

Determination of the Shape and Size of SDS Micelles in Aqueous Salt Solutions Using Viscosity Measurements †

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Abstract: In this work, the viscosity of a series of sodium dodecyl sulfate (SDS) solutions was measured in the presence of salts at various temperatures. The SDS concentrations are above the critical micelle concentration (cmc). The shape and size of SDS micelles in aqueous solutions of the following salts at various concentrations were studied: NaCl, NaNO₃, NH₄Cl, NH₄NO₃, Na₂SO₄, and Na₂HPO₄. When large amounts of salts are added into aqueous solutions of ionic surfactants, the formed micelles of the surfactant undergo a sphere-to-rod transition. A consequence of this transition is the rapid increase in viscosity. Using Einstein's law for the viscosity of colloidal dispersions and Simha's equation for cylindrical rods, the rod's major to minor axis ratio was calculated and subsequently the aggregation number of the micelles. It was observed that the size of the rod micelles, which for some cases was found to be even 100 times greater in comparison to that of the spherical micelles, is reduced in relation with the added salt in the following order: NH₄Cl > NH₄NO₃ > Na₂SO₄ ≈ Na₂HPO₄ > NaCl > NaNO₃. Furthermore, it was found that with an increase in temperature, the size of the micelles is reduced, with the micelles tend to become spherical at very high temperatures above 60°C. Particularly, the size of the micelles is reduced by approximately 30 – 50% with an increase in temperature of 10°C. Lastly, an increase in the size of the micelles with an increase in the SDS concentration was observed for the constant concentration of added salt. It must be noted that certain results, although they do not seem illogical, should be taken with caution. Concluding, more measurements using specialized methods are required to confirm the results of the present work.

Keywords: SDS; micelles; surfactant; salt; sphere-to-rod transition; viscosity; temperature.

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Conflicts of Interest

The authors declare no conflict of interest.

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