SYMPOSIUM: SURFACE ACTIVE AGENTS IN THE TEXTILE INDUSTRY

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Introductory Remarks[1]

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ABSTRACT

Surface active agents are used in the textile industry during the processing of fibers into yarns and fabrics, the finishing of leather products and during the removal of soil from textile products by laundering or dry cleaning. In these introductory remarks to the symposium, attention is directed to the phenomena occurring at solid-liquid interfaces during these processes. The properties of the surface active agents and the solvents used, the surface free energy and structure of the polymeric textile products and other, often poorly defined, surface chemical and physical characteristics of the products influence the interactions of these agents. The interactions of surface active agents, often derived from fats and oils, dissolved or dispersed in liquids, with textile materials, including natural products such as cotton, wool and leather, as well as man-made fibers, are considered in this symposium.

The phenomena occurring at solid-liquid interfaces are of particular interest to the textile industry. During processing of fibers into yarns and fabrics, surface active agents may be added from solution to the fibers not only to lubricate them, thereby decreasing friction and fiber breakage, but also to decrease electrostatic charge. These components in the lubricants also serve to increase the removal of this finish in subsequent scouring and desizing. Fibers, such as cotton and wool, contain some natural lubricants; however, these fibers, as well as man-made fibers, are usually treated with surface active agents. In laundering and dry cleaning of textiles, surface phenomena at the solid-liquid interfaces are also of interest. Surface active agents are applied to leather to improve the tanning process.

In the case of yarn or fabric processing, the adsorption of surface active agents on the solid surface of textile products is usually desired. This adsorption may involve van der Waals forces and/or chemical bonds (chemisorption). After processing and during laundering and dry cleaning the textile products, it is necessary to remove adsorbed material, which may be agents added during the processing or soil picked up during usage. This requires the establishment of a mobile interface where adsorbed material on the solid phase is brought into kinetic motion, permitting migration into the interface and then into the liquid phase.

There has often been confusion in attempting to determine the solid-liquid interfaces in the case of textile products. The chemical composition and physical structure of the surfaces usually lack adequate definition, and the liquids or solutions are usually not pure. Some textile products may have chemically reactive surfaces, either naturally occurring or through chemical modification. Those textile products which have naturally occurring porous surfaces may become smooth after various finishing treatments. Also, the properties of the impurities on the

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surfaces, which are being removed, are factors in establishing a mobile interface. Nearly all adsorption processes are exothermic, i.e., a decrease in free energy is observed during adsorption.

The depth of the interface is usually molecular in dimension or certainly less than 100 A. The molecules adsorbed on the solid phase, particularly if they are present as a monomolecular layer, have a smaller number of degrees of freedom than molecules in solution. Consequently, the removal of the adsorbed molecules from the solid phase into the interface and finally into the liquid phase should be favored, under certain experimental conditions. The most important factors in removal of the adsorbed material into the liquid phase are: (a) competition between the adsorbed material and the solvent for the sites on the solid surface; (b) the solubility of the adsorbed material in the solvent, i.e., the greater the solubility of the material in the solvent the greater the rate and extent of removal of the material; (c) in adsorptions on surfaces involving ion exchange, the exchange of ions or solvent molecules with the material; and (d) the relative polarity of the adsorbed material and the solid surface. Mobile interfaces can be formed by increasing the temperature of the liquid phase and by foaming and emulsification processes. Some technical evaluation of these phenomena at the solid-liquid interface can be made by measuring the heat of wetting of the solid surface, the contact angle of solutions with the surface and interfacial and adhesional tensions and by visual examination (1,2).

In this symposium, our speakers will discuss the applications of these principles to the textile industry. The use of linear alcohol surfactants, which have both anionic and nonionic properties and are low foaming and biodegradable, in all phases of textile wet processing will be discussed. The modification of the surface properties of cotton textiles by the introduction of carboxymethyl, phosphato, sulfato, stearoyl and oleoyl groups, as related to wet soiling, hydrophobicity and lubricity of cotton textiles, is considered. The effects of laundering variables on the durability of finishes on cotton textiles, as affected by surface active agents, are reported. The effects of the interactions of surface active agents with leather and wool during tanning and felting processes, respectively, are outlined. These textile products have a number of different types of reactive groups on their surfaces and anionic, cationic and nonionic surface active agents may be used in their wet processing. The surface properties of man-made fibers, such as polyamides, acrylics, polyesters and polyolefins, are more easily controlled and defined than those of natural fibers. Soon after its extrusion, each type of man-made fiber usually requires the application of surface active agents for lubrication and the reduction of the electrostatic charge on the dried fibers, so that they can be spun into yarn and woven into fabric. The surface active agents, dispersed in emulsions, are applied to the fibers. The selection and formulation of these surfactant emulsions, as related to the properties of the fibers, are discussed.

REFERENCES

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2. Zisman, W.A., Ibid. 87:1 (1968).

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