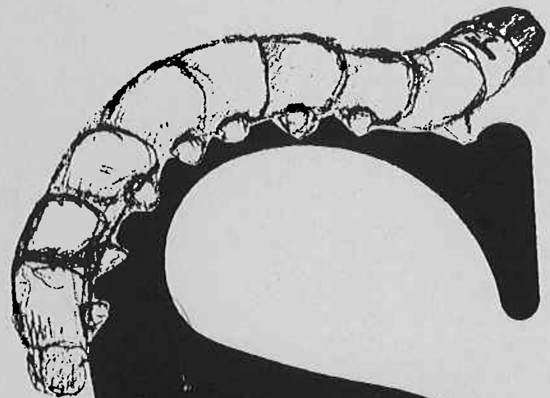
Ballard 11/92



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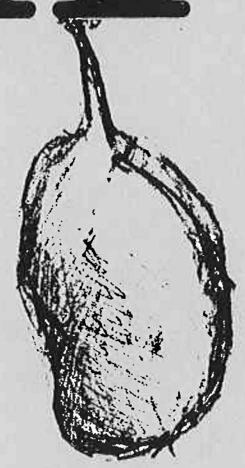

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Surfactants and Silk

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Abstract: The interaction of surfactants upon silk will be reviewed, especially that of nonionic and anionic surfactants on the amphoteric character of the silk fiber. Discussion will compare visual vs. non-visual results, that is, what can occur without apparent changes to the silk. Results of light ageing after various cleaning methods will be evaluated in reference to this study. The purpose of this presentation is to suggest certain correlations between textile science and empirical observations from conservation treatments. Keywords: anionic, nonionic, surfactant, silk, adsorption

There are numerous issues associated with the cleaning of antique textiles, especially silk. Conservators and conservation scientists have focused their soap and surfactant studies on a variety of topics: the type of cleaning agent, the use of auxiliary agents, the effect of water hardness, the type of soiling, the relative merits of non-aqueous drycleaning, the degree of cleanliness achieved, the most appropriate formulation. One issue, addressed in the surfactant and physical chemistry literature, should be added to this list for the textile conservation field: the chemical interaction that surfactants may have with the fiber.

The first step in cleaning or soil removal is the diffusion of water to the soil-fiber interface. This diffusion is usually accomplished by adding a surfactant or soap, since surfactants decrease the surface tension of water. In other words, surfactants reduce the attraction between water molecules, which permits the water to be more readily absorbed in the fiber and to become close to the soil particles.

Surfactants and soaps are organic compounds that have a non-polar, hydrocarbon portion or "tail" and a portion or "head" which is more polar. The non-polar section would not be water soluble without its polar head. The type of "head" determines the category of surfactant: anionic, nonionic, or cationic. Cationic surfactants refer to compounds in which the surface active agent is positively charged (+); these are generally used as softening and antic-static agents in textile processing industries and in household cleaning. Nonionic compounds to not bear any charge, but are polar enough to reduce the surface tension of water significantly. Anionic surfactants are compounds that have negatively charged (-) "heads."

Successful cleaning or soil removal involves matching the type of surfactant with the type of soil or particles marring the fiber surface. For example, nonionic surfactants are effective in removing non-polar oily soil from hydrophobic substrates--

from fiber surfaces that do not interact with water; anionic agents are less effective. Yet much of the (polar) soiling found on cotton fabrics is removed by anionic surfactants, commonly used in home laundry detergents. Also important is the concentration of the surfactant in the bath or cleaning solution. Increasing the concentration increases the cleaning power up to a certain point or "critical micelle concetration." A concentration higher than this will be less effective. Each surfactant has a particular effective concentration or CMC, depending upon the particular chemical structure of surface active agent.

While a considerable amount of work has been done on addessing the adsorption behavior of the surfactant during wet cleaning or washing, much less information is available on how much of the adsorbed surfactant is removed during the rinsing process. Animal fibers like wool or silk adsorb anionic surfactants during washing because of the amphoteric nature of the proteins. Protein fibers are made up of amino acids, with an amino (+) portion and an acid (-) portion in each molecule of the fiber.

Samples of silk cleaned and rinsed with nonionic surfactant show little sulfur present because the amount of sulfur in the silk protein is very small. However, after wet cleaning samples of silk with an anionic surfactant, and rinsing with deionized water, somewhat more sulfur--part of the anionic surfactant molecule--is detected by inorganic elemental analysis (SEM/EDS). Such a residue is not present for cotton. Upon light ageing, differences in mechanical properties also appear for silk samples cleaned by different systems.

The presence of a surfactant residue depends not only on the rinsing procedures but also on the type of surfactant and fiber. This is especially important for silk where the electrostatic attaction between surfactant and fabric plays a critical role in the sorption of surfactant. There are two ways to modify this electrostatic attraction. One will be altering the type of surfactant, nonionic rather than anionic. The other is to change the pH condition of the rinse water. The advantages and disadvantages of the residue itself should be considered.

In this study silk fabrics were obtained from Testfabrics Inc. of Middlesex, New Jersey. The anionic surfactant--sodium lauryl sulfate, buffered to a pH of 7.0--was selected for the primary experimental work, since it is the standard surfactant used in wet cleaning antique textiles across the United States.

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