level. This data indicates that mineral oils and fatty matters have maximum pollution while complexing agents or peroxide stabilisers have practically negligible effect. The table gives values for pollution loads in continuous pretreatment process using 15-1/kg. of water. In a system where totally about 100-200-1/kg. water is used the values will be naturally lower. Textile auxiliaries used in pretreatment have relatively lower pollution loads. They will only cause appreciable loads when a combined continuous pretreatment is carried out when 20-50 g/kg of these agents are utilised.

Practical Experiences

From the point of environment, the following factors have to be kept in mind while formulating a recipe for pretreatment.

- The pollution load has to be considered along with whiteness and absorbancy of pretreated fabric.
- Such considerations have also economical advantages.
- Technicians should be motivated while adapting to modified recipes.

Some of the problems in the

purification process, mainly of physical nature, are discussed below. The waste water quality varies considerably during processing time, particularly if 3 shift working is not practised. For aerobic biological clarifications, however, a constant supply to the system is necessary. The chemical composition of waste water also varies and neutralisation, mixing is a prerequisite.

Many of the chemicals, although not biologically degraded, are absorbed on activated sludge. Hence, chemicals or auxiliaries used should be either biologically degradable or eliminable and their number kept to minimum. The alkyl phenol ethoxylates are substituted by fatty alcohol ethoxylates.

Practical experience over one year after modification of recipes, selection of suitable chemical/auxiliaries in the above plant showed a decrease in pollution leads by 50%. The uniformity and quality of pretreatment as regards whiteness and absorbancy was maintained and no new machinery needed to be installed.

REFERENCE

- P. Wurster, *Textile Veredlung* 23, 354 (1988).