Journal of Dispersion Science and Technology, 35:1419–1426, 2014

ISSN: 0193-2691 print/1532-2351 online
DOI: 10.1080/01932691.2013.848406

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Nonelectrolyte-Induced Micellar Shape Changes in Aqueous Solutions of Silicone Surfactants

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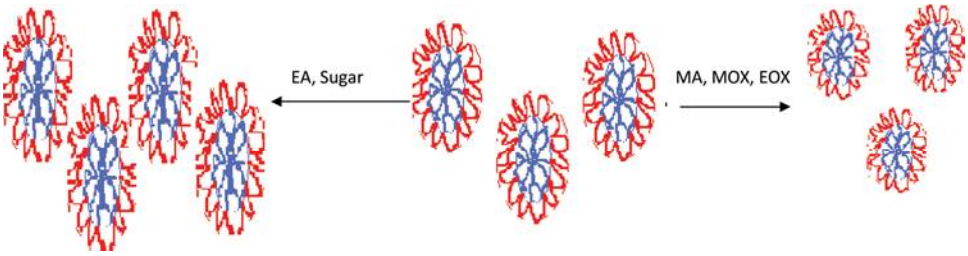
GRAPHICAL ABSTRACT



Dynamic light scattering, cloud point (CP), and surface tension studies have been carried out to examine the influence of six (including two acetates, two alkoxyethanols, and two sugars) nonelectrolyte additives on two silicone surfactants based on poly (dimethyl siloxane)—graft—polyethers in aqueous solutions. The results indicate that the presence of alkoxyethanols induced the oblate ellipsoidal to spherical micellar transition, while sugars increase the size of the ellipsoidal micelles. The effect of cosolvent or additives on critical micelle concentration (CMC) and CP is discussed on the basis of water structure making and breaking effect. The thermodynamic and surface active parameters were calculated from the surface tension isotherm curves.

Keywords Additive, cloud point, DLS, nonelectrolyte, silicone surfactant, thermodynamics of micellization

INTRODUCTION

Silicone surfactants (SS) or silicone glycols are polyether-modified poly (dimethlysiloxane)s.[1,2] Normally, siloxane moiety is insoluble in water and thus contributes to hydrophobic properties of molecules. Due to high flexibility of the polysiloxane chain, it acquires conformation that results in close and efficient packing at the interface between air/water, oil/air, or water/oil.[3] Moreover, SS can decrease the surface tension of both water as well as organic oils and hence, they can be used for surfactant action in organic media where conventional low molecular weight surfactants as well as block copolymer like PEO–PPO–PEO or PEO–PBO–PEO are less effective or even sometimes fail.[4] Another interesting aspect of SS is that the modification of siloxanes can be achieved in a variety of ways to get a wide range of molecular architectures such as comb like siloxanes, α- and ω-functionalized siloxanes, branched siloxanes, or even structures (similar to conventional surfactant), namely trimethyl or heptamethyl siloxanes. The SS have been widely used as stabilizers for polyurethane on one hand and antifoamants in fuel like diesel and heavy oils on the other. Similarly, they are also employed as antifoaming agents in various industrial formulations such as polyether-based dispersion, detergents, adjutants, paints, inks, wetting agents, etc.[3,4] The wide range of applications discovered for SS are mainly due to their high surface activity, low toxicity, and unique association behavior. Despite wide and extensive usage, very

Received 28 August 2013; accepted 22 September 2013.

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