



Light scattering studies of several cationic detergents
by Edwin H Eylar

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree
of Master of Science in Chemistry

Montana State University

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Abstract:

Aqueous solutions of various dodecylalkyl-, dodecyldialkyl-, dodecyltrialkylammonium chlorides and dodecyltrimethyl-ammonium halides were examined by light scattering methods in an attempt to gain further insight into the phenomenon of micelle formation. Molecular weights of micelles formed by these surface active agents and their critical concentrations were measured. Micelle size was found to be influenced both by the nature of the gegen ion and the makeup of the substituent groups on the nitrogen atom. Dodecylmethylammonium chloride micelles (the largest) were found to have a molecular weight of approximately 74,600 while dodecyltrimethylammonium chloride micelles were found to have molecular weights in the neighborhood of 9,300.

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I. ABSTRACT

Aqueous solutions of various dodecylalkyl-, dodecyldialkyl-, dodecyltrialkylammonium chlorides and dodecyltrimethylammonium halides were examined by light scattering methods in an attempt to gain further insight into the phenomenon of micelle formation. Molecular weights of micelles formed by these surface active agents and their critical concentrations were measured. Micelle size was found to be influenced both by the nature of the gegen ion and the makeup of the substituent groups on the nitrogen atom. Dodecylmethylammonium chloride micelles (the largest) were found to have a molecular weight of approximately 74,600 while dodecyltrimethylammonium chloride micelles were found to have molecular weights in the neighborhood of 9,300.

II. INTRODUCTION

McBain (20) in 1913 concluded that certain abnormal properties exhibited by soaps in solution could best be explained by assuming that the long-chain ions of the soap* came together to form large colloidal aggregations, which were later termed micelles. Solutions of surface active agents have been studied quite extensively by osmotic pressure, ultracentrifuge, diffusion, X-ray, conductivity, and light scattering methods in order to determine structure, shape, weight, and other characteristics of their micelles. Since light scattering was used in this investigation, a brief review of the theory follows (2,4,8,9).

The turbidity T of a scattering medium is defined by

$$T = - \frac{1}{I} \frac{dI}{dL}$$

Integration gives

$$I = I_0 e^{-TL}$$

I_0 is the intensity of the incident light and I is the intensity of the light after passing through L cm. of the medium.

According to electromagnetic theory, the intensity of light scattered from a small, isolated, isotropic, dielectric

*McBain studied compounds like potassium stearate, which is properly designated a "soap." However, the compounds considered in this study should not, according to the commonly accepted nomenclature, be termed soaps but shall be referred to throughout this thesis as "detergents" or "surfactants."

