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Opinion

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Bolaform Electrolytes as Dyeing Auxiliaries

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Introduction

Organic compounds possessing two cationic or anionic groups separated by relatively large distances have been named 'bolaform electrolytes (bolytes)' [1,2]. The word 'bola' means a long cord with heavy balls at each end used by the gauchos in the Argentinian pampa to capture cattle. When the distances, generally the alkyl chains, are sufficiently long, the bolaform electrolytes become surface-active compounds. Such surface-active compounds are named 'bolaform amphiphiles (bola-amphiphiles)'. Various physical properties of the bolaform electrolytes or amphiphiles have been extensively studied. The surface activity, solubilization properties and micelle formation for some bolaform electrolytes have been discussed in detail. The application of the bolaform amphiphiles to monolayer lipid membranes has also been reported. Furthermore, a study on the micelles or vesicles formed from crown ether-based bolaform amphiphiles has been reported. These studies show that the bolaform electrolytes or amphiphiles behave peculiarly compared to the corresponding compounds having a single positive or negative site. Zana reviewed the properties of bolaform and dimeric (gemini) surfactants [3].

On the other hand, the binding of small molecules with poly(vinylpyrrolidone) (PVP) have been extensively investigated. The small molecules contain simple aromatic compounds, surfactants, dyes, and fluorescent probes.

The sorption behavior of small molecules by polymeric materials, especially, the sorption of dyes by fibers, has been also studied. For example, the sorption of acid dyes by silk and nylon 6 has been extensively investigated from various points of view. The studies on silk dyeing include the determination of sorption isotherms, the elucidation of mixture dyeing, and the effects of silk and dye structure. In the case of nylon dyeing, the sorption isotherms have been interpreted using a dual sorption mechanism, which consists of partition and Langmuir type sorption. In addition, the effects of cosolutes, for example, sodium chloride and surfactants, on dye sorption by nylon have been reported. The author and coworkers have investigated the sorption behavior of fluorinated acid dyes by a nylon 6 film and a silk fiber and made clear the effects of the substituents in the dyes through the sorption parameters.

So far many studies on the binding and sorption behavior in the presence of organic compounds have been reported, but few investigations using the bolaform electrolytes have been found. The effects of the bolaform electrolytes on the binding of acid dyes with PVP [4-7] and the sorption of acid dyes by nylon 6 and silk [8,9] have been studied in detail. Furthermore, the disperse dyeing of nylon 6 and polyester fiber in the presence of gemini surfactants was examined and the gemini surfactants were found to be more effective than the corresponding conventional surfactants as dispersing agents [10,11].

Figure 1 shows examples of bolaform electrolytes used for dyeing auxiliaries. In our studies, cationic bolaform electrolytes have been used for dyeing auxiliaries of acid dyeing, direct dyeing, and reactive dyeing.

The effects of the bolaform electrolytes on silk dyeing by sodium 1-phenylazo-2-hydroxy-6- naphthalenesulfonate (Figure 2) are introduced in the present paper. Sorption isotherms of the acid dye for the silk fiber in pure water are shown in Figure 3, where r is the amounts of dye sorbed by the silk fiber and C_{free} is free dye concentration in dye bath. Actually the acid dye was not sorbed by the silk fiber in the

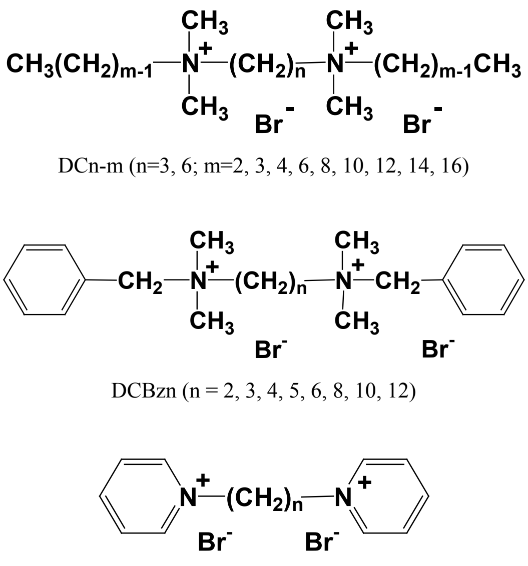

Figure 1: Examples of bolaform electrolytes.

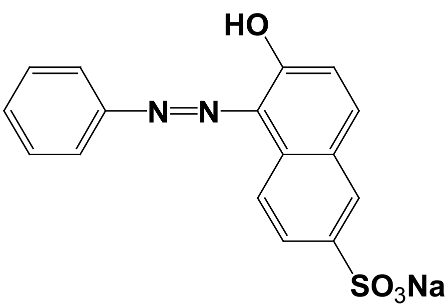

Figure 2: Acid dye used.

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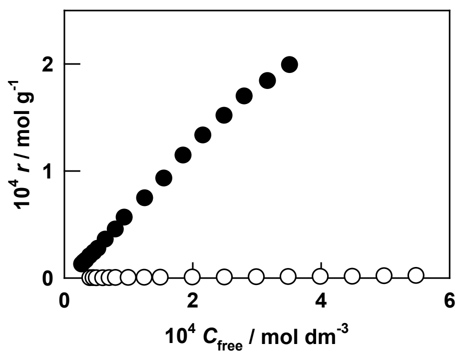

Figure 3: Sorption isotherms of the acid dye for the silk fiber in pure water at 50ºC in the absence (○) and presence (●) of DCBz8 (2×10^{-3} mol dm^{-3}).

absence of any auxiliaries. Because any acidic conditions were not applied in this experiment (pure water was used). The addition of the bolaform electrolyte, DCBz8, enhanced the amounts of dye sorbed by the silk fiber significantly. Thus the bolaform electrolyte makes it possible to sorb the acid dye without any acidic conditions.

The application of bolaform electrolytes to reactive dyeing of cotton has been investigated. We aim that the bolaform electrolytes would become useful dyeing auxiliaries instead of sodium sulfate.

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