

CHAPTER V

CONCLUSIONS

First, analysis of the hydrodynamic properties of dilute aqueous solutions of hydroxypropylcellulose (HPC) and cocamidopropyl dimethyl glycine (CADG), under conditions where the surfactant is strongly cationic (pH = 3.0), shows that the variation of hydrodynamic radius (R_h) determined by dynamic light scattering analysis correlates well with results from the specific viscosity (η_{sp}) measurements as the CADG concentration is increased. This indicates that the changes in η_{sp} with CADG concentration are due to changes in hydrodynamic radius. The addition of even a very small amount of amphoteric surfactant induces a decrease in η_{sp} , indicative of a gradual polymer coil contraction, suggesting a decrease in the solvent quality due to the dissolved surfactant. This contrasts with the situation in conventional anionic or cationic surfactants, which requires large surfactant concentrations, comparable to the CMC, to bring about coil contraction. Above the CMC, an increase in η_{sp} is observed interpreted as evidence that a pronounced polyelectrolyte effect is imparted to the neutral HPC chain, due to the formation of a charged complex with the amphoteric surfactant. Substantial chain expansion, indicated by an increase in η_{sp} (and, at pH = 3, by an increase in R_h), was induced by binding of the surfactant under three different charge conditions, cationic (pH = 3), near isoelectric (pH = 9), and anionic (pH = 12). At very high CADG concentration, above maximum binding, the chain expansion was reduced due to screening of the electrostatic repulsions, when free counterions from excess CADG are present. The

magnitude of the chain expansion at maximum binding relative to the surfactant-free polymer ($\eta_{sp,max}/\eta_{sp,o}$ or $R_{h,max}/R_{h,o} \sim 1$) is much smaller than for the complexes formed by typical anionic or cationic surfactants. This appears to be because of two effects. First, for the CADG system, there is a larger chain contraction before micelle formation indicative of a larger decrease in solvent quality due to the surfactant. Second, the magnitude of chain expansion on binding of the micelles (characterized by $\eta_{sp,max}/\eta_{sp,min}$ or $R_{h,max}/R_{h,min}$) is smaller suggesting that the polymer-micelle interactions are weaker. Finally, we observe a minimum in the relative chain expansion at the isoelectric pH, consistent with expectation on the basis that the force between bound micelles near the isoelectric pH will be attractive, in contrast to the repulsive force under strongly cationic or anionic conditions.