A STUDY ON THE SELF-ORGANIZING BEHAVIOUR OF SURFACTANTS IN MIXED-SOLVENT MEDIA

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ABSTRACT

The thesis entitled, “A Study on the Self-Organizing Behaviour of Surfactants in Mixed-Solvent Media” consists of five chapters.

In chapter 1 a general introduction to the present study along with scope of the work done has been given. In chapter 2 the experimental techniques have been described.

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further study to establish it. Enthalpy – entropy compensation takes place during micellization. The compensation temperature has values within the range reported for sodium alkyl sulfates.[38] Counter ion binding constant, surface excess and aggregation number of SDS show decreasing trend with increasing amount of AA up to 30 % and become almost constant beyond 30 % AA. Such changes taking place in the different parameters at around 30 % AA can be correlated to the destruction of the ice-like structure of water and formation of mixed water – AA structures, which were reported[21] to occur above 30 % AA. I_1/I_3 values of pyrene indicate that initially pyrene is solubilized in the micellar core, but moves to the micellar interface at about 30 weight percent AA. The empirical relations proposed by Aguiar et al.[23] for ionic surfactants based on the analysis of I_1/I_3 data are found to be applicable in the present system of study below 20 % AA only. The values of packing parameter indicate that the SDS micelles in water + AA medium are spherical in shape. Standard free energy of micellization when plotted versus reciprocal of dielectric constant and Gordon parameter of the water + AA medium exhibit fairly good linear relation. We used the ratio of solvent surface tension to limiting surface tension at the cmc, $\gamma_0/\gamma_{\mathrm{lim}}$, as a new scale to express solvophobicity and it has been found that this new scale of solvophobicity works as good as the Gordon Parameter.

In chapter 4, surface tension and conductance of AOT in water + EG media were measured at 20, 25, 30, 35 and 40 °C. Fluorescence emission intensity of pyrene in AOT + water + EG system has been measured at 25 °C. Surface tension and conductance measurements of CPC in water + EG media were made at 25 °C.

The amount of EG was varied from 0 to 100 weight % in an interval of 10. A new break has been found to occur in the surfactant isotherm of AOT far below the cmc when the media contain 60 weight % or more of EG indicating interaction between AOT and EG. This interaction is considered to be due to hydrogen bonding of AOT through oxygen of its C=O and S=O groups with EG. UV spectra of AOT in 60 % EG + water medium also show that interaction takes place between AOT and EG. The present work shows that the cmc of AOT increases with increase in EG content of the medium in accordance with the general trend unlike the reported result.[23,24] Cmc has negligible dependence on temperature in the region where EG $\leq$ 30 %, but above 30 % EG it increases considerably on increasing the temperature. In media containing 30 % or more EG, conductance data of AOT provide cmc values comparable with those obtained from surface tension data. But, below 30 % EG the agreement between the cmc values derived from surface tension and conductance data is not good. It is, however, important to note that determining cmc from conductance data alone is difficult since more than one breaks appear in the plot of specific conductance versus concentration. Surface tension isotherms of CPC do not exhibit any additional break in the submicellar region of the type observed in the case of AOT. On the other hand, surface tension isotherms of CPC exhibit surface tension minima at cmc in water + EG media containing 10 to 70 % EG. The minimum becomes very sharp in 70 % EG + water medium. Since surface tension minimum is not found in either pure water or EG medium, the impurity in CPC does not seem to be the cause of surface tension minima. At the moment, we are unable to explain the mechanism of evolution of such a surface tension minimum of

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In chapter 5, surface tension and conductance of AOT and CPC in water + FA media were measured at 25 °C. In the case of SDS conductance was measured at 25 °C. Similar to the behaviour of AOT in water + EG media, a new break in the surfactant isotherm of AOT occurs much below the cmc when the media contain 40 weight % or more of FA. Such breaks in the surface tension isotherms indicate interaction between AOT and FA similar to that between AOT and EG. The present work shows that the cmc of AOT increases with increase in FA content of the medium in accordance with the general trend unlike the reported result.[10,11] Acceptable cmc values of AOT could not be determined from its conductance data in water + FA media. Similar to the trend noticed in water + EG media, surface tension isotherms of CPC exhibit surface tension minima at the cmc in water + FA media containing 20 to 80 % FA. The minimum becomes very sharp in 60 and 70 % FA media. As pointed out in the case of water + EG media, the occurrence of these surface tension minima are not due to impurities in the CPC sample. Further studies are required to explain the mechanism of evolution of surface tension minimum of CPC in water + FA and water + EG media. Cmc value of CPC increases with increasing amount of FA in the medium and CPC has only one value for cmc in FA. On the basis of surface tension and conductance data it has been established that for SDS also cmc monotonically increases with increase in the amount of FA. Counter ion binding constant of CPC and SDS decreases on adding FA to the medium and passes through a minimum. Surface excess at the cmc of AOT and SDS decreases as the FA amount increases in the medium. The variation of surface excess at the cmc of CPC with percentage of FA has, on the other hand, an unusual trend. For AOT, CPC and SDS, their values of $\gamma_{\lim}$ in water and FA are found to be same within ±2 mN m^{-1}. It has been demonstrated that the ratio $\gamma_0/\gamma_{\lim}$ can also be used as an index to express the solvophobicity of a medium towards ionic surfactants.

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By

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chemistry

DEDICATED TO MY PARENTS

The North Eastern Hill University

Declaration

Month : October **Year : 2009**

I, Mrs. Dipannita Das, hereby declare that the subject matter of the thesis is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to the best of my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other university / Institute.

This is being submitted to the North-Eastern Hill University for the award of degree of Doctor of Philosophy in Chemistry.

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Dated 20th Oct. 2009

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CHAPTER I

General Introduction

1.1 Surfactants, classification and properties

Surfactants are surface-active molecules and the necessary criterion for a molecule to behave as a surfactant is that it should have the dual nature of hydrophobicity and hydrophilicity. In general, these two behaviours are called solvophobicity and solvophilicity of a surfactant. A surfactant molecule therefore contains a solvophobic part of sufficient length and a solvophilic end. The solvophobic part consists of hydrocarbon chain with eight or more carbon atoms, which is simply called 'tail' and the solvophilic part is called 'head'. The solvophobic part may consist of more than one hydrocarbon chains also. Due to the dual nature of surfactants, these molecules are also called amphiphiles.

Surfactants can be broadly classified as biosurfactants and synthetic surfactants. Naturally occurring surfactants are called biosurfactants, which are found in biological systems. Examples are phospholipids, fatty acids and bile salts. Synthetic surfactants are synthesized for specific domestic or industrial uses. Detergents are formulations containing mainly synthetic surfactants as active components. Both natural and synthetic surfactants are further classified as anionic, cationic, nonionic and zwitterionic.

Anionic surfactants can be represented by the general formula RA^-M^+, where R is the hydrophobic chain with A^- head group and M^+ is the counter ion. When dissolved in polar solvents, they dissociate to give negatively charged monomeric species and the corresponding counter ions. They aggregate to give anionic micelles. Sodium dodecyl sulfate (SDS; $CH_3(CH_2)_{11}SO_4^-Na^+$) and sodium alkyl benzene sulfonate ($RC_6H_4SO_3^-Na^+$) are some of the widely used anionic surfactants. Cationic surfactants have the general formula RX^+Y^-, which dissociate in polar solvents to give positively charged surfactant moiety and negatively charged counter ions. They form cationic micelles. Examples of cationic surfactants are cetyl trimethylammonium bromide (CTAB; $CH_3(CH_2)_{15}N^+(CH_3)_3Br^+$) and cetyl pyridinium chloride (CPC; $C_{16}H_{33}C_5H_4N^+Cl^-$). Nonionic surfactants do not carry any electrical charge and hence their aggregates do not have any surface charge. Polyoxyethylene (23) dodecanol (brij 35), polyoxyethylene (9-10) octyl phenol (Triton X–100) and polyoxyethylene (20) sorbitan monooleate (Tween 80) are some well known nonionic surfactants. Zwitterionic surfactants possess both anionic and cationic groups on the hydrophobic moiety and can behave as anionic, cationic or neutral species depending on the pH of the medium. N-alkyl and C-alkyl betaines, phosphatidyl amino alcohols and acids are examples of such surfactants.

Conventional surfactants have one head group attached to one hydrocarbon chain (single-chained) or two hydrocarbon chains (double-chained) or even three hydrocarbon chains (triple-chained).[1] Hydrocarbon chains may be branched also. There is a new class of synthetic surfactants having remarkable surface-active properties and these surfactants are called gemini surfactants.[2] Gemini surfactant molecules contain two head groups and two hydrocarbon chains. The two hydrocarbon chains are connected through another hydrocarbon chain known as spacer. The surfactant is called gemini or dimeric when the spacer is between the two head groups and bolaform if the spacer is between the hydrocarbon chains. The length of the spacer can be varied by varying the number of carbon atoms and nature of the spacer governs the properties of these surfactants. In view of the immense importance and application of surfactants, continuous efforts are going on to synthesize newer surfactants with special properties, for e.g., photo-sensitive surfactants.[3-5]

Surfactants, due to their amphiphilic nature, possess two important properties. These are (i) surface activity or adsorption at an interface and (ii) self-organization or aggregation in a given medium. Surfactants, due to their adsorbing ability, lower the surface tension of a solution and form monolayers, films and multilayers. On the other hand, surfactants form, due to their self-organizing ability, aggregates like micelles, vesicles and membranes. Adsorption and aggregation abilities of surfactant molecules are responsible for their applications in various fields.

1.2 Thermodynamics of adsorption

Equilibrium exists between surfactant molecules at the interface and those in the bulk solution. The change in surface Gibbs function, dG_S at constant temperature and pressure is given as

$$dG_S = \gamma d\sigma + \sum_i \mu_i \, dn_{i\sigma} \qquad (1.1)$$

where γ is the surface tension, $d\sigma$ is the change in the area of the surface, μ_i is the chemical potential of the i^th^ component and $dn_{i\sigma}$ is the change in the amount of the

i^{th} component at the interface. In the light of the thermodynamic principles, we obtain the relation

$$d\gamma = -\sum_i \Gamma_i \, d\mu_i \qquad (1.2)$$

where $d\gamma$ is the change in the surface or interfacial tension of the solvent and $d\mu_i$ is the change in chemical potential of the i^{th} component. Γ_i is the surface excess of the i^{th} component and is defined as

$$\Gamma_i = n_i/\sigma \qquad (1.3)$$

n_i and Γ_i can be positive or negative. Eq. (1.2) is known as the *Gibbs adsorption isotherm.* For a two- component system at constant temperature and pressure Eq. (1.2) reduces to

$$d\gamma = -\Gamma_1 d\mu_2 - \Gamma_2 d\mu_2 \qquad (1.4)$$

Subscripts 1 and 2 refer to solvent and solute, respectively. The location of the dividing surface of the two bulk phases is arbitrarily chosen such that the surface excess concentration of the solvent, Γ_1, becomes zero. This is, in fact, the most realistic position since we are considering a surface layer of adsorbed solute. Eq. (1.4) now becomes

$$d\gamma = -\Gamma_2 d\mu_2 = -RT\Gamma_2 d\ln a_2 \qquad (1.5)$$

where a_2 is the activity of solute, R is the gas constant and T is the temperature. For dilute solutions a_2 can be replaced by the concentration term a_2. For a surfactant solution, we can now write the Gibbs adsorption isotherm as

$$\Gamma = -\left(\frac{1}{RT}\right)\left(\frac{d\gamma}{d\ln c}\right) \qquad (1.6)$$

where c and Γ are the concentration and surface excess of the surfactant, respectively. Since Γ is positive for surfactants, $d\gamma/d\ln c$ must be negative. Therefore, accumulation of surfactants on the surface or interface lowers the surface tension. In surfactant solutions the surface tension initially decreases with increasing surfactant concentration and then attains generally a constant value above a critical concentration.

Eq. (1.6) is, however, found to be valid in the case of nonionic surfactants only. For ionic surfactants, Gibbs adsorption isotherm has a form different from Eq. (1.6), which was discussed in detail by Prosser and Franses.[6] We consider here an anionic surfactant BM in aqueous medium in the presence of an added electrolyte XM. The Gibbs adsorption isotherm given by Eq. (1.2) can be written in the expanded form for the solution containing RM and XM as

$$d\gamma = -RT[\Gamma_M d\ln c_M + \Gamma_B d\ln c_B + \Gamma_X d\ln c_X] \qquad (1.7)$$

where Γ_M, Γ_B and Γ_X are the surface excess of ionic species M^+, B^- and X^-, respectively. We have considered here symmetric univalent surfactant and added electrolyte only. Let c and c_e be the bulk concentrations of surfactant and electrolyte, respectively. If Γ and Γ_e are the surface excess of surfactant and electrolyte, respectively, then for a combination of univalent surfactant and electrolyte, Eq. (1.7) takes the form

$$d\gamma = -RT\Gamma[d\ln(c + c_e) + d\ln c] \qquad (1.8)$$

In the absence of an electrolyte, for surface excess of a symmetric univalent surfactant one gets from Eq. (1.8) an expression of the type

$$\Gamma = -\left(\frac{1}{2RT}\right)\left(\frac{d\gamma}{d\ln c}\right) \tag{1.9}$$

Equation (1.8) on differentiation and further rearrangement yields an expression for the surface excess of a univalent surfactant in the presence of a particular concentration of 1:1 electrolyte, which is of the form

$$\Gamma = -\left(\frac{1}{RT}\right)\left[\frac{1}{1+\frac{c}{c+c_e}}\right]\left(\frac{d\gamma}{d\ln c}\right)_{c_e} \tag{1.10}$$

1.3 Thermodynamics of aggregation

The second important property of a surfactant is its ability to undergo aggregation. Aggregation of a surfactant in solution is commonly known as micellization and the aggregates are called micelles. The surfactant concentration in a given medium at which surfactant molecules start aggregating to form micelles is known as the critical micelle concentration (cmc). Two approaches are used to understand the thermodynamics of the micellization, which are phase - separation and mass - action models. These two models are briefly discussed below.

1.3.1 Phase – separation model

In this model the micelle is treated as a separate phase. The hypothetical standard state for the surfactant in the aqueous phase is taken to be the solvated monomer at unit mole fraction with the properties of the infinitely dilute solution.

For the surfactant in the micellar state, the micellar state itself is considered to be the standard state.[7]

If μ_s and μ_m are the chemical potential of the unassociated surfactant in the aqueous phase and of the associated surfactant in the micellar phase, respectively, and since the two phases are in equilibrium at and above the cmc

$$\mu_s = \mu_m \qquad (1.11)$$

For a non-ionized *surfactant, assuming the concentration of free monomers* to be low, we get

$$\mu_s = \mu_s^0 + RT\ln X_s \qquad (1.12)$$

μ_s^0 corresponds to the chemical potential at the standard state and X_s is the concentration of surfactant monomers in mole fraction. Since micellar phase is treated as a separate hydrocarbon phase the mole fraction of the associated surfactant in this phase is equal to one and therefore

$$\mu_m = \mu_m^0 \qquad (1.13)$$

If ΔG_{mic}^0 is the standard free energy change for transfer of one mole of surfactant from solution to micellar phase, then

$$\Delta G_{mic}^0 = \mu_m^0 - \mu_s^0 = \mu_m - \mu_s + RT\ln X_s = RT\ln X_s \qquad (1.14)$$

Assuming that the concentration of free surfactant in the presence of micelle is constant and equal to the critical micelle concentration, we get $X_s = X_{cmc}$. Eq. (1.14) therefore becomes

$$\Delta G_{mic}^0 = RT\ln X_{cmc} \qquad (1.15)$$

In the case of ionic surfactants, ΔG^0_{mic} must also include the free energy change for the transfer of β moles of counter ion from its standard state in the solution phase to the micellar phase. β is the number of moles of counter ion per mole of the associated monomer in the micellar phase and is known as the counter ion binding constant. If one mole of micelle consist of n mole of surfactant and m moles of counter ion, β = m/n. n is generally know as aggregation number. It is also considered that the free counter ions present in the solution phase are in equilibrium with the counter ions bound to the micelle. For ionic surfactants Eq. (1.15) therefore modifies to

$$\Delta G^0_{mic} = RT\ln X_{cmc} + \beta RT\ln X_c \qquad (1.16)$$

Where X_c is the mole fraction of counter ion in the solution. At the cmc when the micellar phase is just formed, in the absence of added electrolyte it can be approximated that $X_c = X_{cmc}$ and Eq. (1.16) becomes

$$\Delta G^0_{mic} = (1 + \beta)RT\ln X_{cmc} \qquad (1.17)$$

1.3.2 Mass – action model

In this model applicable to ionic surfactants, micelles are assumed to be in equilibrium with the surfactant monomer ions and counter ions. Further it is assumed that micelles are effectively monodispersed. The equilibrium is represented as

$$nB^- + mM^+ \rightleftharpoons A^{(n-m)-} \qquad (1.18)$$

In the above equilibrium, B^-, M^+ and $A^{(n-m)-}$ represent single detergent ion, counter ion and anionic micelle, respectively. Applying the mass-action law to the above equilibrium, the corresponding equilibrium constant, K, can be written as

$$K = \frac{a_A}{a_B^n a_M^m} \qquad (1.19)$$

a_A, a_B and a_M are activities of the surfactant monomer, counter ion and micelle, respectively. The standard free energy of micellization per mole of surfactant monomer is given by

$$\Delta G^0_{mic} = -\frac{RT}{n}\ln K \qquad (1.20)$$

Substituting the value of K from Eq. (1.20), we get near cmc after substituting concentration for activity and ignoring the term $\ln c_A/n$

$$\ln cmc = \frac{\Delta G^0_{mic}}{RT} - \beta \ln c_M \qquad (1.21)$$

c_M is the concentration of the counter ion. Eq. (1.21) is known as the Corrin – Harkins equation.[8]

1.4 Micellization parameters

Micellization behaviour of surfactants is characterized and quantified in terms of different parameters, which are known as micellization parameters. A brief account of the most commonly used micellization parameters are given below.

1.4.1 Critical micelle concentration

The critical value of a surfactant concentration at which micellization starts is known as its critical micelle concentration (cmc) as mentioned above in section 1.3. When micelle forms, sudden change in several physical properties of surfactant solutions takes place enabling us to determine experimentally values of cmc. Normally, changes in physical properties like surface tension, conductivity, viscosity, solubilization, osmotic pressure, etc, take place over a narrow concentration range. Therefore, a precise determination of the cmc is difficult and moreover values of cmc estimated from different experimental methods may also differ to a certain extent. Thus, numerous methods are available for determining the value of cmc. Tensiometry, conductometry, fluorimetry and calorimetry are some of the commonly used methods.

Critical micelle concentration is an important property of a surfactant, which reflects on its micellization ability. Smaller the cmc better is the surfactant. Cmc of a surfactant is affected by several factors.[9,10] It is dependent on the number of carbon atoms in the hydrocarbon chain of the surfactant. As the number of carbon atoms increases cmc decreases. The dependence of cmc on the number of carbon atoms beyond 16 is not very significant. Branching of the hydrocarbon chain also affects the cmc. Nature of hydrophilic group is another factor on which cmc shows strong dependence. There is a pronounced difference between the cmc's of ionic and nonionic surfactants with identical hydrophobic moieties indicating the influence of hydrophilic head group on cmc. The lower cmc's of the nonionic surfactants are a consequence of the lack of electrical work necessary in forming the micelles. Nature of counter ion, its radius and valence, also largely affect the value of cmc of ionic surfactants.[11-17] Cmc has interesting temperature dependence.[18-27] Most of the ionic surfactants exhibit at some temperature a minimum in the cmc.[18,19,25,28] This property of ionic surfactants is used in the differential scanning calorimetry technique for studying the micellization behaviour of ionic surfactants.[29] With increase in pressure cmc of ionic surfactants in water show a maximum.[30-37] Added electrolytes have significant effect on the cmc of both ionic and nonionic surfactants.[11-17,25,38-45] Non-electrolytes like urea, amides, alcohols, etc on addition produce both increase and decrease of cmc of surfactants.[46-53]

1.4.2 Aggregation number

Aggregation number is another important fundamental parameter concerning a micelle and it is equal to the number of monomers present in a micelle. It gives an idea about the size of a micelle. It is determined using experimental techniques like dynamic light scattering (DLS), small-angle neutron scattering (SANS), steady-state fluorescence quenching and time-resolved fluorescence quenching.[39,55-61] Some of the factors affecting aggregation number are structure of a surfactant, concentration of surfactant,[56,60-62] concentration of added electrolyte,[41-43,52,61-65] counter-ion binding constant, nature of solvent, etc. Significant changes in aggregation number lead to micellar shape transition. In a micellar solution, all micelles may not have same aggregation number and poly-dispersity exists.[66] However, for the sake of simplicity such polydispersity is generally ignored for calculation purpose and only monodispersed micelles with single aggregation number are taken into account.

1.4.3 Counter ion binding constant

In the case of ionic surfactants counter ion binding constant is an important parameter. As mentioned above in section 1.3.1, counter ion binding constant (β) is equal to the number of moles of counter ion bound to the ionic micelle divided by the aggregation number. β is always found to be less than one thereby signifying presence of residual electric charge on the surface of an ionic micelle. Counter ion binding ability is one of the important characteristics of ionic micelles. Counter ions control not only the critical micelle concentration (cmc) and aggregation number (N_{agg}) of ionic surfactants, but also the reactions[67] that take place in the presence of ionic surfactants. The shape of an ionic micelle appears to have an influence on the value of β. In non-aqueous polar solvent media, β generally has lower value than in water.

Due to the presence of effective electric charge on the ionic micelle, an electric potential is developed at the surface of the ionic micelle, which is known as surface potential of the ionic micelle. The surface potential value controls different processes that take place near the micelle – solution interface.

1.5 Shape and structure of micelles

Micelles are aggregates of surfactant monomers and the aggregated species are in dynamic equilibrium with the monomers. Therefore, considering micelles to have rigid structures with precise shapes may be unrealistic. However, SANS, DLS and phase diagram studies made on micellar solutions support the concept of micelles having regular shapes. It is assumed that near the cmc micelles are roughly spherical. The radius of a micelle cannot be greater than the stretched-out length of the surfactant molecule. Typically micelles may have average radii of 1.2 – 3 nm and can contain 20 – 100 monomers. Added electrolyte has great influence on the shape of ionic micelles. As the counter ion concentration is increased, the shape of ionic micelles is reported to change from spherical to non-spherical shapes like ellipsoidal, cylindrical, hexagonal, etc.

The interior of a micelle consists of a liquid core, which is oil like, formed by the associated hydrocarbon chains. In ionic micelle the charged head groups project out into the water phase. Similar structure of micelles exists in polar non-aqueous solvents also. In non-polar solvents the structure of micelle gets reversed. The region immediately surrounding the core is the Stern layer, which contains the ionic head groups and a part of counter ions (bound counter ions). The Stern layer constitutes the inner part of the electrical double layer surrounding the micelle. The outer layer, which is a diffuse layer contains the remaining counter ions (free counter ions) and is known as Gouy-Chapman layer.

1.6 Scope of the work

Hydrophobic interaction is a type of water – solute interaction where the solute has either full or partial hydrophobicity. Similarly, hydrophilicity is also due to water – solute interaction. These interactions responsible for hydrophobicity and hydrophilicity are not water specific and exist in other solvents also. Therefore, solvophobicity and solvophilicity are the general terms used. When the solutes are amphiphilic in nature, solvophobic interaction leads to two significant phenomena, viz. adsorption and aggregation. Thus, adsorption and self-organization of surfactants take place only in the presence of a solvent. Solvents therefore play a decisive role in controlling the adsorption and micellization characteristics of surfactants. For instance, solvophobicity of the tail part of a surfactant towards one solvent can change over to solvophilicity in another solvent. Consequently, a particular surfactant may form normal micelles, no micelles or reverse micelles by changing the polarity of solvent. Recent works of Eastoe and coworkers[61,68-71] illustrate the profound effects of solvent properties on aggregation and adsorption of surfactants. For example, Seguin et al.[68] showed that in a mixed solvent containing ethylene glycol (EG) and propylene glycol (PG) the aggregation of nonionic surfactants can be switched 'on' or 'off' by controlling the EG:PG ratio. Despite extensive studies made on the micellization behaviour of surfactants in different types of media, it is still not exactly clear which property of a solvent controls the micellization process, although hydrogen bonding between the solvent molecules is considered to be a prerequisite for aggregation of surfactants. Moreover, quantifying solvophobicity and solvophilicity is still an unsettled problem. Studying the adsorption and aggregation behaviours of surfactants in different solvents of varying property therefore provides useful information of fundamental and practical importance. The different solvent media used for such study are (i) water in the absence and presence of various types of additives that alter the water structure, (ii) non-aqueous polar solvents including ionic liquids, (iii) mixed solvents containing water and organic polar solvent, and (iv) non-polar organic solvents. Continued studies on the adsorption and micellization behaviours of surfactants in organic polar solvents and their aqueous mixtures indicate the importance and relevance of such studies.[61,68-111]

In view of the above points, we have undertaken in this thesis a study on the adsorption and aggregation of ionic surfactants in binary mixed solvents containing water as one of the components.

The reported results about the cmc of SDS in water + acetamide medium based on conductance method are not consistent.[112,113] Therefore, in chapter 3 we have made a detailed study on the adsorption and micellization of SDS in water + acetamide medium by using surface tension, conductance and fluorescence methods.

Normally, cmc of a surfactant in organic polar solvent is more than that in water. But for sodium dioctylsulfosuccinate (AOT)[89,90] in water + EG and water + formamide (FA) media unusual trends in the variation of cmc with increase in the amount of organic solvent were reported. The reported cmc values of AOT in pure EG and FA are even lower than that in water, which is contradictory to the normal trend. Similarly, inconsistent cmc values were reported[80,81,91,102] for SDS in water + FA media using conductance method. The reported trend in the variation of cmc of SDS with increase in the amount of FA is also contradictory to the normal trend. Furthermore, on surveying the literature,[73,103,114] we found that the micellization behaviour of CPC, a commonly used cationic surfactant, has not been studied in water + EG and water + FA mixed solvent media covering the entire composition range, i.e., from 0 to 100 % of EG or FA. Therefore, in chapter 4 we investigated the adsorption and aggregation behaviours of AOT and CPC in water + EG media, while in chapter 5 we investigated the adsorption and aggregation behaviours of AOT, CPC and SDS in water + FA media.

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CHAPTER II

Experimental Techniques

2.1 Surface Tension Measurement

Surface tension measurements were made using a K11 Krüss Tensiometer. This instrument determines the surface tension with the help of an optimally wettable probe suspended from a precision balance. The probe is either a ring or a plate. We used here a plate known as Wilhelmy plate method. A height-adjustable sample carrier is used to bring the liquid or solution in the sample vessel into contact with the plate. A force acts on the balance as soon as the plate touches the liquid surface. If the length of the plate is known, the force measured can be used to calculate the surface tension using the following relation

$$\gamma = \frac{F}{L\cos\theta} \qquad (2.1)$$

where γ is the surface tension, F is the force acting on the balance, L is the wetted length of the plate and θ is the contact angle. The plate is made of roughened platinum and is optimally wetted so that the contact angle is virtually 0^o such that $\cos\theta \approx 1$. The K11 tensiometer is first calibrated using the prescribed method described in the instrument's manual. By calibrating the tensiometer actually the force measuring balance is calibrated. For calibration the supplied 1g weight is used which gives an equivalent surface tension of 243.95 mN m^{-1} according to Eq. (2.1) since the length of the plate, L = 0.0402 m. Before every use the plate is first rinsed with acetone to remove any organic material sticking to the plate and thereafter washed with double-distilled water. Finally, the plate was heated to red hot with a Bunsen burner and then cooled. The recommended sample vessel made up of Corning glass was used for holding the liquid or solution. This sample vessel is also cleaned thoroughly with acetone and water. The dry sample vessel is also flamed off with a Bunsen burner to make it free from any surface-active substance. The sample vessel containing the solution is then placed in the steel jacket of the tensiometer. The steel jacket is maintained at the required temperature using Haake DC 10 circulation bath. The supplied temperature sensor senses the temperature of the solution. The recommended immersion speed, search speed and immersion depth were selected. The entire operation of the tensiometer is controlled by the microprocessor. The instrument is attached to a PC and the surface tension values are displayed on the monitor screen. Ten surface tension values taken at an interval of 1 second and an average of these values were displayed on the screen. This particular tensiometer has a resolution of 0.01mN m^{-1}. The reproducibility of the measured surface tension values of the solutions was found to be within ±1 mN m^{-1}.

2.2 Electrical Conductance Measurement

All conductance measurements were made at 1 kHz using Wayne Kerr B905 Automatic Precision Bridge. This LCR meter has 0.01 nS resolution and measures conductance with an accuracy of 0.05%. It has an averaging facility and averages 2 ('Average' 1) to 128 ('Average' 9) measurements in a time span of about 670 ms to 36 s, respectively. We have used throughout the 'Average' 9 option. The bridge works basically on the principle of Ohm's law. Matching currents are passed through the standard resistor and the solution under test. The corresponding two voltages produced, whose values depend upon the impedances at the standard resistor and the test solution, are measured, resolved and computed to give the desired information on the display. All functions of the instrument are under the direct control of a microprocessor. A dip-type conductivity cell having platinized platinum electrodes was used. The cell constant was determined using standard KCl solution.

2.3 Fluorescence Quenching Method for Aggregation Number Measurement

Pyrene has been used as a fluorescence probe and cetylpyridinium chloride (CPC) as a quencher. In a homogeneous solution the Stern – Volmer equation relates the fluorescence emission intensity to the quencher concentration. Stern – Volmer equation is written as

$$\frac{I_0}{I_q} = 1 + K_{SV}[Q] \qquad (2.2)$$

I_0 and I_q are the intensities of fluorescence emission of pyrene in the absence and presence of the quencher, respectively. [Q] is the quencher concentration and K_{SV} is called Stern – Volmer constant. In a micellar solution, pyrene and the quencher reside in the micellar phase. For quenching to take place quencher molecule and the probe molecule must reside in the same micelle. Selecting Poisson statistics to describe the distribution of probe and quencher among the micelles and assuming that intramicellar quenching rate is much faster than the rate of intramicellar fluorescence decay of the probe, in a micellar solution Eq. (2.2) takes the form

$$\frac{I_0}{I_q} = \exp\left\{\frac{[Q]}{[\text{Micelle}]}\right\} \qquad (2.3)$$

From Eq. (2.3) micelle concentration can be obtained. After obtaining micelle concentration, aggregation number, N_{agg}, is calculated using the relation

$$N_{agg} = \frac{c_s - c_0}{[\text{micelle}]} \quad (2.4)$$

Here c_s is the concentration of the surfactant which is taken above cmc and c_0 is the cmc. In this method, steady-state fluorescence quenching is considered. The instrument used for recording fluorescence emission spectra is Hitachi F4500 FL spectrophotometer. The temperature of the sample was controlled by circulating water of required temperature from the circulation bath.

2.4 UV Spectral Measurement

The uv absorption spectra of sodium dioctylsulfosuccinate (AOT) solution were recorded using Hitachi U2900 model spectrophotometer. 1 cm quartz cells were used for holding the samples. All measurements were carried out at 25 ^{0}C. The temperature was maintained by circulating water around the cell holder at the required temperature from a Julabo F-25 ED thermostat.

2.5 Density Measurement

Density of solutions whenever required to convert molal to molar concentration was measured using Anton Paar DMA 5000 Density Meter.

All weighing were done in a Mettler Toledo AG245 Electronic Balance.

CHAPTER III

Aggregation and Adsorption Properties of Sodium Dodecylsulfate in Water – Acetamide Mixtures

3.1 Introduction

Self-organization of amphiphiles takes place only in the presence of a solvent and solvent properties greatly influence the adsorption and aggregation phenomena. Studies are therefore made on the aggregation behaviour of surfactants by altering the solvent property and such studies provide information that are of fundamental and applied importance. Solvent property can be varied in different ways, for example, (i) by taking pure solvents of different polarity, (ii) by taking mixed solvents containing either mixtures of water and non-aqueous solvent or mixtures of two non-aqueous solvents, and (iii) by adding electrolytes or non-electrolytes to water or any other solvent of interest. Among all solvents water is the most important solvent due to its biological and industrial importance and it is used in different human activities. Therefore, investigations about the micellization characteristics of different types of surfactants are still carried out mostly in water and in aqueous media containing additives that can alter the water structure. As mentioned in the last section of chapter 1, it is still not exactly clear which property of a solvent controls the micellization process, although hydrogen bonding between the solvent molecules has been reported to be a prerequisite for aggregation of surfactants.[1] In recent years there has been a renewed interest on the study of adsorption and aggregation of surfactants in solvent media containing a binary mixture of water and a polar non-aqueous solvent as evident from the published papers.[2-14] Carrying out investigation on the effect of added non-electrolytes on the micellization of surfactants is also equally important so as to gather knowledge about the role of solvent structure on aggregation phenomenon. Several such studies were carried out in aqueous medium and the commonly used non-electrolytes are alcohols and urea. Acetamide (AA) is another non-electrolyte which has two sites for hydrogen bonding and there are two reports[15,16] in the literature about the micellization of ionic surfactants in water + AA medium. In this medium Emerson and Holtzer[15] reported an increase in the cmc of SDS with increasing AA whereas Akhter[16] reported a decrease in the cmc and in both the studies only conductance method was used. We have therefore made a detail study of the micellization behaviour of sodium dodecylsulfate (SDS) in water + AA medium by using surface tension, conductance and fluorescence methods.

3.2 Experimental

In this study SDS (Aldrich, ≥99%), AA (Fluka, ≥99%), pyrene (Fluka) and cetylpyridinium chloride (CPC; Sigma) were used without further purification. Conductance measurements were made using Wayne Kerr B905 automatic precision bridge and a dip-type cell. Surface tension measurements were made by the Wilhelmy plate method using K11 Krüss tensiometer. Hitachi F4500 FL spectrophotometer was used to record the fluorescence emission intensities of pyrene. Density measurements were made using Anton Paar DMA 5000 density meter. Haake DC10 circulation bath was used for maintaining the temperature. Milli-Q grade water was used for preparing solutions. Concentration of AA in water is expressed in weight %.

3.3 Results and Discussion

3.3.1. Critical micelle concentration determination

Conductivity data of the solution of SDS in AA + water mixtures at different temperatures are shown in Table 3.1. Plots of specific conductance versus concentration at temperatures ranging from 20 to 40 °C are shown in Fig. 3.1 and from such plots the values of cmc of SDS were determined as functions of temperature and AA concentration. Although dielectric constant of the water + AA medium was reported[17] to increase up to the addition of about 70 % (≈ 0.4 mole fraction) AA, conductance of SDS solution of a particular concentration decreases with increase in the AA concentration similar to the case in other media containing water and non-aqueous solvents.[2,6,9-14,18,19]

Experimental values of surface tension (γ) of the solution of SDS in water + AA mixtures at different temperatures are shown in Table 3.2. Plots of surface tension versus concentration at different temperatures (20 to 40 °C) are shown in Fig. 3.2. SDS sample used in this study exhibits surface tension minima when the AA amount in the mixed solvent is less than 50 % and the minimum disappears when the AA amount is ≥ 50 %. For the sample of SDS used in the present study it was observed that the cmc values determined by the conductance method are comparable to the SDS concentration at which surface tension starts becoming almost constant. Similar observation was reported by Lin et al.[20] also. Accordingly, cmc values were estimated from the surface tension plots. In Fig. 3.3 we have shown the change in surface tension that takes place on adding AA to water in the presence and absence of SDS. Surface tension decreases on adding AA to water and passes through a minimum. This minimum occurs at 30 % AA in the absence of SDS and shifts to lower AA concentrations with the addition of SDS (concentration of SDS being less than the cmc). It is reported[21] that (i) AA forms hydrogen bonding with water through its polar groups, (ii) water retains the tetrahedral configurations without appreciable steric distortion up to the addition of 11 – 12 mole % (region of 30 %) AA, and (iii) above 30 % AA the ice-like structure of water is destroyed with the formation of mixed water–AA structures. Hydration of the methyl group of AA has also been reported from nmr study.[22] In the light of these reported[21,22] information about the structure of water + AA system the decrease in surface tension up to 30 % AA may be ascribed to loosening of the ice-like structure of water by the addition of AA, which would decrease the energy required for taking water molecules to the air – water interface. Increase in surface tension above 30 % AA may be attributed to the formation of new water–AA mixed structures. In the presence of amphiphiles due to hydrophobic interactions the rupture of tetrahedral configurations of water may take place at lower concentrations of added AA and this could be the reason for shifting of the surface tension minimum in Fig. 3.3 to lower AA concentrations on adding SDS. The limiting surface tension at the cmc (40 ± 2 mN m^{-1}) is, however, found to have no dependence on the amount of added AA. Recently Eastoe and co-workers[3] also reported a weak dependence of limiting surface tension of nonionic surfactants on solvent in water + ethylene glycol mixture.

The values of the ratio I_1/I_3 of the intensities of fluorescence emission of pyrene at 374 (I_1) and 384 (I_3) nm in SDS + water + AA system at 25 °C are listed in Table 3.3. Fluorescence emission measurements of pyrene made at 25 °C are shown in Fig. 3.4 as plots of I_1/I_3 versus SDS concentration. The values of cmc at

25 °C were estimated from these plots using the treatment reported by Aguiar et al.[23] All the cmc values determined from conductance, surface tension and fluorescence data are listed in Table 3.4. The cmc values determined from the three methods are found to be comparable. The nature of the variation of I_1/I_3 with SDS concentration is considered to be sigmoid type and the data were fitted to Eq. (3.1)

$$I_1/I_3 = \{(A_1 - A_2) / (1 + \exp[(c - c_0) / b])\} + A_2 \qquad (3.1)$$

In Eq. (3.1) c represents SDS concentration, c_0 is the value of x corresponding to the centre of the sigmoid, A_1 and A_2 are the upper and lower limits of the sigmoid, respectively, and b is a term that reflects the range of c where sudden change of I_1/I_3 occurs. In the light of the analytical treatment described by Aguiar et al.[23] the value of cmc was estimated to be equal to either c_0 or $c_0 + 2b$. The values of the parameters of Eq. (3.1) obtained from the fitting are given in Table 3.5. Aguiar et al.[23] made very interesting conclusions from the analysis of the I_1/I_3 data, which are (i) for ionic surfactants the cmc value is equal to $c_0 + 2b$ and the value of the ratio c_0/b is more than 10, and (ii) for nonionic surfactants the cmc value is equal to c_0 and the ratio c_0/b has a value less than 10 (the value was typically in the range of 3 to 5). Aguiar et al.[23] showed that the conclusions made by them hold well in water, water + ethylene glycol and water + urea media. We tested the applicability of the empirical correlations observed by Aguiar et al.[23] to the present system of study. From Table 3.5 it can be seen that in pure water and 10 % AA medium the cmc values of SDS are equal to $c_0 + 2b$ and the values of c_0/b are higher than 10 which is in agreement with the observation made by Aguiar et al.[23] for ionic surfactants. However, when the amount of AA in the solvent medium becomes equal to or more than 30 %, cmc and c_0/b of SDS take up the values that are characteristic of nonionic surfactants, i.e., cmc ≈ c_0 and $c_0/b < 10$. The behaviour of SDS in 20 % AA medium appears to be a border line case, because cmc is nearly equal to c_0 as well as $c_0 + 2b$ and $c_0/b \approx 10$. Moreover, the nature of the plots given in Fig. 3.4 also indicates that micelle formation of SDS is accompanied by a sudden decrease in the 1:3 intensity ratio of pyrene in media containing up to 20 % AA, which is a characteristic of ionic surfactant, but when the media contain 30 % or more AA the micellization process of SDS occurs in a gradual manner, which is a characteristic of nonionic surfactant. The present study therefore reveals that the characteristics of the parameters of Eq. (3.1) for ionic surfactant, particularly c_0 and b parameters, are strongly dependent on the nature of the surfactant as well as on the nature of the solvent. The influence of the solvent was not observed by Aguiar et al[23] in the systems investigated by them.

3.3.2. Critical micelle concentration trend

3.3.2.1. Temperature dependence

The variation of cmc with temperature is shown in Fig. 3.5. In water cmc of SDS is known to have a minimum value at about 298 K and it has been observed in the present study also. However, in the presence of AA the minimum in cmc disappears and it increases monotonically with temperature in the range from 20 to 40 °C. On increasing the temperature two opposing effects operate in the surfactant solution: (i) the degree of hydration of the head group decreases thereby favouring micellization, and (b) the ordered structure of solvent molecules around the hydrophobic tails breaks thereby disfavoring micellization. In solvents containing water + AA or water + non-aqueous solvent the second effect seems to predominate over the first one thereby resulting in an increase of cmc with increase in temperature.

3.3.2.2. Dependence on acetamide content

The dependence of cmc on the amount of AA in the medium can be seen from Fig.3.6. On addition of AA, cmc increases relatively slowly up to about 45 % AA and above this the increase in cmc becomes sharp. This type of trend in the variation of cmc is common in mixed solvents containing water and non-aqueous solvent. By the addition of AA two opposing effects start operating. Firstly, due to the addition of lipophilic non-electrolyte the solvophobicity of the medium decreases, this enhances the solubility of the surfactant and consequently increases cmc. Secondly, due to the increase in dielectric constant of the medium by the addition of AA the electrostatic repulsive interaction between the head groups of the ionic surfactant decreases and this, in turn, favours micellization. In the present system the first effect dominates and therefore accounts for the increase of cmc with increase in the amount of AA. In Fig. 3.6 we have compared the reported[15,16] cmc values with the present values. The cmc values of SDS in water + AA mixtures at three different concentrations of AA (the highest AA concentration was 34.6 %) reported by Emerson and Holtzer[15] are in good agreement with the present cmc values. However, the cmc values reported by Akhter[16] in the AA concentration range from 0 to 13.4 % do not agree with the present values. Moreover, Akhter[16] reported a decrease in cmc with increase in the amount of AA (Fig. 3.6), whereas we as well as Emerson and Holtzer[15] observed an increase in cmc with increasing

AA content in the medium. To verify further the trend in the variation of cmc between 0 and 10 % AA, we determined the cmc of SDS in water + AA media containing 0.3, 1.8 and 5.1 % of AA at 25 °C by using the surface tension method and obtained the values of cmc as equal to 8.5, 8.7 and 9.5 mmol kg^{-1}, respectively. Thus, no decrease in cmc with increasing amount of AA was observed even in the range from 0 to 10 % AA. It has been reported[24] that conductance method may give sometimes erroneous cmc values, particularly when the medium is non-aqueous, because ion-ion interaction can also cause break in the conductivity versus surfactant concentration. This may be a probable reason for the anomalous decrease in cmc with increase in AA content in the range of 0 to 13.4 % reported by Akhter.[16]

3.3.3. Polarity

The values of I_1/I_3 at the cmc of SDS as a function of AA amount in the solution are shown in Fig. 3.7. The value in water is equal to 1.25 which is in agreement with the value reported by Aguiar et al.[23] and slightly high compared to the value 1.14 reported by Kalyanasundaram and Thomas.[25] I_1/I_3 value reflects about the polarity of the medium around pyrene and therefore it is apparent from Fig. 3.7 that as the AA amount in the solution increases the polarity of the location where pyrene resides (i) remains constant up to 10 % AA, (ii) increases from 10 to 40 % AA, (iii) decreases from 40 to 50 % AA, and (iv) increases again above 50 % AA. In Fig. 3.7 we have also plotted the values of I_1/I_3 of pyrene in water + AA medium without SDS as functions of AA % and the reported dielectric constant[17] of the bulk medium. From Fig. 3.7 it can be realized that at the cmc the polarity of the location where pyrene resides is always less than that of the bulk, which clearly indicates that pyrene has been solubilized into the micelle. Up to 10 % AA pyrene appears to reside at the micelle core since addition of AA hardly affects the value of I_1/I_3. Kalyanasundaram and Thomas[25] had also reported that in water containing SDS micelles solubilization of pyrene takes place in the interior core of the micelle. When the amount of AA exceeds 10 %, the value of I_1/I_3 sharply increases up to 20 % and between 20 and 30 % AA the increase in I_1/I_3 is negligible. With increase in AA, the area per head group of the micelle increases due to decrease in the aggregation number (see section 3.5) and this may cause water molecules along with some AA molecules to penetrate into the palisade layer of the micelle. This may facilitate movement of pyrene from the core to the palisade layer and hence accounting for the increase in the value of I_1/I_3 between 10 and 20 % AA. Pyrene appears to reside at the palisade layer up to 30 % AA because there is no change in the value of I_1/I_3 between 20 and 30 % AA. From Fig. 3.7 it is quite clear that both in the absence and presence of SDS micelle the trends in the variation of I_1/I_3 with AA concentration in the range from 30 to 70 % AA are similar thereby indicating that pyrene is located at the surface of the micelle.

3.3.4. Counter ion binding

The counter ion binding behavior of ionic micelles is quantified in terms of counter ion binding constant, β, which is equal to $1-\alpha$, α being the degree of dissociation of SDS micelles. α is generally determined from the conductivity data by considering it to be approximately equal to S_2/S_1, where S_1 and S_2 are the slopes of the conductivity versus concentration plot below and above the cmc, respectively. The values of β obtained thus from the conductance data are shown in Fig 3.8. The dependence of β on temperature is found to be weak and not regular and therefore in every water + AA medium we determined an average value of β. With increase in AA content, β initially decreases and remains almost constant beyond 30 % of AA. In media containing water + polar non-aqueous solvent it has been reported[2,8-12,14,18,19,26] that depending upon the nature of the non-aqueous solvent β either decreases or remains almost constant with increase in the content of the non-aqueous component. The decrease of β with decrease in water content of the medium irrespective of decrease or increase of dielectric constant of the medium indicates that β is controlled more by the solvophobicity of the medium. In water + AA medium both solvophobicity and polarity favour a decrease in β. An exceptional case of increase in β with decrease in the water content has also been reported for CPC in water + glycerol medium.[26] In the region of 30 – 70 % AA, the surface area of the head group of the SDS micelles is large causing AA molecules along with water molecules to penetrate into the palisade layer. Presence of AA molecules at the micellar interface and also at the palisade layer may cause steric hindrance to the binding of counter ion to the micelle. This may be the reason for having almost constant value for β above 30 % AA.

A plot of S_1 and S_2 versus AA amount has also been shown in Fig. 3.9. In water + alcohol systems the plots of S_1 and S_2 versus alcohol content were reported[27,28] to be linear and at a certain concentration of alcohol S_1 becomes equal to S_2. In water + AA medium such plots are not linear and S_1 does not tend to become equal to S_2. Therefore, conductance method can be used for determining cmc of ionic surfactants even at high AA concentration; however solubility problem has to be overcome. In fact, in pure AA melt conductance method was successfully used to determine the cmc of ionic surfactants.[29,30]

3.3.5 Aggregation number, size and shape

The aggregation numbers, N_{agg}, of SDS in water and water + AA media were determined from the fluorescence quenching data (Table3.6) by using Eq. (3.2).

$$\ln [I_0 / I_q] = [Q]\, N_{agg} / (c - \mathrm{cmc}) \qquad (3.2)$$

I_0 and I_q represent intensity of fluorescence emission of pyrene in the absence and presence of quencher CPC, respectively and [Q] refers to quencher concentration. Plots of Eq. (3.2) are shown in Fig. 3.10 and from the slopes of these plots the values of N_{agg} were determined, which are listed in Table 3.7. The aggregation number of SDS decreases with the addition of AA (Fig. 3.11) which is similar to the trend observed for N_{agg} by the addition of non-aqueous solvent to water.[2,9,10,12,18] The value of N_{agg} appears to reach an almost constant value equal to 13 ± 2 when the AA amount becomes $\geq$ 30 % (Fig. 3.11). Decrease in N_{agg} of SDS by the addition of AA to water irrespective of the fact that dielectric constant of the medium increases indicates that the size of the micelle is predominantly controlled by the solvophobicity.

The volume (v) in $Å^3$ and length (l) in Å of the hydrocarbon chain of SDS were calculated from the Tanford's[31] equations $v = 27.4 + 26.9n$ and $l = 1.5 + 1.265n$, where n is the number of carbon atoms in the hydrocarbon chain. The radius (r) of the micelle, the surface area per head group (a_0) and the packing parameter (P) were calculated from the expressions $r = [3vN_{agg}/(4\pi)]^{1/3}$, $a_0 = 3v/r$ and $P = v/(a_0 l)$, respectively. The values of r, a_0 and P are given in the Table 3.7. The values of P indicate that the shape of the micelle in the water + AA media is spherical since the geometrical condition for spherical micelle is $P \leq 1/3$. The surface area per head group increases by the addition of AA to water and attains an almost constant value when the AA concentration becomes ≥ 30 %.

3.3.6 Free energy, entropy and enthalpy terms

The standard free energy of micellization per mole of surfactant, ΔG^0_{mic}, was evaluated from the expression

$$\Delta G^0_{mic} = (1+\beta)RT\ln X_{cmc} \tag{3.3}$$

where X_{cmc} is cmc in mole fraction unit, R is the gas constant and T is the absolute temperature. The calculated values of ΔG^0_{mic} are presented in Fig. 3.12 as plots of ΔG^0_{mic} versus temperature. With increasing concentration of AA ΔG^0_{mic} becomes less favorable to micellization. It is interesting to note that for SDS the values of ΔG^0_{mic} in water + AA medium are comparable with that in water + formamide medium [2]. Moya et al.[2] reported 30.6 and 22.9 kJ mol^{-1} values for ΔG^0_{mic} of SDS at 25 °C in 10 and 30 weight % water + formamide media, respectively which are surprisingly in perfect agreement with the corresponding values for SDS in water + AA medium. From the temperature dependence of X_{cmc} or ΔG^0_{mic}, standard entropy change (ΔS^0_{mic}) of micellization per mole of monomer was determined using the relation $\Delta S^0_{mic} = -(\partial \Delta G^0_{mic}/\partial T)_P$ and then standard enthalpy change (ΔH^0_{mic}) of micellization per mole of monomer was calculated as $\Delta H^0_{mic} = \Delta G^0_{mic} + T\Delta S^0_{mic}$. The values of ΔS^0_{mic} and ΔH^0_{mic} obtained thus are always approximate and they are found to be different from the calorimetrically determined values.[32] The values of ΔG^0_{mic}, $\Delta S^0_{\mathrm{mic}}$ and $\Delta H^0_{\mathrm{mic}}$ at 298 K are listed in Table 3.8 and the values at other temperatures are given in Tables 3.9-3.11 . From the values of $\Delta H^0_{\mathrm{mic}}$ and $\Delta S^0_{\mathrm{mic}}$ at 298 K it is clear that micellization becomes less favorable with increasing AA amount mainly due to decrease in entropy change, which in turn is due to decrease in solvophobicity. $\Delta S^0_{\mathrm{mic}}$ was found to become even negative in 50 % AA at temperatures ≤ 303 K and in 60 and 70 % AA at temperatures ≥ 303 K. The type of sign reversal of $\Delta S^0_{\mathrm{mic}}$ found in 60 and 70 % AA was reported in several other systems[32-37] and is attributed to the decrease in the ordering of solvent molecules along the hydrocarbon tail and also to the decrease in the solvation of the hydrophilic head group as the temperature increases. However, the type of sign reversal observed in 50 % AA has not been reported to our knowledge in any other system. In view of the fact that the values of $\Delta S^0_{\mathrm{mic}}$and $\Delta H^0_{\mathrm{mic}}$ are approximate, further investigation is required to establish the type of trend observed for $\Delta S^0_{\mathrm{mic}}$ in 50 % AA. In spite of such unexpected entropy – temperature dependence in 50 % AA, a very good enthalpy – entropy compensation relation has been observed for micellization of SDS in water + AA medium at all concentrations of AA as shown in Fig. 3.13. This relation is given by the expression $\Delta H^0_{\mathrm{mic}} = \Delta H^*_{\mathrm{mic}} + T_c \Delta S^0_{\mathrm{mic}}$, where the slope T_c is known as compensation temperature, which gives a measure of the desolvation part of the micellization process and the intercept $\Delta H^*_{\mathrm{mic}}$ gives a measure of the aggregation of the hydrocarbon tails of surfactants. The value of T_c for SDS in water is found to be 308 K and in water + AA media an average value of 302±2 K was obtained. These values of T_c are comparable with the value 304±3 K reported[38] for sodium alkyl sulfates in aqueous medium. ΔH^{*}_{mic} is interestingly found to have a very good linear relation with ΔG^{0}_{mic} and is given by the expression $\Delta H^{*}_{mic} = 0.93 + 1.03\Delta G^{0}_{mic}$, where values at 298 K are used for ΔG^{0}_{mic}. Thus ΔH^{*}_{mic} indirectly reflects about the free energy change of micellization in conformity with the significance attached to this parameter and, similar to ΔG^{0}_{mic}, ΔH^{*}_{mic} is reported[38] to decrease linearly with increase in the length of the hydrocarbon chain of surfactants.

An attempt has been made to rationalize solvophobic effect in terms of the bulk phase properties by correlating ΔG^{0}_{mic} with dielectric constant (ε) and Gordon parameter. The Gordon parameter is defined as $\gamma/V^{1/3}$, where γ and V represent surface tension and molar volume of the solvent medium, respectively. V was calculated from the measured density values of water + AA system at 298 K. The Gordon parameter has values (Table 3.8) higher than the reported[39] limiting value 1.1 J m^{-3} needed for initiating micellization. ΔG^{0}_{mic} appears to vary almost linearly with Gordon parameter and $1/\varepsilon$ (Fig. 3.14) similar to the observation made by Moya et al [2] in water + formamide medium. As mentioned above (section *3.3.1*), the limiting surface tension at the cmc (γ_{lim}) shows no dependence on the amount of AA. This is a notable observation in view of the fact that the initial values of surface tension of the solvent media (γ_0) are different. This envisages a probable correlation between the ratio of the initial to the limiting surface tension and the solvophobicity of a medium toward a particular surfactant. We, therefore, made an attempt to use the ratio γ_0/γ_{lim} as a new scale to express solvophobicity. In Fig. 3.14, we have shown the plot of ΔG^0_{mic} versus γ_0/γ_{lim} and it is interesting to note that this new solvophobicity index works as good as the Gordon Parameter.

3.3.7 Adsorption Behaviour

Surface excess values of SDS at the air – solvent interface, Γ, were calculated from the surface tension data lying below cmc by using the expression

$$\Gamma = -\,[1/(2RT)]\,[d\gamma/d\ln c] \qquad (3.4)$$

The slope, $d\gamma/d\ln c$, was determined by fitting γ versus lnc data below cmc to a second order polynomial. The values of Γ of SDS as a function of *c* in water + AA media calculated by using the values of $d\gamma/d\ln c$ obtained from the parameters of polynomial fit of γ are shown in Table 3.12. The adsorption isotherms at 25 °C are shown in Fig. 3.15 and the surface excess of SDS decreases with increase in the amount of AA, which may be explained as due to decrease in the solvophobicity of the medium on replacing water by AA. From Fig. 3.15 it can be observed that surface excess attains its maximum value, Γ_{max}, before reaching cmc and the values of Γ_{max} at 25 °C are shown in Fig. 3.16. The value of Γ_{max} for SDS in water is in agreement with the reported[40] value. The adsorption decreases sharply by adding AA and beyond 30 % AA Γ_{max} has negligible dependence on further addition of AA (Fig. 3.16). The Γ_{max} values at different weight % of AA in water are listed in Table 3.13. Almost no variation in Γ_{max} beyond 30 % AA is similar to the observation reported recently by Eastoe and coworkers[3,7] that Γ_{max} of nonionic surfactants in aqueous ethylene glycol medium has no dependence on the glycol amount. The SDS concentration, c_a, at which surface excess attains maximum value, is linearly dependent on cmc (Fig. 3.16) according to the relation c_a (mol kg^{-1}) = 0.9045cmc

– 0.0039. Such type of relation between c_a and cmc was reported[41] for SDS in water in the presence of NaCl. Thus, micellization does not occur immediately after the attainment of saturation in adsorption at the air – solution interface.

The standard free energy of adsorption, ΔG^0_{ad} was calculated using the expression[42]

$$\Delta G^0_{ad} = \Delta G^0_{mic} - \pi_{cmc}/\Gamma_{max} \tag{3.5}$$

where π_{cmc} is the surface pressure at cmc equal to γ_0 - γ_{lim}. The values of ΔG^0_{ad} are given Table 3.8. ΔG^0_{ad} is about 10 kJ less than ΔG^0_{mic} and hence in a surfactant solution adsorption always precedes aggregation. Similar to ΔG^0_{mic}, the value of ΔG^0_{ad} increases by the addition of AA accounting thereby for less adsorption in water + AA medium.

Conclusions

Cmc values of sodium dodecylsulfate in water + AA medium were determined at 20, 25, 30, 35 and 40 °C by the conductance, surface tension and fluorescence (at 25 °C only) methods. This study confirms that cmc of SDS increases with increase in AA amount up to 70 %. The decrease in cmc with increase in AA concentration reported by Akhter[16] in the region of 0 to 13.4 % AA was not observed. The cmc minimum observed for SDS in water at 25 °C disappears on addition of AA and in water + AA medium cmc of SDS instead increases monotonically with increase in temperature from 20 to 40 °C. The conductance method is shown to be applicable to study the micellization of ionic surfactants in water + AA medium even at high amounts of AA unlike the situation in water + alcohol medium.

Standard free energy, entropy and enthalpy of micellization were estimated and they reveal that solvophobicity is a dominant factor in controlling the micellization characteristics. Standard entropy of micellization is found to be negative in 50 % AA at temperatures ≤ 30 °C and in 60 and 70 % AA at temperatures ≥ 30 °C. The type of sign reversal of standard entropy of micellization in 50 % AA is not in accordance with the usual trend and needs further study to establish it. Enthalpy – entropy compensation takes place during micellization. The compensation temperature has values within the range reported for sodium alkyl sulfates.[38]

Counter ion binding constant, surface excess and aggregation number of SDS show decreasing trend with increasing amount of AA up to 30 % and become almost constant beyond 30 % AA. Such changes taking place in the different parameters at around 30 % AA can be correlated to the destruction of the ice-like structure of water and formation of mixed water – AA structures, which were reported[21] to occur above 30 % AA. I_1/I_3 values of pyrene indicate that initially pyrene is solubilized in the micellar core, but moves to the micellar interface at about 30 weight percent AA. The empirical relations proposed by Aguiar et al.[23] for ionic surfactants based on the analysis of I_1/I_3 data are found to be applicable in the present system of study below 20 % AA only.

The values of packing parameter indicate that the SDS micelles in water + AA medium are spherical in shape.

Standard free energy of micellization when plotted versus reciprocal of dielectric constant and Gordon parameter of the water + AA medium exhibit fairly good linear relation. We used the ratio of solvent surface tension to limiting surface tension at the cmc, γ_0/γ_{lim}, as a new scale to express solvophobicity and it has been found that this new scale of solvophobicity works as good as the Gordon Parameter.

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Table 3.1a Specific Conductance (κ) Values of SDS in Acetamide - Water Mixture at 20° C

[SDS] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	κ x 10^4/ S m^{-1}
Wt.% AA = 0					
0.0000	1.0931	2.6031	171.00	9.6768	514.07
0.1569	12.219	3.0488	196.74	10.190	525.25
0.3133	22.689	3.6370	232.41	10.697	537.55
0.4692	33.733	4.2183	266.42	11.198	546.58
0.6246	44.761	4.7928	296.75	11.818	559.50
0.7796	54.842	5.3606	326.56	12.429	570.06
0.9341	65.046	5.9219	359.16	13.032	594.06
1.0881	75.157	6.4768	393.69	14.793	620.51
1.2416	84.509	7.0253	422.06	15.929	642.15
1.3947	95.317	7.5676	443.45	17.037	663.17
1.5474	105.05	8.1038	467.51	18.116	681.43
1.8513	124.57	8.6340	487.82	19.169	703.17
2.1534	143.125	9.1583	501.09		
Wt.% AA = 10					
0.0000	222.43	9.7621	727.31	17.790	959.70
0.8252	268.96	10.435	740.36	19.444	990.86
1.6369	307.68	11.098	757.56	20.246	1025.6
2.4354	350.87	11.751	782.85	21.033	1046.0
3.2211	400.53	12.394	812.90	21.804	1055.2
3.9943	440.24	13.028	824.54	22.810	1089.8
4.7552	483.17	13.653	845.78	23.789	1124.4

Table 3.1a Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 10			
5.5042	526.69	14.270	864.71	24.745	1129.3
6.2415	564.63	14.877	879.98	26.134	1189.2
6.9674	601.05	15.476	896.97	27.472	1219.0
7.6821	643.44	16.067	913.87	29.183	1270.4
8.3860	678.95	16.649	928.64	30.816	1312.5
9.0792	695.95	17.223	939.57	33.129	1372.8
		Wt.% AA = 20			
0.0000	180.08	4.9191	428.05	10.527	706.67
0.3311	199.59	5.2018	440.63	10.989	723.06
0.6589	213.84	5.4818	451.26	11.444	754.73
0.9833	228.94	5.7591	486.12	11.890	771.83
1.3044	244.11	6.0339	506.66	12.329	779.52
1.6223	259.37	6.3060	523.15	13.186	808.25
1.9370	276.60	6.5757	547.73	14.015	835.77
2.2486	292.35	6.9491	566.05	14.817	859.34
2.5571	309.04	7.3176	575.05	15.595	886.15
2.8626	323.80	7.6815	598.42	16.716	914.58
3.1650	340.46	8.0408	609.95	17.787	930.26
3.4645	352.61	8.3956	622.40	18.812	973.66
3.7611	366.51	8.7459	642.83	19.792	998.85
4.0548	379.85	9.0919	653.36	20.731	1020.0
4.3457	397.99	9.5787	679.05		
4.6338	410.43	10.057	703.74		

Table 3.1a Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 30					
0.0000	202.90	9.5894	510.00	26.025	1051.8
0.3147	213.37	10.276	541.06	27.090	1069.3
0.7843	230.66	10.956	554.51	28.136	1088.5
1.2509	247.03	11.630	583.85	29.165	1120.9
1.7146	263.07	12.296	601.46	30.176	1156.4
2.3283	284.25	12.957	619.06	31.170	1179.9
2.7852	294.67	13.871	646.07	32.147	1208.7
3.2393	313.22	14.772	690.18	33.109	1214.0
3.6906	324.82	15.788	721.24	34.055	1254.0
4.1391	339.32	16.789	760.29	35.901	1286.9
4.5849	350.14	18.019	799.95	37.689	1348.1
5.1749	373.04	18.986	824.74	39.421	1399.3
5.7602	387.16	19.939	858.02	41.099	1436.7
6.3407	410.24	20.879	886.76	42.728	1480.8
6.9166	426.48	21.805	923.28	44.307	1517.5
7.4878	444.70	22.717	949.58	48.058	1596.7
8.1953	474.14	23.839	980.94		
8.8959	491.21	24.942	1004.5		
Wt.% AA = 40					
0.0000	326.93	11.557	649.02	21.961	929.49
0.1062	330.27	12.291	669.94	22.948	954.00
0.2120	333.16	13.007	687.07	23.896	979.53
0.4228	339.21	13.705	706.34	24.807	1003.4

Table 3.1a Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt. % AA = 40					
1.0475	358.29	14.387	725.01	25.683	1023.8
1.5597	372.55	15.052	744.18	26.527	1038.2
2.0643	388.89	15.702	759.98	27.733	1070.1
3.0518	414.21	16.337	778.43	28.876	1096.3
4.0112	440.92	16.958	795.05	29.958	1123.9
4.9437	466.94	17.564	811.45	30.986	1146.2
5.8504	492.26	18.157	827.35	31.963	1169.3
6.7323	515.91	18.736	841.50	32.893	1189.7
7.5905	540.32	19.303	860.47	33.779	1210.0
8.4259	563.39	19.858	875.03	34.624	1222.1
9.2394	586.26	20.400	889.60	35.432	1244.2
10.032	608.21	20.932	903.85		
10.804	629.13	21.452	916.16		
Wt.% AA = 50					
0.0000	248.55	4.1548	334.75	23.829	716.85
0.1482	252.24	4.9790	350.97	26.617	767.95
0.2960	255.89	5.9261	369.81	29.249	819.78
0.4435	258.94	6.9896	389.21	31.739	864.31
0.5906	261.74	8.2918	414.97	34.855	922.97
0.8837	268.27	9.5645	439.92	38.458	986.77
1.1754	274.28	10.809	463.57	41.771	1048.3
1.4657	280.75	12.026	487.90	44.829	1099.7
1.7545	286.68	13.216	509.82	48.200	1160.7

Table 3.1a Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 50			
2.0420	293.01	15.520	554.92	51.774	1220.3
2.4707	301.56	17.728	597.69	55.452	1268.5
2.8962	309.66	19.845	637.49	59.534	1337.0
3.4589	319.88	21.877	677.20		
		Wt.% AA = 60			
0.0000	231.65	37.147	789.72	72.367	1261.2
5.7835	316.09	39.191	816.38	76.344	1309.5
8.5647	360.24	41.190	845.09	80.118	1356.5
11.276	405.39	43.147	874.01	84.861	1412.8
13.920	447.21	45.062	900.77	89.301	1466.3
16.499	486.38	46.937	926.30	94.468	1527.6
19.016	524.43	48.774	951.94	101.07	1603.2
21.472	561.55	50.572	976.56	107.84	1679.8
23.870	594.67	52.335	1000.4	121.90	1837.9
26.213	630.36	54.061	1025.4	127.73	1893.5
28.501	663.07	57.413	1068.3	137.59	2003.2
30.736	695.06	60.635	1109.5	149.12	2128.0
32.922	728.43	63.735	1151.7	162.74	2267.3
35.058	758.76	68.170	1204.6		

Table 3.1a Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 70					
0.0000	255.53	42.117	700.91	104.65	1289.4
1.1713	270.08	46.775	753.11	114.06	1367.5
3.4939	296.33	51.316	794.33	122.89	1445.8
5.7900	317.00	55.743	837.09	131.21	1511.1
8.6235	350.02	60.061	876.26	139.06	1574.5
11.417	380.86	64.275	916.05	148.85	1649.0
14.718	414.49	68.386	954.51	160.12	1738.0
17.964	451.14	72.400	991.32	170.44	1816.9
22.210	499.93	76.320	1031.5	181.74	1899.7
27.388	554.88	83.890	1102.4	192.01	1973.0
32.428	604.21	91.120	1160.0	204.32	2057.6
37.336	653.74	98.032	1231.0	217.86	2147.6

Table 3.1b Specific Conductance (κ) Values of SDS in Acetamide - Water Mixture at 25° C

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 0					
0.0000	1.1930	6.4334	489.42	11.106	684.72
0.5061	41.244	6.6561	505.16	11.508	700.81
1.0071	80.299	6.8778	522.24	11.906	711.33
1.5033	118.26	7.0985	539.54	12.302	726.70
1.9946	155.57	7.3182	555.73	12.693	732.27
2.4811	192.37	7.5368	570.80	13.082	748.86
2.9629	229.53	7.7545	583.45	13.467	752.71
3.4401	264.70	7.9711	594.48	13.848	768.79
3.9128	300.56	8.1868	603.28	14.227	775.06
4.3845	329.39	8.4015	612.18	14.602	786.50
4.8446	365.79	8.6152	617.54	14.974	794.89
5.0748	384.03	8.8279	625.64	15.343	800.96
5.3039	401.07	9.0396	634.94	15.709	811.59
5.5319	417.38	9.4603	645.47	16.071	821.00
5.7588	437.81	9.8771	656.49	16.431	824.94
5.9847	452.83	10.290	667.42		
6.2096	471.42	10.700	676.73		

Table 3.1b Continued

[SDS] $\times 10^3$ / mol kg^{-1}	$\kappa \times 10^4$ / S m^{-1}	[SDS] $\times 10^3$ / mol kg^{-1}	$\kappa \times 10^4$ / S m^{-1}	[SDS] $\times 10^3$ / mol kg^{-1}	$\kappa \times 10^4$ / S m^{-1}
		Wt.% AA = 0.30			
0.0000	54.572	4.1909	333.17	10.688	617.78
0.0633	59.478	4.7527	369.08	11.523	642.84
0.1895	70.066	5.3059	404.13	12.427	672.88
0.3780	83.621	5.8507	433.21	13.564	704.30
0.6280	100.89	6.3873	467.25	14.828	736.34
0.8763	118.21	6.9158	503.04	16.043	765.97
1.1230	135.43	7.4366	530.44	17.591	805.35
1.3682	152.31	7.9496	553.42	19.062	843.45
1.8537	184.08	8.4551	567.22	21.137	885.23
2.4520	223.00	8.9533	577.45	23.069	936.43
3.0408	259.17	9.4443	585.22	25.446	997.68
3.6203	296.41	10.024	603.93		
		Wt.% AA = 1.84			
0.0000	53.433	2.3074	208.56	10.652	630.00
0.0613	57.940	2.6298	228.69	11.280	646.97
0.1832	66.434	2.9988	250.96	11.879	661.55
0.3044	74.880	3.4114	278.16	12.454	676.89
0.4248	83.351	3.8642	303.84	13.270	697.35
0.5444	91.696	4.3538	333.54	14.036	715.91
0.6634	99.782	5.2926	387.55	14.988	739.98
0.7815	107.82	6.1811	447.32	16.079	761.29
0.9574	119.28	7.0234	501.77	17.074	784.69

Table 3.1b Continued

[SDS] x10^3 / mol kg^{-1}	**κ x 10^4 / S m^{-1}**	**[SDS] x10^3 / mol kg^{-1}**	**κ x 10^4 / S m^{-1}**	**[SDS] x10^3 / mol kg^{-1}**	**κ x 10^4 / S m^{-1}**
		Wt.% AA = 1.84			
1.1316	131.59	7.8228	541.48	17.984	801.64
1.3042	143.70	8.2075	557.44	18.819	828.39
1.4753	154.74	8.5827	569.66	19.736	854.99
1.6447	166.32	8.9487	582.36	20.704	871.65
1.8126	177.51	9.3058	594.11		
2.0342	191.19	9.9948	614.34		
		Wt.% AA = 5.14			
0.0000	104.72	5.7376	461.26	14.417	757.51
0.0621	108.23	6.1686	489.94	15.461	781.67
0.1856	116.26	6.5874	513.79	16.585	806.26
0.3693	127.91	6.9944	535.02	17.590	829.62
0.6113	143.24	7.3901	552.99	18.494	852.07
0.9092	161.03	7.7749	570.13	19.311	870.78
1.2600	181.86	8.1494	587.97	20.054	889.60
1.6603	206.07	8.5139	597.77	20.731	905.60
2.1066	232.84	9.2146	623.28	21.547	920.90
2.5948	261.86	9.8799	644.42	22.449	940.00
3.1207	292.69	10.817	668.30	23.241	978.94
3.8789	344.12	11.965	695.74		
4.8364	405.91	13.258	731.01		

Table 3.1b Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 10					
0.0000	231.64	6.9290	651.13	15.694	989.54
0.5289	264.70	7.3874	676.83	16.070	1002.4
1.0523	298.65	7.8414	704.85	16.443	1014.1
1.5702	331.50	8.2909	730.04	17.180	1036.8
2.0826	362.59	8.7360	753.72	17.903	1057.0
2.5898	392.72	9.1769	774.66	18.614	1079.5
3.0918	423.22	9.6135	794.79	19.313	1101.1
3.5887	454.43	10.046	809.87	20.000	1121.1
4.0804	484.21	10.474	824.94	20.675	1142.0
4.5672	514.45	10.899	842.14	21.339	1162.3
5.0491	542.47	12.556	894.44	21.992	1181.6
5.5262	570.50	13.760	929.96	22.635	1195.0
5.9984	597.61	14.931	966.98	23.266	1215.2
6.4660	625.25	15.314	978.11		
Wt.% AA =20					
0.0000	217.50	5.4525	453.51	14.238	805.14
0.0895	220.82	6.0972	481.49	15.453	848.36
0.2679	229.65	6.7343	511.31	16.769	887.75
0.5346	241.78	7.3638	535.96	19.297	965.09
0.8881	257.91	7.9859	561.91	22.849	1071.0
1.4143	281.00	8.6007	589.22	27.186	1190.8
1.9356	303.13	9.2083	612.98	32.053	1327.5

Table 3.1b Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 20			
2.4521	325.77	9.8089	636.39	37.210	1464.5
2.9637	348.30	10.403	654.23	42.454	1599.5
3.4706	369.98	10.989	677.59	47.622	1737.4
3.9729	391.39	11.714	723.35	52.599	1874.7
4.4706	413.27	12.428	749.21		
4.9638	438.12	13.271	774.77		
		Wt.% AA = 30			
0.0000	223.11	10.825	651.94	29.436	1282.8
0.3328	236.15	11.821	698.78	30.500	1277.5
0.8292	253.71	12.804	720.74	31.545	1316.0
1.3223	267.11	13.635	754.73	32.572	1338.4
1.6492	282.10	14.997	816.24	33.581	1379.8
2.4601	320.59	16.332	862.78	35.548	1426.7
3.2622	355.46	17.641	918.42	37.448	1521.9
4.0555	388.75	18.924	945.33	39.286	1550.7
4.8403	419.85	20.183	1008.0	41.064	1613.9
5.6166	446.75	21.417	1046.3	42.786	1665.4
6.3846	480.06	22.628	1088.7	44.453	1707.5
7.1443	509.39	23.816	1112.4	46.069	1745.1
7.8961	537.42	24.982	1159.0	49.898	1828.9
8.6399	565.14	26.126	1186.7	53.453	1924.2
9.3758	590.13	27.250	1221.8		
10.104	622.09	28.353	1250.3		

Table 3.1b Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 40					
0.0000	374.33	11.608	752.90	27.093	1213.9
0.2309	385.55	12.406	778.13	27.953	1238.2
0.6881	402.02	13.181	802.33	29.182	1271.5
1.1394	414.53	13.937	826.43	30.342	1302.2
1.6954	432.85	14.673	848.17	31.438	1329.2
2.2425	450.36	15.389	869.50	32.476	1356.3
2.7810	468.44	16.088	890.62	33.777	1389.7
3.3111	484.87	16.769	911.54	34.992	1419.4
3.9363	505.89	17.433	932.56	36.402	1456.7
4.5500	530.58	18.714	972.04	37.704	1487.1
5.3509	556.93	19.934	1007.4	38.911	1516.5
6.3251	586.88	21.098	1042.7	40.032	1544.9
7.2705	617.33	22.210	1075.5	41.076	1568.4
8.1885	646.46	23.272	1107.3	42.050	1593.5
9.0802	675.58	24.289	1136.2	42.963	1615.5
9.9468	701.22	25.263	1162.6	43.818	1635.2
10.789	727.88	26.197	1191.5		
Wt.% AA = 50					
0.0000	293.51	20.158	756.55	46.786	1338.3
0.9232	313.41	22.678	814.76	50.128	1403.4
1.8324	333.22	25.075	869.74	53.182	1454.5
2.9055	357.50	27.358	925.00	57.040	1525.0

Table 3.1b Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 50					
4.1332	385.13	29.535	975.10	61.399	1597.5
5.5054	416.13	31.613	1020.2	65.595	1670.4
7.0112	450.19	33.598	1068.5	70.566	1748.1
8.6388	487.88	35.498	1111.6	76.295	1887.8
10.221	521.92	37.316	1148.8	82.804	1985.1
11.758	554.80	39.059	1184.6	90.261	2093.7
14.710	626.81	41.541	1235.9		
17.505	693.36	43.877	1278.4		
Wt.% AA = 60					
0.0000	269.96	26.924	726.44	71.708	1416.2
0.8377	284.15	30.406	784.28	76.667	1440.8
1.6709	299.76	33.806	827.97	79.073	1469.9
2.9127	321.51	37.127	878.52	81.432	1502.4
4.1449	344.22	40.371	928.97	86.015	1570.5
6.1774	379.60	43.543	975.02	90.425	1622.9
8.1839	411.49	46.643	1031.3	96.737	1702.5
10.165	445.97	49.675	1087.7	102.71	1784.6
12.121	479.39	52.640	1133.9	108.38	1854.3
14.053	508.99	55.541	1174.5	113.75	1903.9
15.96	545.86	58.380	1221.6	120.51	1990.0
18.218	579.70	61.159	1260.5	126.84	2107.7
20.443	620.10	63.879	1306.5		
23.359	669.63	66.543	1341.3		

Table 3.1b Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 70			
0.0000	299.59	41.768	840.68	133.38	1747.8
3.2587	340.77	44.900	873.60	147.17	1887.7
6.4646	382.83	48.991	922.20	159.60	2011.0
9.6189	425.97	53.975	981.79	170.86	2118.4
12.723	471.76	58.818	1028.9	181.11	2221.2
15.778	513.66	63.528	1084.3	192.25	2313.1
18.785	552.63	68.108	1135.6	202.31	2404.3
21.745	589.75	76.904	1241.2	214.29	2505.5
24.659	626.26	85.243	1334.4	227.35	2612.1
27.528	664.92	93.161	1421.5	238.69	2701.7
30.354	700.40	100.69	1501.6	248.62	2783.2
33.137	735.26	107.86	1576.6	257.38	2853.7
35.879	767.26	114.69	1639.2	272.17	2978.4
38.579	802.12	124.35	1648.0		

Table 3.1c Specific Conductance (κ) Values of SDS in Acetamide - Water Mixture at 30° C

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 0			
0.0000	1.6531	7.1566	625.23	12.353	800.96
0.5880	52.497	7.6607	653.56	12.809	811.79
1.1692	99.956	8.1643	676.63	13.483	837.49
1.7439	149.44	8.6627	692.00	14.147	861.87
2.3121	196.92	9.0330	707.38	14.801	876.54
2.8739	243.02	9.4004	718.61	15.446	895.96
3.4295	291.86	9.7649	726.30	16.291	920.14
3.9789	326.52	10.127	740.06	17.120	950.09
4.5223	379.92	10.485	751.55	18.134	975.89
5.0597	424.70	10.842	758.78	19.124	1009.5
5.5969	467.70	11.195	766.46	20.091	1035.6
6.1170	503.27	11.546	779.92		
6.6371	541.26	11.894	791.45		
		Wt.% AA = 10			
0.0000	264.73	7.3289	773.65	12.248	1026.3
0.4630	295.51	7.7268	800.09	12.605	1038.1
0.9218	327.16	8.1212	824.54	12.959	1051.5
1.3763	359.61	8.5123	854.28	13.310	1064.5
1.8267	390.07	8.9001	885.44	14.004	1090.6
2.2730	423.89	9.2846	904.16	14.687	1114.7
2.7153	452.34	9.6659	921.25	15.691	1150.5

Table 3.1c Continued

[SDS] x10^3 / mol kg^{-1}	**κ x 10^4 / S m^{-1}**	**[SDS] x10^3 / mol kg^{-1}**	**κ x 10^4 / S m^{-1}**	**[SDS] x10^3 / mol kg^{-1}**	**κ x 10^4 / S m^{-1}**
Wt.% AA = 10					
3.5879	515.36	10.044	938.86	16.672	1185.6
4.4451	576.77	10.419	954.54	17.630	1256.7
5.2872	633.93	10.791	970.42	18.874	1261.8
6.1145	690.79	11.160	983.78	20.081	1304.1
6.5229	719.12	11.525	997.23		
6.9276	746.94	11.888	1013.2		
Wt.% AA = 20					
0.0000	232.18	9.2437	716.76	25.009	1271.2
0.3049	276.79	10.329	769.37	29.320	1421.6
1.2132	323.61	11.400	817.20	35.326	1609.2
2.4093	381.74	12.718	878.29	42.578	1829.1
3.5884	434.04	14.014	929.73	50.613	2047.5
4.7511	495.61	15.542	985.82	59.011	2298.5
5.8977	554.12	17.040	1035.4		
7.0284	610.12	18.752	1080.2		
8.1437	663.81	20.662	1136.1		
Wt.% AA = 30					
0.0000	266.54	9.9793	700.30	22.319	1218.5
0.8059	299.10	10.541	715.07	23.249	1250.1
1.6032	343.28	11.099	740.36	24.393	1284.8
2.3919	367.28	11.652	775.77	25.516	1342.6
3.1722	403.41	12.200	799.24	26.619	1370.7

Table 3.1c Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 30					
3.9442	441.42	12.745	821.40	27.702	1413.0
4.7081	477.33	13.284	841.94	28.766	1456.2
5.0114	497.79	13.820	866.52	29.812	1494.7
5.3135	510.10	14.351	894.95	30.84	1530.5
5.6143	515.97	14.879	914.07	32.843	1589.7
5.9138	536.51	15.402	936.73	34.779	1633.2
6.2120	547.23	15.921	956.87	36.652	1731.6
6.6571	560.89	16.564	981.86	39.349	1820.4
7.0994	582.44	17.201	1007.1	41.919	1907.3
7.5390	596.90	17.832	1024.5	45.164	2017.3
7.9758	619.87	18.457	1048.3	48.954	2111.0
8.4100	627.76	19.444	1099.5	52.477	2250.3
8.8415	645.16	20.417	1137.6		
9.4127	670.66	21.375	1161.8		
Wt.% AA = 40					
0.0000	426.83	6.3651	652.61	16.041	995.22
0.3739	440.39	6.8626	669.87	17.394	1039.7
0.7453	455.28	7.3554	687.48	18.708	1080.6
1.1142	467.88	7.8436	705.11	19.985	1124.6
1.4807	480.12	8.3272	723.88	21.228	1164.5
1.8447	492.59	8.8062	741.21	23.614	1241.8
2.2062	503.69	9.2808	757.62	25.876	1320.9
2.5654	518.17	9.7510	774.54	28.023	1393.2

Table 3.1c Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 40			
2.9222	531.64	10.217	791.39	30.064	1454.2
3.2767	543.60	10.831	811.45	32.007	1513.7
3.6289	555.94	11.438	834.63	34.753	1593.2
3.9787	567.29	12.038	855.65	37.313	1662.7
4.3263	580.83	12.631	877.09	40.470	1753.5
4.6716	592.31	13.216	897.80	43.366	1832.1
5.0147	604.69	13.938	921.39	46.033	1906.6
5.3555	615.66	14.649	946.51	48.497	1972.2
5.8627	634.32	15.351	968.45		
		Wt.% AA = 50			
0.0000	336.98	33.885	1209.5	60.198	1817.8
2.5140	404.31	36.048	1261.5	64.232	1901.4
4.9256	471.00	38.106	1308.7	67.764	1976.6
7.2410	532.76	40.066	1359.0	69.370	2011.8
9.4658	592.59	41.936	1406.8	85.896	2364.6
11.605	648.98	43.722	1451.3	87.801	2413.5
13.664	702.96	45.428	1492.5	97.186	2593.4
15.647	755.23	47.061	1530.2	108.14	2798.4
18.180	818.64	48.625	1563.9	120.51	3034.7
21.179	896.79	50.124	1597.7	134.14	3305.4
24.008	965.63	51.843	1634.6	148.86	3575.8
26.682	1033.9	53.745	1676.8	164.50	3856.8
29.212	1095.2	55.796	1720.4		

Table 3.1c Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 50			
31.610	1153.3	57.958	1767.1		
		Wt.% AA = 60			
0.0000	311.59	21.436	749.72	47.949	1251.1
0.8332	328.87	23.243	786.23	50.936	1304.3
1.6621	343.00	25.029	821.09	55.296	1384.4
2.8973	369.82	26.793	854.01	60.895	1483.0
4.1231	395.30	28.536	890.42	66.261	1576.8
5.7428	432.53	30.259	923.85	71.411	1669.8
8.1414	483.56	31.962	955.94	76.356	1752.0
10.113	521.45	33.644	987.73	81.108	1833.8
12.059	562.37	35.307	1020.2	85.679	1912.2
13.981	600.41	36.951	1048.4	90.078	1992.6
15.879	638.77	38.577	1081.9	94.316	2055.6
17.754	678.04	41.772	1139.2		
19.606	713.21	44.895	1196.5		
		Wt.% AA = 70			
0.0000	356.40	30.484	849.32	86.230	1651.2
1.3706	364.75	32.815	883.25	94.455	1748.0
2.7318	382.43	35.117	915.77	105.27	1915.5
5.4263	442.69	37.390	958.15	116.72	2078.7
8.0845	482.71	39.635	986.44	129.84	2124.8
10.707	531.98	41.852	1020.3	141.79	2253.8

Table 3.1c Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 70					
13.294	580.51	44.042	1057.0	162.77	2540.0
15.848	611.62	48.342	1158.1	180.58	2638.1
18.367	662.36	52.539	1178.4	195.89	2777.9
20.854	699.11	56.637	1230.3	209.19	2911.0
23.308	740.39	62.605	1297.3	220.86	3002.7
25.731	776.63	68.369	1375.8	231.17	3073.9
28.123	812.37	77.547	1536.2		

Table 3.1d Specific Conductance (κ) Values of SDS in Acetamide - Water Mixture at 35° C

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 0			
0.0000	1.7035	6.1861	547.13	12.462	880.69
0.5820	53.954	6.5720	578.09	13.134	900.51
1.1574	106.92	6.9548	608.94	12.796	921.25
1.7263	158.34	7.3345	640.10	14.448	947.56
2.2888	208.64	7.7112	671.67	15.303	973.15
2.5677	232.17	8.0850	702.53	16.141	1000.8
2.8451	258.76	8.4557	730.95	16.963	1026.2
3.1209	280.12	8.8236	744.81	17.769	1052.7
3.3952	302.84	9.1886	770.21	18.756	1088.0
3.8038	341.87	9.5508	787.00	19.720	1123.5
4.2090	374.83	9.9101	799.34	20.662	1151.6
4.6109	408.75	10.385	809.87	21.583	1181.4
5.0096	442.57	10.855	825.35	22.483	1209.7
5.4049	478.93	11.320	841.94	23.363	1239.3
5.7971	510.10	11.780	853.37		
		Wt.% AA =10			
0.0000	294.60	10.283	1046.9	18.651	1416.3
1.0796	380.51	10.720	1089.5	19.721	1458.8
2.1362	463.03	11.153	1110.4	20.763	1498.3
3.1705	541.34	11.582	1141.2	21.778	1535.7
4.1800	617.64	12.427	1160.3	22.768	1580.3

Table 3.1d Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 10			
5.1750	691.70	12.844	1179.2	24.049	1615.4
6.1464	763.73	13.257	1196.2	24.983	1654.4
6.6247	799.24	13.666	1215.7	25.894	1693.3
7.0982	833.24	14.071	1230.3	26783	1722.7
7.5669	868.75	14.472	1248.0	27.651	1760.0
8.0309	902.34	14.869	1263.1	28.499	1793.5
8.4903	936.61	15.653	1295.6	29.327	1824.6
8.9451	969.01	16.423	1325.5	30.402	1871.2
9.3955	997.94	17.179	1357.4		
9.8414	1024.6	17.921	1387.6		
		Wt.% AA = 20			
0.0000	269.68	9.5750	796.82	19.810	1263.2
0.3862	292.78	10.380	836.30	20.723	1299.4
0.7697	315.00	11.173	874.48	21.870	1338.0
1.3401	346.41	11.953	916.01	23.721	1408.4
1.9048	376.53	12.722	950.10	26.645	1516.8
2.6488	422.74	13.479	999.27	30.943	1672.5
3.5649	473.07	14.224	1028.6	35.749	1839.1
4.4660	521.40	14.959	1075.2	40.821	2006.0
5.3523	569.75	15.683	1096.0	45.956	2170.8
6.2242	616.96	16.537	1136.9	50.996	2338.5
7.0821	662.33	17.376	1174.9	55.830	2498.2
7.9263	707.73	18.201	1201.0	60.386	2664.3

Table 3.1d Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 20					
8.7572	751.98	19.012	1233.8		
Wt.% AA = 30					
0.0000	307.61	10.717	834.86	24.189	1433.4
0.8202	348.57	11.424	868.24	25.337	1493.8
1.6315	394.92	12.124	889.39	26.464	1567.1
2.4339	434.63	12.817	940.38	27.570	1601.1
3.2276	466.58	13.503	968.40	28.657	1652.1
4.0129	506.76	14.182	1000.2	29.724	1701.4
4.7897	553.60	14.854	1025.2	30.773	1733.6
5.5582	585.98	15.519	1060.5	31.804	1771.4
6.0155	615.92	16.178	1094.9	32.816	1806.4
6.4698	640.61	16.831	1113.1	34.790	1855.4
6.9212	658.31	17.477	1136.5	36.699	2055.1
7.3699	682.70	18.117	1169.6	39.445	2146.8
7.8156	704.55	18.750	1208.4	42.060	2231.4
8.2586	719.93	19.378	1240.7	44.554	2336.1
8.6989	743.40	20.369	1286.5	49.209	2492.9
9.1364	762.22	21.346	1334.1	52.783	2599.6
9.5711	782.15	22.308	1367.5		
10.147	808.05	23.256	1398.3		

Table 3.1d Continued

[SDS] x10^{3} / mol kg^{-1}	κ x 10^{4} / S m^{-1}	[SDS] x10^{3} / mol kg^{-1}	κ x 10^{4} / S m^{-1}	[SDS] x10^{3} / mol kg^{-1}	κ x 10^{4} / S m^{-1}
		Wt.% AA = 40			
0.0000	500.69	8.3666	869.50	23.712	1510.4
0.5477	524.43	9.1097	900.47	25.730	1581.8
1.0920	548.73	9.8462	932.77	27.690	1651.8
1.6328	572.62	10.576	964.35	29.609	1720.1
2.1703	598.46	11.299	992.96	31.473	1780.3
2.7044	623.28	12.016	1021.3	35.059	1893.8
3.2352	647.38	12.727	1051.6	38.468	2008.7
3.7626	669.94	13.665	1087.5	41.712	2106.3
4.2868	692.60	14.592	1124.3	46.297	2243.4
4.8078	717.21	15.508	1197.0	50.572	2366.1
5.3256	738.85	16.414	1231.9	55.844	2524.3
5.8402	762.64	17.309	1267.2	61.829	2693.3
6.3517	785.72	18.414	1306.8	67.232	2850.8
6.8600	806.74	19.503	1350.7	76.606	3117.1
7.6167	838.63	21.637	1431.4	84.456	3350.3
		Wt.% AA = 50			
0.0000	380.89	47.158	1896.2	105.25	3338.0
4.9558	542.50	51.596	2014.7	116.65	3588.7
9.8559	703.42	55.987	2138.2	127.73	3841.0
14.701	869.64	60.331	2262.4	138.48	4064.4
19.493	1025.7	64.630	2379.1	148.93	4287.7
24.231	1172.9	68.883	2489.4	162.41	4568.4

Table 3.1d Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 50					
28.917	1314.3	73.092	2591.2	178.57	4903.0
33.552	1482.7	81.380	2796.4	194.02	5190.5
38.137	1618.7	89.499	2985.4		
42.672	1741.7	97.454	3165.0		
Wt.% AA =60					
0.0000	358.08	21.568	859.75	47.785	1422.6
1.6433	395.30	23.472	894.52	50.937	1488.9
3.2698	435.32	25.351	939.64	54.776	1562.8
4.8799	475.61	27.207	979.94	58.507	1633.6
6.4736	514.07	29.040	1023.5	62.135	1704.8
8.0514	551.50	30.850	1062.3	69.097	1837.5
9.6133	586.26	32.638	1103.3	75.694	1970.2
11.160	623.59	34.403	1142.4	81.953	2079.9
12.691	660.20	36.580	1188.0	87.900	2191.7
14.207	694.85	38.724	1233.2	93.558	2299.0
15.708	730.65	40.836	1276.4	101.55	2434.2
17.687	775.05	42.916	1318.3	108.99	2569.1
19.640	814.63	45.372	1372.0	115.95	2646.3

Table 3.1d Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 70			
3.9335	570.10	96.373	1952.7	205.57	3270.6
7.8158	628.55	109.94	2131.7	213.94	3347.4
11.648	711.37	122.80	2350.4	223.53	3444.1
19.165	833.19	135.00	2485.4	232.65	3537.0
30.087	1001.1	146.59	2607.2	242.74	3634.5
40.605	1163.6	157.62	2722.3	252.30	3725.8
50.743	1311.8	168.12	2843.0	262.61	3822.0
60.519	1458.7	178.13	2977.9	273.51	3933.5
73.024	1632.3	187.69	3159.8	284.82	4032.2
84.963	1795.6	196.83	3206.3		

Table 3.1e Specific Conductance (κ) Values of SDS in Acetamide - Water Mixture at 40° C

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 0			
0.0000	2.2604	5.7294	558.26	8.9963	840.52
0.5032	52.467	6.1781	599.13	9.4153	860.35
1.0015	102.11	6.6227	643.64	9.8305	881.80
1.4950	150.97	7.0632	682.59	10.242	899.50
1.9837	199.55	7.2819	704.65	10.853	924.19
2.4677	247.16	7.4996	725.49	11.455	948.57
2.9470	294.26	7.7163	746.74	12.246	977.51
3.4218	340.41	7.9321	764.64	13.024	1003.9
3.8921	385.37	8.1469	782.75	13.788	1037.2
4.3579	429.11	8.3607	801.17	14.725	1068.3
4.8194	473.43	8.5735	815.13	15.643	1103.8
5.2765	515.87	8.7854	830.20		
		Wt.% AA = 10			
0.0000	327.17	9.7530	1148.8	18.380	1553.7
0.8924	410.30	10.481	1201.8	18.975	1581.2
1.7691	483.89	11.197	1230.2	19.563	1593.0
2.6304	560.68	11.901	1275.8	20.142	1633.4
3.4767	634.68	12.595	1310.7	20.712	1657.1
4.3085	704.85	13.278	1344.6	21.275	1687.4
5.1261	773.24	13.950	1377.9	22.376	1732.9
5.9299	842.75	14.612	1409.8	23.447	1778.4
6.7202	910.94	15.264	1439.1	24.999	1851.2
7.4973	975.18	15.906	1468.4	26.490	1915.9

Table 3.1e Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 10			
8.2616	1038.6	17.161	1492.8	28.848	1979.2
9.0134	1097.8	17.775	1520.8	31.059	2082.7
		Wt.% AA = 20			
0.0000	298.73	8.9584	875.99	23.037	1637.1
0.5402	334.29	9.4125	904.50	24.356	1698.2
1.0750	368.00	9.8624	933.11	25.636	1752.6
1.6045	402.46	10.308	962.33	26.876	1800.3
2.1287	436.68	10.750	992.56	28.080	1857.6
2.6478	471.48	11.188	1020.8	29.248	1906.7
3.1617	504.66	11.622	1047.5	30.382	1952.2
3.6707	536.81	12.052	1075.0	31.484	1999.5
4.1747	567.35	12.478	1101.9	32.555	2046.7
4.6739	600.83	13.319	1153.5	33.596	2093.7
5.1682	634.21	14.145	1201.1	35.104	2156.7
5.6579	666.88	14.957	1255.3	36.553	2216.2
6.1428	698.23	15.755	1297.6	37.486	2255.7
6.6232	728.57	16.539	1325.7	38.396	2311.1
7.0991	757.69	17.310	1368.2	39.282	2363.6
7.5704	788.63	18.813	1481.8	40.569	2397.4
8.0374	818.26	20.267	1515.9	41.809	2448.4
8.5000	850.01	21.674	1579.1	43.392	2506.7
		Wt.% AA = 30			
0.0000	337.03	9.3169	844.49	22.200	1541.2
0.6186	373.45	9.8607	869.99	23.093	1601.1

Table 3.1e Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 30			
1.2321	405.32	10.400	901.16	24.842	1683.5
1.8405	435.01	10.936	930.40	25.699	1733.5
2.4439	468.99	11.467	959.60	26.543	1778.6
3.0424	502.97	12.308	1004.9	28.199	1858.8
3.6360	536.77	13.140	1047.7	29.810	1937.2
4.2248	567.97	13.961	1096.1	31.378	2005.2
4.8089	596.63	14.772	1124.7	32.906	2108.8
5.3882	631.76	15.574	1168.8	35.125	2203.8
5.9630	663.30	16.563	1237.8	37.260	2295.0
6.5331	690.27	17.537	1290.5	39.317	2378.8
7.0987	721.54	18.497	1346.8	41.299	2463.2
7.6598	751.23	19.443	1396.2	43.833	2547.8
8.2166	782.23	20.375	1454.2	46.251	2660.3
8.7689	811.85	21.294	1483.8	49.121	2764.9
		Wt.% AA = 40			
0.0000	557.51	8.0293	951.53	22.238	1592.3
0.5088	582.88	8.7225	986.61	24.152	1679.4
1.0146	608.92	9.4099	1018.0	26.018	1760.2
1.5174	633.23	10.092	1052.3	27.837	1835.3
2.0173	657.84	10.768	1081.5	29.612	1905.9
2.5144	682.35	11.438	1114.2	31.345	1977.3
3.0085	701.11	12.103	1145.8	36.300	2166.8
3.4998	727.98	12.762	1176.4	39.415	2283.7
3.9882	751.57	13.633	1214.7	43.831	2429.1

Table 3.1e Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% AA = 40			
4.4739	775.46	14.495	1252.4	47.965	2584.7
4.9568	800.48	15.347	1292.7	53.083	2747.9
5.4369	825.09	16.190	1329.5	58.920	2954.5
5.9143	847.65	17.232	1375.6	64.216	3143.2
6.6253	883.85	18.259	1423.5	73.461	3444.8
7.3303	918.00	20.275	1507.2	81.260	3669.1
		Wt.% AA = 50			
0.0000	431.78	27.712	1475.9	76.208	3039.8
0.5958	452.28	31.054	1597.0	81.147	3183.6
1.3097	487.77	34.369	1710.8	86.026	3317.4
2.1411	527.74	37.658	1822.4	91.802	3470.1
3.0893	571.85	40.921	1932.2	98.435	3650.3
4.1536	617.81	44.160	2037.1	105.88	3856.3
5.3331	657.87	47.373	2141.4	114.09	4072.2
6.5094	703.02	50.561	2245.8	123.00	4293.2
8.2679	777.34	53.725	2360.5	140.22	4716.4
10.602	867.03	56.865	2460.0	164.62	5331.9
14.079	991.98	59.981	2549.4	194.75	6043.2
17.528	1109.6	63.074	2653.1	229.00	6773.9
20.950	1229.9	67.161	2777.5		
24.344	1346.0	71.207	2891.4		
		Wt.% AA = 60			
0.0000	403.86	38.031	1324.5	79.909	2206.7
4.1859	510.85	41.414	1397.1	87.562	2353.6

Table 3.1e Continued

[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% AA = 60					
8.2791	611.59	44.729	1473.7	94.826	2475.3
12.283	713.83	47.978	1550.0	106.15	2708.0
16.200	809.80	51.165	1621.7	116.59	2876.7
20.033	903.03	54.289	1697.4	126.25	3048.6
23.785	991.63	57.354	1751.3	135.21	3225.5
27.459	1078.6	63.311	1877.8	151.32	3491.7
31.056	1167.3	69.048	1992.6	165.40	3762.5
34.579	1246.5	74.577	2111.1		
Wt.% AA = 70					
0.0000	574.82	38.387	1297.5	129.21	2673.8
3.1868	639.58	46.394	1430.4	144.04	2864.2
6.3317	705.77	56.632	1592.8	159.13	3054.2
9.4357	767.52	66.400	1746.7	172.93	3207.6
12.500	829.18	77.998	1909.7	185.60	3352.2
18.510	940.46	88.967	2080.4	197.27	3487.3
24.368	1052.2	101.37	2279.9	218.07	3693.2
30.080	1153.5	114.89	2475.9	236.04	3961.5

Table 3.2a Surface Tension (γ) Values of SDS in Acetamide - Water Mixture at 20° C

[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}
		Wt.% AA = 0			
0	72.8	4.1479	41.2	7.9721	35.8
0.2055	71.8	4.3370	37.0	8.1467	38.2
0.4101	69.9	4.5254	38.0	8.3208	38.3
0.6139	66.8	4.7131	40.8	8.4942	38.5
0.8169	64.1	4.9001	39.7	8.6669	38.6
1.0191	61.4	5.0863	39.1	8.8390	38.8
1.2205	58.8	5.2718	38.3	9.0105	38.7
1.4211	56.8	5.4567	38.1	9.1813	39.1
1.6209	54.7	5.6408	37.7	9.3516	39.1
1.8199	53.2	5.8242	36.9	9.5212	38.9
2.0181	51.7	6.0069	36.7	9.6901	39.0
2.2155	50.6	6.1889	36.2	9.8585	39.2
2.4122	49.4	6.3703	35.5	10.026	38.7
2.6081	48.3	6.5510	35.5	10.360	38.6
2.8032	47.1	6.7309	35.8	10.691	38.7
2.9975	46.2	6.9102	34.9	11.020	38.8
3.1911	45.1	7.0889	34.4	11.347	38.7
3.3840	44.7	7.2668	34.7	11.671	38.7
3.5761	43.7	7.4441	33.8	11.993	38.8
3.7674	43.2	7.6208	34.1	12.312	38.7
3.9580	42.3	7.7967	35.0		

Table 3.2a Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% AA = 10					
0	65.6	4.5802	37.5	8.7747	38.8
0.5954	53.4	5.1246	37.0	9.7687	39.6
1.1841	48.7	5.6631	36.2	10.258	39.7
1.7661	45.4	6.1957	35.5	10.742	39.9
2.3416	42.8	6.7226	34.7	11.459	40.1
2.9106	41.1	7.2439	34.4	12.165	40.4
3.4734	39.9	7.7596	35.6	12.861	40.3
4.0299	39.1	8.2698	37.4		
Wt % of AA = 20					
0	57.7	4.4969	40.0	10.246	35.3
0.1928	51.7	4.8297	39.7	10.788	36.1
0.3844	49.8	5.1588	39.6	11.319	37.1
0.5749	49.1	5.4843	39.1	11.839	39.0
0.7643	48.2	5.8063	38.6	12.350	39.7
0.9525	48.0	6.1247	38.0	12.850	40.2
1.3257	46.3	6.4398	37.8	13.342	40.9
1.6945	45.1	6.7514	37.5	13.823	41.2
2.0590	44.0	7.2127	37.5	14.296	41.2
2.4194	43.6	7.6666	37.0	14.761	41.3
2.7755	43.1	8.1134	36.5	15.216	41.3
3.1277	42.1	8.5532	36.3	15.664	41.5
3.4758	41.8	8.9862	36.0	16.103	41.4

Table 3.2a Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% AA = 20			
3.8200	41.1	9.4126	35.5	16.534	41.5
4.1603	40.6	9.8325	35.2		
		Wt.% AA = 30			
0	51.7	7.1694	40.5	18.916	40.6
0.1432	49.1	7.9008	39.8	19.651	40.8
0.2860	48.8	8.6205	39.2	20.372	41.5
0.4283	48.2	9.3285	39.1	21.255	41.3
0.5702	47.7	10.025	38.6	22.118	41.7
0.8528	47.1	10.711	38.0	23.457	41.8
1.4130	46.2	11.386	37.8	24.750	42.1
1.6907	45.8	12.050	37.8	25.998	42.0
1.9668	45.2	12.705	37.5	27.498	42.1
2.5141	44.8	13.349	37.2	28.936	42.0
3.0552	43.7	13.983	37.1	30.315	42.0
3.5900	43.2	14.608	37.5	31.639	42.0
4.1188	42.4	15.223	37.3	32.911	41.9
4.6416	42.0	15.829	37.9	35.312	41.8
5.1585	41.4	16.426	38.4	37.539	42.1
5.6696	41.2	17.015	39.0	37.594	41.9
6.1751	40.9	17.595	39.6		
6.6750	40.4	18.166	40.0		

Table 3.2a Continued

[SDS] x10^3/ mol kg^{-1}	**γ / mN m^{-1}**	**[SDS] x10^3/ mol kg^{-1}**	**γ / mN m^{-1}**	**[SDS] x10^3/ mol kg^{-1}**	**γ / mN m^{-1}**
Wt.% AA = 40					
0	57.7	2.0302	47.3	14.705	39.6
0.0232	54.4	2.2486	47.2	16.123	39.5
0.0464	54.0	2.5735	46.7	17.470	39.4
0.0928	53.3	2.8954	46.3	18.752	39.5
0.1391	52.9	3.3199	45.8	19.974	39.9
0.1853	52.4	3.7391	45.6	21.139	40.4
0.2315	52.1	4.3581	45.1	22.252	41.1
0.3007	51.7	4.9658	44.3	23.316	41.1
0.3697	51.5	5.5623	43.8	24.333	41.2
0.4615	50.9	6.1482	43.5	25.308	41.5
0.5759	50.5	6.7235	43.2	26.243	41.7
0.6900	50.1	7.4748	42.8	28.000	42.0
0.8264	49.8	8.2087	42.3	29.624	42.0
0.9622	49.3	9.1022	42.0	31.586	42.2
1.1425	49.1	9.9705	41.7	37.574	42.3
1.3666	48.7	10.981	41.2	44.773	42.0
1.5892	48.3	11.958	40.8	48.955	42.1
1.8104	47.9	13.211	40.0	53.632	41.9
Wt.% AA = 50					
0	53.5	0.9664	51.3	15.361	43.7
0.0163	53.0	1.2842	50.9	16.726	43.6
0.0244	53.1	1.9138	50.0	18.477	43.2
0.0325	53.1	2.8430	49.2	20.562	42.7

Table 3.2a: Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% AA = 50			
0.0455	53.2	3.7543	48.7	22.541	42.3
0.0650	53.1	4.9425	48.0	26.209	41.9
0.0975	52.9	6.1012	47.4	29.537	41.5
0.1300	52.5	7.5095	46.1	32.570	41.5
0.1948	52.6	8.8753	45.5	36.647	41.5
0.2596	52.6	10.201	45.0	41.352	41.6
0.3566	52.4	11.487	44.4	46.306	41.6
0.4856	52.0	12.736	44.5	51.944	41.5
0.7105	51.8	13.950	44.3	57.047	41.5
		Wt.% AA = 60			
0	53.1	6.8096	50.0	36.469	44.0
0.0578	53.1	9.0239	49.6	41.099	43.3
0.1156	53.0	11.211	48.9	45.601	42.8
0.2311	53.0	13.372	48.4	49.981	42.3
0.4619	52.6	15.507	47.7	55.084	41.9
0.8076	53.0	17.617	47.2	60.025	41.8
1.3823	52.6	19.702	46.8	66.377	41.2
2.2981	52.0	21.761	46.4	73.9587	41.2
3.4365	51.4	24.806	46.0	100.832	41.2
4.5678	50.8	27.798	45.4	117.979	41.0
5.6922	50.4	31.707	44.4	142.152	40.8

Table 3.2a Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% AA = 70			
0	51.5	6.1926	49.0	63.552	40.5
0.1258	51.4	7.4083	48.6	72.243	40.0
0.2514	51.1	9.2180	48.3	80.498	39.7
0.3770	51.0	11.011	47.9	95.830	39.2
0.6280	51.0	13.377	47.0	109.77	39.3
1.0038	51.1	15.714	46.7	122.49	39.3
1.5038	51.0	19.168	45.8	139.63	39.1
2.0026	50.8	23.677	45.3	154.79	39.2
2.5001	50.7	29.168	44.2	176.52	39.3
3.1203	50.7	36.592	43.3	194.73	39.2
3.9854	50.0	44.723	42.4		
4.9694	49.6	54.392	41.2		

Table 3.2b Surface Tension (γ) Values of SDS in Acetamide - Water Mixture at 25° C

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% AA = 0					
0	72.0	3.4479	46.7	7.1676	36.0
0.1745	70.9	3.9060	45.1	7.3001	36.0
0.3479	68.5	4.0568	44.6	7.4319	35.7
0.5202	67.6	4.2069	43.9	7.5630	36.4
0.6914	65.7	4.3560	43.4	7.6934	36.9
0.8616	64.1	4.5043	42.8	7.8231	37.4
1.0307	62.8	4.6518	42.0	7.9520	37.9
1.1988	61.1	4.7983	41.5	8.0803	38.2
1.3658	59.8	4.9441	40.8	8.2079	38.4
1.5319	58.8	5.0890	40.5	8.3348	38.5
1.6969	57.2	5.2331	40.1	8.5866	38.7
1.8609	56.0	5.3764	39.4	8.8357	38.7
2.0239	54.9	5.5189	38.8	9.2045	38.7
2.1860	54.1	5.6605	38.6	9.5676	38.8
2.3470	53.1	5.8014	38.3	9.9250	38.8
2.5071	52.0	5.9414	37.9	10.277	38.7
2.6663	50.9	6.0807	37.6	10.623	38.8
2.8245	50.1	6.2193	37.5	10.965	38.8
2.9817	49.3	6.3570	37.3	11.301	38.7
3.1380	48.5	6.4940	36.8	11.632	38.7
3.2934	47.5	6.7657	36.4	11.958	38.8
3.6015	46.0	6.9004	36.2	12.280	38.7

Table 3.2b Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt % AA = 0					
3.7542	45.5	7.0344	36.0	12.597	38.8
Wt % AA = 0.30					
0	71.2	1.0871	58.4	9.8866	38.5
0.0197	70.9	1.4679	54.2	10.773	38.6
0.0394	70.5	2.0321	50.6	11.777	38.3
0.0787	70.7	2.7714	46.5	12.888	38.4
0.1376	70.3	3.6752	41.5	14.226	38.5
0.2160	69.2	4.7312	37.1	16.739	38.2
0.3138	67.1	5.9255	33.9	20.154	38.3
0.4308	65.2	6.7546	32.0	24.148	38.1
0.5668	63.6	7.5647	33.6	29.189	38.3
0.7217	61.8	8.3563	37.6		
0.8952	59.8	9.1301	38.3		
Wt % AA = 1.84					
0	70.6	1.3931	50.8	6.6223	32.0
0.0048	70.1	1.8354	47.2	6.8844	32.0
0.0145	70.5	2.3524	44.3	7.2060	33.4
0.0289	69.9	2.9374	41.5	7.5834	35.6
0.0481	69.4	3.5037	39.3	8.0123	37.6
0.8653	67.7	4.0523	36.8	8.4882	38.6
0.1344	66.9	4.5840	35.4	9.0061	38.9
0.1918	64.5	5.0995	34.3	9.5609	39.0

Table 3.2b Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt % AA = 1.84			
0.2584	63.1	5.5996	33.3	10.610	39.1
0.3343	61.9	5.7397	32.9	12.049	39.1
0.4288	60.5	5.8787	33.0	13.751	39.0
0.5696	58.3	6.0165	32.9	15.594	39.1
0.7558	56.2	6.2210	32.6	17.472	39.0
1.0316	53.3	6.4229	32.3		
		Wt % AA = 5.14			
0	68.8	0.6200	56.7	6.6046	33.2
0.0045	68.8	0.8791	54.5	7.1900	34.1
0.0135	68.2	1.2187	51.6	7.7521	36.9
0.0270	67.9	1.6339	49.2	8.2924	38.4
0.0450	68.0	2.1191	46.6	9.3123	39.3
0.0720	67.4	2.6679	43.9	9.7941	39.4
0.1078	66.2	3.2734	41.7	10.259	39.5
0.1615	64.7	3.9285	39.4	11.139	39.7
0.2328	63.7	4.6259	37.5	12.350	39.6
0.3216	60.7	5.3582	35.8	13.790	39.7
0.4451	59.0	5.9946	34.1	15.356	40.0
		Wt.% AA = 10			
0	56.0	4.7220	39.2	9.0187	39.1
0.2907	52.6	4.9859	38.9	9.2594	39.5
0.5796	49.7	5.2484	38.4	9.4989	39.9

Table 3.2b Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% AA = 10			
0.8670	48.0	5.5094	38.3	9.7371	39.9
1.1526	47.3	5.7690	38.1	9.9740	39.9
1.4366	45.9	6.0272	37.4	10.210	40.2
1.7190	44.8	6.2840	37.3	10.444	40.3
1.9998	44.1	6.5393	36.8	10.678	40.3
2.2790	43.3	6.7933	36.4	10.910	40.5
2.5566	42.8	7.0459	36.1	11.140	40.5
2.8326	42.4	7.2972	35.8	11.370	40.5
3.1071	42.6	7.5471	35.9	11.826	40.6
3.3800	42.1	7.7957	35.9	12.277	40.6
3.6514	41.5	8.0429	36.5	12.724	40.6
3.9213	40.8	8.2888	37.0	13.166	40.6
4.1897	40.4	8.5334	37.9	13.603	40.6
4.4566	39.7	8.7767	38.5		
		Wt.% AA = 20			
0	55.7	4.2425	41.2	10.149	35.9
0.0986	53.3	4.5851	40.6	10.427	36.0
0.1968	52.4	4.9239	40.3	10.704	36.3
0.2948	51.8	5.2589	40.0	11.112	36.7
0.3925	51.3	5.5902	39.6	11.515	37.9
0.5869	50.0	5.9177	39.2	12.043	38.7
0.7802	49.1	6.2416	38.8	12.432	39.5

Table 3.2b Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% AA =20			
0.9723	48.6	6.5620	38.5	12.815	40.2
1.1633	47.8	6.8789	38.1	13.317	40.6
1.3531	47.0	7.1923	37.9	13.809	40.9
1.5418	46.6	7.5023	37.6	14.292	40.8
1.7293	45.9	7.8090	37.2	14.766	40.8
1.9158	45.4	8.1124	36.8	15.231	41.2
2.1011	45.1	8.4126	36.6	15.688	41.2
2.4685	44.5	8.7096	36.4	16.136	41.2
2.8316	43.8	9.0034	36.3	16.576	41.2
3.1905	43.0	9.2942	36.2	17.008	41.3
3.5452	42.4	9.5820	36.0	17.221	41.2
3.8958	42.0	9.8667	35.8		
		Wt % AA = 30			
0	51.5	6.2423	41.1	16.981	37.8
0.1449	49.0	6.9976	40.9	17.568	38.1
0.2893	48.4	7.7403	40.6	18.147	38.4
0.4333	47.6	8.4709	40.3	18.717	38.9
0.5768	47.3	9.1895	39.9	19.278	39.2
0.7200	46.9	9.8965	39.5	19.832	39.8
0.8627	46.5	1.0.592	39.1	20.378	40.1
1.1468	46.2	11.277	38.7	21.094	40.8
1.4293	46.0	11.951	38.3	21.797	41.1

Table 3.2b Continued

[SDS] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ/ mN m^{-1}
Wt % of AA = 30					
1.7101	45.6	12.614	38.0	24.804	41.6
2.5426	44.7	13.267	37.8	25.753	41.7
2.8169	44.3	13.910	37.6	26.678	41.7
3.3607	43.7	14.543	37.4	29.592	41.7
3.8982	43.1	15.166	37.3	32.274	41.7
4.6930	42.1	15.780	37.4	33.622	41.6
5.4742	41.6	16.385	37.4	34.842	41.7
Wt % of AA = 40					
0	55.9	3.6935	47.2	15.358	40.6
0.0637	54.4	3.9902	46.9	16.061	40.4
0.1272	54.0	4.2853	46.6	16.755	40.4
0.1907	53.6	4.5787	46.5	17.438	40.2
0.2542	53.0	4.8706	46.3	18.111	40.1
0.3175	52.8	5.4494	45.7	18.774	40.2
0.4124	52.4	6.0220	45.5	19.428	40.2
0.5071	52.4	6.5883	45.2	20.073	40.3
0.6332	51.8	7.1486	44.8	20.709	40.5
0.7904	51.7	7.7029	44.4	21.749	40.8
0.9471	51.3	8.2513	43.9	22.765	41.1
1.1034	50.9	8.7938	43.7	23.759	41.1
1.2592	50.7	9.3307	43.2	24.730	41.2
1.4146	50.3	9.8619	42.8	26.609	41.4
1.5695	50.0	10.388	42.4	28.407	41.6

Table 3.2b Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt % of AA = 40			
1.7549	49.8	10.908	42.2	30.130	41.6
1.9396	49.4	11.423	42.1	39.239	41.8
2.1849	48.9	12.437	41.8	50.370	41.9
2.4900	48.7	12.936	41.6	55.347	41.8
2.7934	48.5	13.430	41.4	62.405	41.9
3.0952	48.0	13.919	41.2	68.150	41.9
3.3952	47.5	14.644	40.9		
		Wt % of AA = 50			
0	53.8	0.9464	51.3	20.201	43.2
0.0080	53.8	1.2578	50.8	22.152	42.7
0.0159	53.8	1.5672	50.3	24.007	42.3
0.0319	53.7	2.1800	49.8	25.772	41.9
0.0637	53.7	2.7851	49.4	27.455	41.9
0.0955	53.5	3.6784	48.4	30.594	41.4
0.1273	53.2	4.5550	48.1	33.464	41.1
0.1590	53.0	5.6987	47.5	36.097	41.1
0.2225	52.9	7.3622	46.8	39.664	40.9
0.2542	53.1	8.7032	46.3	43.821	41.0
0.3175	52.8	10.260	46.2	48.245	41.1
0.4124	52.1	11.764	45.5	51.995	41.1
0.5071	52.1	13.690	45.0	55.213	41.0
0.6330	51.8	15.979	44.3		
0.7900	51.4	18.146	43.7		

Table 3.2b Continued

[SDS] $\times 10^3$ / mol kg^{-1}	γ / mN m^{-1}	[SDS] $\times 10^3$ / mol kg^{-1}	γ / mN m^{-1}	[SDS] $\times 10^3$ / mol kg^{-1}	γ / mN m^{-1}
		Wt % of AA = 60			
0	52.8	2.8512	51.2	36.304	43.2
0.0361	52.5	4.2497	51.0	41.242	42.8
0.0722	52.6	6.3148	50.0	45.927	42.2
0.1443	52.6	9.6716	49.2	54.612	41.7
0.2884	52.4	13.566	48.3	62.490	41.3
0.5043	52.6	16.705	47.3	69.668	41.0
0.7197	52.4	19.751	46.5	79.316	40.8
1.0778	52.0	22.710	45.5	92.970	40.9
1.4347	52.2	25.584	44.8	104.27	40.8
2.1452	51.9	31.093	44.1		
		Wt % of AA = 70			
0	51.3	9.5790	48.7	69.086	40.5
0.2452	50.9	11.903	48.0	77.294	39.7
0.4900	50.7	15.338	47.3	86.626	39.5
0.8568	50.6	18.713	46.8	94.002	39.2
1.2228	50.4	23.122	45.4	10.777	39.1
1.8315	50.4	28.493	44.6	120.36	39.1
2.4383	50.4	33.714	43.5	137.34	38.9
3.1640	50.2	38.791	43.1	152.40	39.0
3.8871	50.1	43.731	42.6	174.02	38.9
4.8472	49.7	49.484	41.9	192.20	38.9
6.0408	49.4	55.055	41.1	207.70	39.0
7.2273	49.3	60.453	41.1	221.07	38.9

Table 3.2c Surface Tension (γ) Values of SDS in Acetamide - Water Mixture at 30° C

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% AA = 0					
0	71.5	4.3370	37.0	8.3208	38.3
0.5600	61.3	4.5254	38.0	8.8721	38.5
0.8376	58.5	4.5723	38.8	9.3396	38.5
1.1138	55.7	4.8286	38.0	9.8024	38.5
1.3885	53.8	5.0836	37.4	10.261	38.7
1.6617	51.6	5.3372	37.0	10.714	39.0
1.9334	50.0	5.5896	36.4	11.164	38.9
2.0237	48.7	5.8406	36.5	11.609	38.7
2.4725	47.2	6.0903	36.4	12.049	38.9
2.7399	46.4	6.3387	35.4	12.486	38.7
3.0059	44.7	6.5859	34.4	12.918	38.9
3.2704	43.9	6.8318	34.6	13.346	38.8
3.5336	42.6	7.0764	35.4	13.770	38.9
3.7953	41.9	7.3198	36.3	14.190	38.9
4.0557	40.8	7.8029	38.0		
4.3147	39.9	8.1467	38.2		
Wt.% AA = 10					
0	57.9	5.5597	38.6	9.5313	38.8
0.3089	54.2	5.8353	38.2	9.7842	39.5
0.6158	52.0	6.1093	37.9	10.036	39.9
0.9209	50.0	6.3816	37.8	10.286	39.9

Table 3.2c Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% AA = 10			
1.2241	48.6	6.6525	37.4	11.028	40.3
1.5255	47.7	6.9217	37.0	11.516	40.7
1.8250	46.5	7.1894	36.9	11.999	40.7
2.1228	45.5	7.4556	36.6	12.476	40.8
2.4187	44.9	7.7202	36.5	12.948	40.5
2.7128	44.1	7.9834	36.3	13.416	40.4
3.0052	43.8	8.2450	36.0	13.878	40.7
3.5847	42.3	8.5052	36.4	14.335	40.7
4.1574	41.1	8.7639	37.2	14.788	40.4
4.7233	39.9	9.0211	37.6		
5.2826	39.1	9.2769	38.5		
		Wt % AA = 20			
0	54.6	3.3013	42.5	10.697	35.8
0.0993	52.0	3.4798	42.3	11.109	35.8
0.1982	51.4	3.8336	41.7	11.648	36.8
0.2969	50.6	4.1834	41.2	12.177	37.8
0.3952	49.9	4.5291	40.7	12.695	39.0
0.4933	49.6	4.8709	40.2	13.203	39.5
0.6885	48.4	5.2088	39.7	13.701	40.1
0.8825	47.3	5.5429	39.2	14.189	40.4
1.0753	46.8	5.8733	39.0	14.668	40.3
1.2670	46.1	6.6832	38.6	15.139	40.8

Table 3.2c Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt % AA = 20			
1.4575	45.7	7.1585	37.9	15.600	40.7
1.6469	45.2	7.6260	37.3	16.053	41.0
1.8351	44.8	8.0860	36.8	16.497	41.1
2.0222	44.5	8.5386	36.6	16.934	40.8
2.2082	44.3	8.9840	36.0	17.362	40.8
2.5769	43.7	9.4224	35.9	17.783	41.2
2.7596	43.3	9.8539	35.6	18.196	41.2
3.1218	42.9	10.279	35.7	18.502	41.0
		Wt % AA = 30			
0	51.7	6.3085	40.6	17.926	38.7
0.1465	49.7	6.8183	40.4	18.506	39.1
0.2926	48.9	7.3225	39.9	19.265	39.6
0.4382	48.6	8.0681	39.6	20.011	40.0
0.5833	47.9	8.8015	39.0	20.742	40.6
0.8724	47.3	9.5228	38.8	21.459	40.5
1.1596	46.4	10.232	38.1	22.509	41.0
1.4452	46.1	10.930	37.9	23.531	40.8
1.7291	45.4	11.844	37.5	24.525	41.1
2.0113	45.3	12.738	37.2	25.492	41.1
2.5707	44.1	13.614	36.8	26.434	41.2
3.1235	43.8	14.471	36.9	27.950	41.2
3.6698	43.2	15.102	36.9	29.401	41.5

Table 3.2c Continued

[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}
		Wt % AA = 30			
4.2098	42.2	15.724	37.4	33.409	41.3
4.7435	41.9	16.134	37.5	38.064	41.4
5.2712	41.4	16.740	37.9		
5.7928	41.1	17.337	38.2		
		Wt % AA=40			
0	53.8	3.5431	46.6	16.507	40.0
0.0366	53.4	3.8850	46.2	17.295	39.7
0.0732	53.2	4.2247	45.9	18.071	39.6
0.1827	52.0	4.8976	45.5	18.833	39.6
0.2920	51.7	5.5621	45.0	19.831	39.5
0.4012	51.0	6.2184	45.1	20.807	39.4
0.5101	50.7	6.8664	44.2	21.998	39.5
0.6188	50.4	7.5065	43.8	23.158	39.7
0.7272	50.5	8.1388	43.5	24.287	40.0
0.9076	49.9	8.7634	43.5	27.509	40.4
1.0873	49.2	9.3803	43.1	25.260	40.5
1.2664	49.2	9.9899	42.7	31.448	40.5
1.4450	48.8	10.592	42.6	33.281	40.6
1.6229	48.6	11.187	42.5	35.031	40.8
1.8003	48.4	11.775	41.8	62.694	40.8
2.1534	48.0	12.357	41.6	79.727	40.8
2.3642	47.7	13.216	41.3	89.041	40.5

Table 3.2c Continued

[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}
		Wt % AA = 40			
2.5741	47.6	14.060	41.0	98.875	40.6
2.8527	47.2	14.890	40.7	111.92	40.5
3.1990	47.2	15.705	40.4		
		Wt % AA = 50			
0	53.5	0.5847	52.5	18.526	44.5
0.0082	53.5	0.7459	52.0	22.592	43.5
0.0163	53.6	1.0666	51.6	26.259	42.5
0.0327	53.2	1.7018	50.9	29.584	41.7
0.0523	53.2	2.5460	50.2	34.026	41.4
0.0718	53.2	3.7698	49.7	39.118	41.0
0.9794	53.3	5.2558	48.6	44.437	40.4
0.1305	53.0	6.6954	47.8	48.867	40.3
0.1631	53.0	8.0907	47.8	52.613	40.4
0.1957	53.0	9.7095	47.0	55.823	40.3
0.2607	52.8	11.525	46.3	59.116	40.4
0.3257	52.7	13.993	45.5		
0.4230	52.9	16.323	44.8		
		Wt % AA = 60			
0	51.9	18.460	46.0	78.057	39.2
0.1209	51.9	20.650	45.5	85.747	39.2
0.3623	51.9	22.815	45.0	93.082	39.2
0.7240	51.9	26.017	44.3	106.79	39.2

Table 3.2c Continued

[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}
		Wt % AA = 60			
1.2053	51.4	29.166	43.7	119.34	39.3
1.8052	51.1	32.263	42.9	130.87	39.3
2.6422	51.0	35.309	42.5	141.51	39.2
3.5945	50.8	39.294	41.9	151.35	39.3
4.7785	50.2	43.194	41.5	160.48	39.2
7.1256	49.5	47.954	40.7	168.98	39.2
9.4454	48.3	52.589	40.3	176.91	39.3
1.1738	47.9	57.996	40.0	184.32	39.2
14.005	47.2	63.239	39.7		
16.245	46.8	69.987	39.5		
		Wt % AA = 70			
0	50.3	14.427	47.1	71.739	40.5
0.1247	50.3	16.731	46.7	79.954	40.1
0.3737	50.3	20.137	46.2	87.771	39.7
0.7467	50.0	23.484	45.6	95.219	39.3
1.2430	50.1	26.772	44.9	109.11	39.1
1.8616	50.0	30.004	44.5	121.79	38.9
2.7245	49.8	33.181	44.1	138.89	39.0
3.7062	49.6	36.304	43.8	154.04	38.9
4.9264	49.5	40.387	43.3	175.75	38.7
6.1393	49.2	44.381	43.1	193.97	38.8
7.3447	48.5	49.250	42.4	209.49	38.8

Table 3.2c Continued

[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}
		Wt % AA = 70			
8.5429	48.4	53.989	41.8	222.87	38.8
9.7338	48.3	59.511	41.4	234.51	38.7
12.094	47.8	64.860	41.0	244.74	38.8

Table 3.2d Surface Tension (γ) Values of SDS in Acetamide - Water Mixture at 35° C

[SDS] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ/ mN m^{-1}
		Wt.% AA = 0			
0	70.5	4.9618	39.6	9.0852	38.6
0.6098	61.3	5.2388	39.1	9.4658	38.6
1.2123	55.3	5.5142	38.8	9.8433	38.7
1.8078	51.4	5.7880	37.9	10.218	38.6
2.1029	49.5	6.0603	37.8	10.589	38.6
2.3963	47.8	6.3311	36.6	11.080	38.5
2.6880	46.8	6.6004	36.3	11.565	38.7
2.9780	45.7	6.8681	35.7	12.046	38.7
3.2664	44.6	7.1344	35.5	12.521	38.8
3.5530	43.1	7.3992	36.1	12.991	38.6
3.8380	42.8	7.6625	36.8	13.457	38.7
4.1214	41.6	7.9244	38.0	13.917	38.8
4.4031	40.7	8.3145	38.3		
4.6833	39.8	8.7014	38.5		
		Wt.% AA =10			
0	59.6	5.5715	40.4	10.056	38.9
0.3096	52.5	5.8476	39.5	10.307	39.5
0.6172	50.2	6.1221	39.3	10.556	39.7
0.9230	48.9	6.3951	39.1	10.804	39.7
1.2268	47.6	6.6664	38.8	11.050	40.0
1.5289	46.2	6.9362	38.6	11.781	40.4
1.8291	45.5	7.2044	38.3	12.262	40.3

Table 3.2d Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% AA = 10			
2.1274	44.8	7.4711	38.4	12.738	40.4
2.4240	44.0	7.7362	38.0	13.208	40.4
2.7188	43.3	7.9998	37.8	13.674	40.4
3.0118	42.9	8.2620	37.6	14.134	40.5
3.5925	42.3	8.5226	37.3	14.590	40.7
4.1663	42.0	8.7818	37.2	15.041	40.7
4.4507	41.7	9.0395	37.6	15.138	40.5
4.7334	41.2	9.2958	37.6	15.603	40.4
5.0144	40.8	9.5506	38.0		
5.2938	40.5	9.8040	38.6		
		Wt % AA = 20			
0	54.2	3.6138	42.1	10.159	35.6
0.1909	51.5	3.9530	41.6	10.564	35.6
0.3806	50.6	4.2885	40.9	11.094	35.7
0.5692	49.4	4.6202	40.5	11.614	36.1
0.7567	48.9	4.9484	40.1	11.997	36.6
0.9431	47.9	5.2729	39.7	12.375	37.5
1.1284	47.4	5.5940	39.2	12.747	38.0
1.3126	47.2	6.2257	38.7	13.114	38.7
1.4958	46.6	6.5365	38.2	13.476	38.8
1.6779	46.3	6.8440	37.8	13.833	39.4
1.8590	45.3	7.1483	37.6	14.531	39.5
2.2180	44.2	7.4493	37.2	15.323	39.8

Table 3.2d Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt % AA = 20					
2.5729	43.6	8.3339	36.7	15.764	40.0
2.9238	42.8	9.3318	36.0	16.197	40.1
3.2707	42.5	9.7486	35.9	18.642	40.1
Wt % AA = 30					
0	52.2	7.3935	40.0	20.596	39.2
0.1537	49.5	7.9156	40.0	21.537	39.9
0.3069	48.4	8.4317	39.8	22.456	40.1
0.4597	47.8	9.1947	39.8	23.352	40.2
0.6119	47.4	9.9445	39.2	24.227	40.5
0.9150	46.9	10.682	38.9	25.081	40.7
1.2162	46.3	11.406	38.5	25.916	40.6
1.5155	46.0	12.119	38.2	26.731	40.7
1.8129	45.2	12.820	37.8	28.306	41.0
2.4021	44.6	13.509	37.4	29.812	40.9
2.9841	43.3	14.187	37.2	31.253	40.9
3.5590	42.8	14.854	37.2	32.633	40.9
4.1268	42.5	15.510	37.2	33.956	40.9
4.6878	41.8	16.369	37.1	36.444	40.9
5.2419	41.5	17.210	37.3	37.387	41.1
5.7895	41.0	18.034	37.6	39.077	40.9

Table 3.2d Continued

[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}
		Wt % AA = 30			
6.3305	40.7	18.840	38.2		
6.8651	40.5	19.630	38.8		
		Wt % AA = 40			
0	55.1	4.3085	48.3	16.432	42.8
0.0553	54.2	4.8313	47.9	17.765	42.4
0.1105	53.0	5.3507	47.4	19.074	42.0
0.2209	52.7	5.8667	47.0	20.360	41.6
0.3311	52.4	6.3794	46.7	22.041	41.3
0.4412	52.1	6.8889	46.5	25.682	40.9
0.5512	51.7	7.3950	46.1	27.626	40.7
0.7158	51.3	7.8980	45.9	29.516	40.8
0.8801	50.9	8.3977	45.6	31.355	40.9
1.0440	50.5	8.8943	45.3	34.888	41.0
1.2077	50.4	9.3877	45.0	38.238	40.8
1.5340	50.1	9.8780	44.7	41.421	40.9
2.1827	49.9	10.365	44.4	44.447	40.8
2.4515	49.7	11.331	44.2	47.329	40.8
2.9864	49.5	12.284	44.0	52.699	40.8
3.5179	49.1	13.226	43.7	57.599	40.9
3.7823	48.7	14.156	43.4	62.091	40.9
4.0458	48.5	15.075	43.1	66.221	40.8

Table 3.2d Continued

[SDS] $\times10^3$ / mol kg^{-1}	**γ / mN m^{-1}**	**[SDS] $\times10^3$ / mol kg^{-1}**	**γ / mN m^{-1}**	**[SDS] $\times10^3$ / mol kg^{-1}**	**γ / mN m^{-1}**
		Wt % AA = 50			
0	52.6	0.8545	50.8	13.635	45.5
0.0080	52.1	1.1049	50.7	15.948	45.1
0.0160	52.2	1.4161	50.4	18.139	44.5
0.0319	52.0	1.7253	50.2	20.218	44.1
0.0511	52.2	2.3380	49.4	24.073	42.9
0.0702	51.8	2.9430	49.5	29.200	41.7
0.0957	52.1	3.5405	49.4	33.673	41.0
0.1275	52.0	4.1306	49.0	38.821	40.3
0.1594	51.9	5.0024	48.6	44.223	39.7
0.2230	51.9	6.1402	48.1	70.586	40.0
0.2865	51.5	7.2509	48.0	75.919	39.9
0.3816	51.3	8.6026	47.1	102.31	39.9
0.4766	51.4	10.173	46.7		
0.6344	51.0	11.691	46.2		
		Wt % AA = 60			
0	53.3	15.682	46.8	68.755	39.9
0.1255	51.3	19.130	45.8	73.865	39.7
0.3761	50.9	22.518	45.1	80.440	39.5
0.7516	50.7	25.846	44.5	88.302	38.9
1.2511	50.7	29.117	44.0	95.790	38.7
1.8737	50.4	32.332	43.5	102.93	38.6
2.7422	50.3	35.492	42.9	116.27	38.8
3.7302	49.8	38.599	42.5	128.48	38.6

Table 3.2d Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt % AA = 60			
4.9584	49.5	42.661	41.9	144.97	38.6
6.1790	49.1	46.634	41.3	159.60	38.4
8.5981	48.4	50.521	40.9	172.67	38.5
12.172	47.5	54.325	40.5		
		Wt % AA = 70			
0.1259	49.7	16.895	46.0	72.341	40.3
0.3775	49.4	20.332	45.4	80.607	40.0
0.7543	49.1	23.709	45.1	88.471	39.6
1.2557	48.9	28.120	44.2	95.960	39.2
1.8806	48.8	32.430	43.5	109.92	38.5
2.7522	48.7	36.641	43.1	122.66	38.3
3.7437	48.3	40.758	42.8	139.82	38.0
4.9761	47.9	44.783	42.7	155.00	38.1
7.4184	47.6	49.691	42.0	176.75	38.0
9.8308	47.1	54.466	41.5	195.00	38.0
12.214	46.6	60.028	41.1	210.52	38.0
14.569	46.4	65.415	40.7	223.88	38.0

Table 3.2e Surface Tension (γ) Values of SDS in Acetamide - Water Mixture at 40° C

[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}
Wt.% AA = 0					
0	69.9	4.1328	41.1	7.4533	37.7
0.5711	53.8	4.3965	40.7	7.4533	37.7
1.1358	51.2	4.6587	40.2	7.6994	37.8
1.6943	48.8	4.9196	39.0	8.4302	38.3
1.9712	47.8	5.1790	38.7	8.9111	38.4
2.2466	46.9	5.4371	38.4	9.8583	38.4
2.5205	46.3	5.6938	38.0	10.325	38.3
2.7929	45.6	5.9492	36.8	10.786	38.3
3.0638	44.8	6.2032	36.4	11.696	38.3
3.3332	43.5	6.4558	36.2	12.144	38.2
3.6012	43.0	6.7071	35.3	12.588	38.3
3.8677	42.2	6.9572	35.9	13.027	38.2
Wt.% AA = 10					
0	60.1	4.9852	40.6	9.2441	37.6
0.3077	53.0	5.2630	40.0	9.4976	38.4
0.6134	50.5	5.5393	39.7	9.7498	39.2
0.9174	49.3	5.8139	39.1	10.001	39.5
1.2194	47.6	6.0869	38.9	10.250	39.8
1.5196	46.5	6.3584	38.6	10.498	40.0
1.8180	46.0	6.6282	38.2	10.744	40.2

Table 3.2e Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% AA = 10			
2.1147	45.2	6.8966	37.8	11.476	40.4
2.4095	44.6	7.1634	37.5	11.718	40.4
2.7025	43.8	7.4287	37.1	11.958	40.4
2.9938	43.0	7.6924	36.9	12.434	40.4
3.5713	42.9	7.9547	37.1	12.904	40.5
3.8574	42.5	8.2155	36.7	13.370	40.3
4.1419	42.2	8.4748	36.8	13.831	40.6
4.4246	41.7	8.7327	37.0	14.287	40.5
4.7057	41.0	8.9891	37.6	14.267	40.5
		Wt % AA = 20			
0	58.1	4.4042	43.9	13.682	39.2
0.1581	54.9	4.6947	43.6	14.162	39.7
0.3158	54.1	4.9835	43.4	14.637	39.9
0.4730	53.5	6.1228	41.9	15.341	39.9
0.6297	52.9	6.6830	41.2	16.034	40.0
0.7860	52.5	6.9608	40.9	16.717	40.2
0.9418	51.7	7.5119	40.0	17.390	40.2
1.0972	51.0	8.0569	39.3	18.052	40.4
1.4065	50.6	8.5960	39.1	18.705	40.2
1.7141	50.0	9.1293	38.4	19.561	40.6
2.0199	49.3	9.6569	38.2	20.401	40.6
2.3240	48.5	10.179	37.8	21.429	40.4
2.6263	47.7	10.695	37.5	22.432	40.6

Table 3.2e Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt % AA = 20			
2.9268	46.8	11.206	37.5	23.412	40.5
3.2257	46.3	11.712	37.9	24.370	40.5
3.5228	45.7	12.212	38.0	25.307	40.7
3.8183	45.3	12.707	38.5		
4.1121	44.6	13.197	38.5		
		Wt % AA = 30			
0	53.1	5.7615	42.9	16.929	38.0
0.3054	49.9	6.3001	42.4	17.755	38.2
0.6088	49.5	7.0961	41.5	18.563	38.6
0.9104	48.1	7.8783	41.1	19.354	39.0
1.2100	47.6	8.6468	40.6	20.512	39.5
1.5078	47.3	9.4022	40.5	21.451	39.9
1.8037	47.1	10.145	40.1	23.261	40.1
2.0978	46.8	11.593	39.5	24.986	40.2
2.3901	46.3	12.298	39.4	31.144	40.6
2.6806	46.1	12.993	39.3	32.522	40.6
2.9693	45.9	13.449	39.1	33.842	40.8
3.5413	44.9	14.125	38.8	40.788	40.9
4.1065	44.8	14.789	38.6	42.127	40.9
4.6648	43.7	15.443	38.4		
5.2164	43.5	16.087	38.1		

Table 3.2e Continued

[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt % AA = 40					
0	54.0	6.9120	47.1	24.041	41.7
0.1101	53.3	7.4159	46.7	25.237	41.4
0.2200	52.9	7.9166	46.3	26.800	41.1
0.3298	52.7	8.4142	46.0	28.328	40.8
0.4941	52.1	8.9086	45.8	29.823	40.8
0.6582	52.0	9.3999	45.6	31.286	40.6
0.8219	51.5	9.8881	45.4	33.070	40.7
1.0397	51.6	10.373	45.5	38.149	40.5
1.2570	50.9	11.335	45.0	44.342	40.1
1.4736	50.6	12.284	44.7	47.217	40.3
1.6897	50.3	13.222	44.4	49.958	40.0
1.9590	49.9	14.148	44.2	52.575	40.0
2.2274	49.7	15.063	44.0	55.075	40.1
2.4949	49.9	15.967	43.8	57.467	40.0
2.7616	49.7	16.860	43.6	61.951	40.1
3.2922	49.3	17.743	43.3	70.496	40.0
3.8195	48.9	18.615	43.0	76.090	39.9
4.3433	48.4	19.477	42.7	81.106	40.1
4.8637	48.1	20.329	42.4	85.629	40.0
5.3807	48.1	21.170	42.2	89.729	39.8
5.8944	47.8	22.003	42.0	93.462	39.9
6.4048	47.4	22.825	41.9		

Table 3.2e Continued

[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}
Wt % AA = 50					
0	53.4	4.1646	49.4	32.738	42.0
0.0290	53.0	5.9886	48.8	36.360	41.4
0.0580	52.7	7.9877	48.0	40.601	40.8
0.1159	52.8	10.367	46.8	51.864	40.4
0.2892	52.6	12.623	46.0	59.874	40.2
0.5766	52.0	14.765	45.6	74.090	39.8
0.8624	51.9	16.801	45.1	97.114	39.9
1.4289	51.4	18.740	44.7	133.95	39.4
1.9888	51.0	22.350	43.8	186.65	39.0
2.8165	50.3	28.660	42.5		
Wt % AA = 60					
0	51.3	13.210	46.6	64.669	40.3
0.1241	50.5	16.664	46.1	71.538	39.9
0.3721	50.5	20.058	45.6	79.744	39.4
0.7435	50.1	23.393	44.9	87.556	39.1
1.2376	49.9	26.671	44.7	95.000	38.8
1.8536	49.7	29.893	43.9	108.89	38.5
2.7129	49.5	34.104	43.4	121.58	38.5
3.6904	49.2	39.237	43.0	133.23	38.4
4.9056	48.8	44.230	42.3	143.96	38.4
6.1134	48.5	49.088	41.6	153.88	38.4
8.5074	48.1	53.817	40.9		
10.873	47.3	58.422	40.6		

Table 3.2e Continued

[SDS] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[SDS] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt % AA = 70					
0	48.8	15.544	46.5	95.189	39.8
0.2485	48.9	18.963	45.9	109.11	39.2
0.4967	48.5	23.431	45.3	121.84	38.7
0.8684	48.4	28.872	44.5	139.02	38.4
1.2395	48.2	34.161	43.7	154.23	37.9
1.8564	48.1	39.303	43.2	167.81	37.9
2.7169	48.3	44.305	43.0	18.000	37.9
3.6958	48.1	50.131	42.4	194.43	37.8
4.9129	47.9	55.772	41.9	210.08	37.8
7.3250	47.6	63.021	41.5	223.57	37.9
9.7083	47.4	71.671	40.9		
12.063	47.0	79.896	40.3		

Table 3.3 Ratio of the intensities of Fluorescence Emission of Pyrene at 374 nm (I_1) and at 384 nm (I_3) in SDS + water + AA system at 298 K

% AA	[SDS] x10^3/ mol kg^{-1}	I_1 / I_3	% AA	[SDS] x10^3/ mol kg^{-1}	I_1 / I_3
0	1.0276	1.6618	10	0	1.4956
	2.9972	1.6053		3.0112	1.5876
	4.9668	1.6189		3.9938	1.5940
	6.5083	1.4618		6.0223	1.5890
	7.9640	1.3627		7.0366	1.5218
	8.9917	1.1922		8.2411	1.5109
	9.5055	1.1879		8.8750	1.4644
	14.986	1.1696		9.5089	1.3227
	19.953	1.1800		1.5848	1.1931
	29.972	1.1435		3.1696	1.1703
5	0	1.7424		3.8036	1.1315
	1.9849	1.6599		4.4375	1.1462
	4.0040	1.6897	20	0	1.7130
	5.9890	1.6903		3.0526	1.6227
	8.0423	1.5562		4.9180	1.6363
	9.0690	1.3477		7.0379	1.6646
	10.267	1.2604		8.0554	1.6320
	11.978	1.2521		8.9900	1.6249
	13.689	1.1956		10.006	1.6098
	15.400	1.2817		15.000	1.3503
				20.011	1.2720
				30.526	1.2392
				39.853	1.2113
				50.876	1.2017

Table 3.3 continued

% AA	[SDS] x10^3/ mol kg^{-1}	I_1 / I_3	% AA	[SDS] x10^3/ mol kg^{-1}	I_1 / I_3
30	0	1.7055	50	0	1.6680
	2.9826	1.7041		3.0176	1.6359
	5.0705	1.6865		7.0410	1.6289
	7.4566	1.6661		20.117	1.6170
	9.9918	1.6474		30.176	1.6014
	19.984	1.4967		36.580	1.5521
	29.826	1.3295		50.293	1.4658
	38.774	1.2771		59.986	1.4425
	49.810	1.2561		73.154	1.3572
	59.653	1.2468		80.470	1.3498
40	0	1.8593	60	0	1.6996
	4.2126	1.9133		9.8024	1.7344
	8.4251	1.8838		28.962	1.7062
	10.531	1.8794		38.764	1.6852
	18.957	1.8595		49.012	1.6766
	25.275	1.7678		66.835	1.5993
	31.594	1.6400		86.885	1.5125
	42.126	1.4990		144.81	1.3452
	52.657	1.4390		191.59	1.2912
	73.720	1.3998		254.25	1.2610
	84.251	1.3712		354.77	1.2170

Table 3.3 continued

% AA	[SDS] x10^3/ mol kg^{-1}	I_1 / I_3	% AA	[SDS] x10^3/ mol kg^{-1}	I_1 / I_3
70	0	1.8081	70	127.38	1.5850
	8.9166	1.7878		191.07	1.4747
	44.583	1.7080		318.45	1.3328
	70.060	1.6925		382.14	1.3246
	82.800	1.6675		445.83	1.2912
	89.170	1.6102		509.52	1.2739

Table 3.4 Critical micelle concentration of SDS in aqueous medium as functions of temperature and acetamide amount

Weight % AA	Temperature / °C				
	20	25	30	35	40
	cmc ± 0.1 / mmol kg^{-1}				
0	8.4[a] / 8.4[b]	8.2 / 8.1 / 8.4[c]	8.4 / 8.3	8.6 / 8.6	8.8 / 8.7
10	10.1 / 9.5	10.6 / 10.0 / 10.7	11.1 / 10.2	11.2 / 10.8	11.3 / 11.0
20	13.8 / -	14.3 / 14.0 / 13.8	15.0 / 15.0	15.5 / 15.7	16.6 / 16.5
30	21.5 / 22.2	22.4 / 22.6 / 20.6	23.0 / 24.0	26.2 / 26.0	27.3 / 27.0
40	26.8 / 25.5	27.3 / 27.0 / 29.0	28.4 / 28.0	30.2 / 30.0	31.8 / 31.5
50	32.7 / 34.0	39.6 / 40.0 / 42.6	49.8 / 51.0	55.0 / 55.0	57.8 / 58.0
60	62.0 / 63.0	67.2 / 67.0 / 67.9	74.3 / -	90.7 / 90.0	106.5 /105.0
70	90.7 / 90.0	96.3 / 95.0 / 97.0	104.4 / 105.0	135.3 / 135.0	154.1 / 53.0

[a] from surface tension, [b] from conductance, [c] from fluorescence

Table 3.5 Values of the fitted parameters of Eq. (1) for SDS in aqueous medium as a function of acetamide amount at 25 °C

Weight % AA	A_1	A_2	$10^3 b$ / mol kg^{-1}	x_0 / mol kg^{-1}	$x_0 + 2b$ / mol kg^{-1}	cmc[a] / mol kg^{-1}	x_0/b
0	1.515	1.170	0.40	0.0076	0.0084	0.0082	19.0
10	1.587	1.170	0.72	0.0093	0.0107	0.0106	12.9
20	1.641	1.227	1.52	0.0138	0.0168	0.0143	9.1
30	1.716	1.245	5.50	0.0206	0.0316	0.0224	3.7
40	1.940	1.390	9.80	0.0290	0.0486	0.0273	3.0
50	1.675	1.339	12.0	0.0426	0.0666	0.0396	3.6
60	1.810	1.271	49.8	0.0679	0.1679	0.0672	1.4
70	1.940	1.295	82.2	0.0970	0.2614	0.0963	1.1

[a] from surface tension

Table 3.6 Ratio of the intensities of fluorescence emission of pyrene in the absence (I_0) and presence (I_q) of the quencher (CPC) at 373 nm in SDS + AA + water system at 298K.

% AA	(c – cmc) / mol kg^{-1}	[CPC] x 10^{5}/ mol kg^{-1}	I_0/ I_q
0	0.019	0	1.0000
		1.9773	1.0549
		2.9660	1.0837
		3.9547	1.1194
		4.9433	1.1319
10	0.019	0	1.0000
		1.8679	1.0440
		2.4906	1.0504
		3.1132	1.0762
		3.4245	1.0743
20	0.02	0	1.0000
		0.8155	1.0124
		5.0967	1.0559
		6.1161	1.0634
		7.1354	1.0676
		9.1741	1.0993
		20.386	1.2190
30	0.024	0	1.0000
		18.593	1.0949
		27.890	1.1354
		41.834	1.2346
		51.131	1.3169
		65.076	1.4127
		79.021	1.5378

Table 3.6 Continued

%f AA	(c – cmc) / mol kg^{-1}	[CPC] x 10^{3}/ mol kg^{-1}	I_0 / I_q
40	0.023	0	1.0000
		20.546	1.0825
		30.820	1.1456
		77.049	1.4535
		92.459	1.4942
		102.73	1.5844
50	0.023	0	1.0000
		3.8262	1.0139
		6.3770	1.0605
		8.9278	1.0965
		51.016	1.3818
60	0.022	0	1.0000
		0.9851	1.0013
		1.9701	1.0091
		9.8505	1.0545
		11.820	1.0566
70	0.020	0	1.0000
		7.1142	1.0476
		8.5370	1.0667
		15.651	1.1114

Table 3.7 Values of aggregation number, radius of the micelle, surface area per head group and packing parameter for SDS in aqueous medium as a function of acetamide amount at 25 °C

Weight % AA	N_{agg}	r / Å	a_0 / Å^2	P
0	51	16.2	64.8	0.32
10	42	15.2	69.1	0.30
20	20	11.9	88.5	0.24
30	14	10.5	99. 7	0.21
40	13	10.3	102.2	0.21
50	15	10.8	97.4	0.22
60	11	9.7	108.0	0.19
70	13	10.3	102.2	0.21

Table 3.8 Thermodynamic parameters for the micellization and adsorption of SDS, and Gordon parameter and dielectric constant (ref. 17) of water + acetamide medium at 25 °C

Weight % AA	ΔG^0_{mic} / kJ mol^{-1}	ΔS^0_{mic} / kJ mol^{-1} K^{-1}	ΔH^0_{mic} / kJ mol^{-1}	ΔH^*_{mic} / kJ mol^{-1}	ΔG^0_{ad} / kJ mol^{-1}	$\gamma/V^{1/3}$ J m^{-3}	ε[a]
0	-35.6	0.110	-2.9	-36.7	-44.3	2.75	78.4
10	-30.9	0.063	-12.1	-31.0	-45.3	2.26	80.6
20	-26.9	0.065	-7.6	-27.3	-36.6	2.03	83.0
30	-22.9	0.047	-8.9	-23.2	-32.4	1.82	85.2
40	-21.7	0.054	-5.5	-22.0	-34.9	1.93	87.2
50	-20.3	-0.046	-34.0	-19.8	-36.2	1.8	89.0
60	-18.4	0.010	-15.4	-18.5	-29.3	1.7	90.0
70	-17.4	0.017	-12.2	-17.5	-27.3	1.57	90.0

[a] from ref. 17

Table 3.9 Standard free energy of micellization of SDS in water + acetamide medium at different temperatures and ΔG^0_{ad} (last column) at 25 °C

Weight % AA	Temperature / °C				
	20	30	35	40	25
	ΔG^0_{mic} / kJ mol^{-1}				ΔG^0_{ad} / kJ mol^{-1}
0	-34.9	-36.1	-36.6	-37.1	-44.3
10	-30.6	-31.3	-31.8	-32.2	-45.3
20	-26.6	-27.2	-27.6	-27.8	-36.6
30	-22.6	-23.1	-23.2	-23.5	-32.4
40	-21.4	-21.9	-22.1	-22.3	-34.9
50	-20.5	-19.9	-19.9	-20.1	-36.2
60	-18.3	-18.4	-18.1	-17.9	-29.3
70	-17.2	-17.4	-16.9	-16.7	-27.3

Table 3.10 Standard entropy of micellization of SDS in water + acetamide medium at different temperatures

Weight % AA	Temperature / °C				
	20	25	30	35	40
	ΔS^0_{mic} / kJ mol^{-1} K^{-1}				
0	0.121	0.110	0.099	0.088	0.077
10	0.052	0.063	0.074	0.085	0.096
20	0.070	0.065	0.059	0.054	0.049
30	0.057	0.047	0.038	0.028	0.018
40	0.063	0.054	0.046	0.037	0.029
50	- 0.079	- 0.046	- 0.013	0.020	0.053
60	0.035	0.010	-0.015	- 0.040	- 0.065
70	0.047	0.017	-0.013	- 0.043	- 0.073

Table 3.11 Standard enthalpy of micellization of SDS in water + acetamide medium at different temperatures and ΔH^{*}_{mic} (last column) at 25 °C

Weight % AA	Temperature / °C					
	20	25	30	35	40	25
	ΔH^{0}_{mic} / kJ mol^{-1}					ΔH^{*}_{mic}/ kJ mol^{-1}
0	0.5	-2.9	-6.2	-9.5	-13.1	-36.7
10	-15.3	-12.1	-8.8	-5.5	-2.1	-31.0
20	-6.0	-7.6	-9.2	-11.0	-12.6	-27.3
30	-6.0	-8.9	-11.9	-14.6	-17.8	-23.2
40	-3.0	-5.5	-8.1	-10.7	-13.4	-22.0
50	-43.7	-34.0	-23.9	-13.8	-3.6	-19.8
60	-8.0	-15.4	-22.9	-30.4	-38.2	-18.5
70	-3.4	-12.2	-21.2	-30.0	-39.5	-17.5

Table 3.12a Surface excess of SDS in water + AA at 293 K.

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 0			
0.2055	1.14	2.8032	2.94	5.2718	3.38
0.4101	1.62	2.9975	2.99	5.4567	3.40
0.6139	1.89	3.1911	3.03	5.6408	3.42
0.8169	2.09	3.3840	3.07	5.8242	3.45
1.0191	2.24	3.5761	3.11	6.0069	3.47
1.2205	2.37	3.7674	3.15	6.1889	3.49
1.4211	2.47	3.9580	3.18	6.3703	3.51
1.6209	2.56	4.1479	3.21	6.5510	3.53
1.8199	2.64	4.3370	3.24	6.7309	3.55
2.0181	2.71	4.5254	3.27	6.9102	3.56
2.2155	2.78	4.7131	3.30	7.0889	3.58
2.4122	2.84	4.9001	3.33		
2.6081	2.89	5.0863	3.35		
		Wt % AA = 10			
0.5954	1.57	3.4734	1.60	6.1957	1.61
1.1841	1.58	4.0299	1.60	6.7226	1.61
1.7661	1.59	4.5802	1.60	7.2439	1.61
2.3416	1.59	5.1246	1.61		
2.9106	1.60	5.6631	1.61		

Table 3.12a Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 20			
0.1928	0.29	3.1277	1.09	6.4398	1.29
0.3844	0.49	3.4758	1.12	6.7514	1.31
0.5749	0.60	3.8200	1.14	7.2127	1.32
0.7643	0.68	4.1603	1.17	7.6666	1.34
0.9525	0.75	4.4969	1.19	8.1134	1.36
1.3257	0.84	4.8297	1.21	8.5532	1.37
1.6945	0.91	5.1588	1.23	8.9862	1.39
2.0590	0.97	5.4843	1.25	9.4126	1.40
2.4194	1.01	5.8063	1.26	9.8325	1.41
2.7755	1.05	6.1247	1.28		
		Wt % AA = 30			
0.2860	0.15	3.5900	0.77	8.6205	0.98
0.4283	0.25	4.1188	0.80	9.3285	1.00
0.5702	0.32	4.6416	0.83	10.025	1.02
0.8528	0.42	5.1585	0.86	10.711	1.04
1.4131	0.54	5.6696	0.88	11.386	1.05
1.6907	0.58	6.1751	0.90	12.050	1.06
1.9668	0.62	6.6750	0.92	12.704	1.08
2.5141	0.68	7.1694	0.94	13.349	1.09
3.0551	0.73	7.9008	0.96	13.983	1.10

Table 3.12a Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 40			
0.0464	0.09	1.3666	0.57	6.7235	0.80
0.0928	0.19	1.5892	0.59	7.4748	0.81
0.1391	0.24	1.8104	0.61	8.2087	0.83
0.1853	0.29	2.0302	0.63	9.1022	0.84
0.2315	0.32	2.2486	0.64	9.9705	0.85
0.3007	0.35	2.5735	0.66	10.981	0.87
0.3697	0.38	2.8954	0.68	11.958	0.88
0.4615	0.42	3.3199	0.70	13.211	0.89
0.5759	0.45	3.7390	0.71	14.705	0.91
0.6900	0.47	4.3581	0.74	16.123	0.92
0.8264	0.50	4.9657	0.76	17.470	0.93
0.9622	0.52	5.5623	0.77		
1.1425	0.55	6.1482	0.79		
		Wt % AA = 50			
0.1948	0.04	2.8430	0.50	12.736	0.76
0.2596	0.09	3.7543	0.55	13.949	0.78
0.3566	0.15	4.9425	0.60	15.361	0.79
0.4856	0.20	6.1012	0.63	16.726	0.81
0.7105	0.27	7.5095	0.67	18.477	0.82
0.9664	0.32	8.8753	0.70	20.562	0.84
1.2842	0.37	10.200	0.72	22.541	0.86
1.9138	0.43	11.487	0.74	26.209	0.88

Table 3.12a Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 60			
1.3823	0.11	13.372	0.70	36.469	0.96
2.2981	0.25	15.507	0.74	41.099	1.00
3.4365	0.35	17.617	0.78	45.601	1.02
4.5678	0.42	19.701	0.80	49.981	1.05
5.6922	0.48	21.761	0.83	55.084	1.07
6.8096	0.53	24.806	0.86	60.025	1.09
9.0239	0.60	27.798	0.89		
11.211	0.66	31.707	0.93		
		Wt % AA = 70			
1.5038	0.09	7.4083	0.50	29.167	0.85
2.0026	0.17	9.2180	0.56	36.592	0.91
2.5001	0.22	11.011	0.60	44.723	0.96
3.1203	0.28	13.377	0.65	54.392	1.01
3.9854	0.34	15.714	0.69	63.552	1.05
4.9694	0.40	19.167	0.74	72.243	1.08
6.1926	0.45	23.677	0.80	80.498	1.11

Table 3.12b Surface excess of SDS in water + AA at 298 K

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA =0			
0.1745	0.08	2.8245	2.92	5.2331	3.55
0.3479	0.78	2.9817	2.97	5.3764	3.57
0.5202	1.19	3.1380	3.02	5.5189	3.6
0.6914	1.48	3.2934	3.07	5.6605	3.63
0.8616	1.71	3.4479	3.12	5.8014	3.65
1.0307	1.89	3.6015	3.16	5.9414	3.67
1.1988	2.04	3.7542	3.21	6.0807	3.7
1.3658	2.18	3.9060	3.25	6.2193	3.72
1.5319	2.29	4.0568	3.29	6.3570	3.74
1.6969	2.40	4.2069	3.32	6.4940	3.77
1.8609	2.49	4.3560	3.36	6.6302	3.79
2.0239	2.58	4.5043	3.39	6.7657	3.81
2.1860	2.66	4.6518	3.43	6.9004	3.83
2.3470	2.73	4.7983	3.46	7.0344	3.85
2.5071	2.79	4.9441	3.49		
2.6663	2.86	5.0890	3.52		
		Wt % AA = 10			
0.2907	0.50	2.8326	1.13	5.2484	1.30
0.5796	0.69	3.1071	1.16	5.5094	1.32
0.8670	0.80	3.3800	1.18	5.7690	1.33
1.1526	0.88	3.6514	1.20	6.0272	1.34

Table 3.12b Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
Wt % AA = 10					
1.4366	0.94	3.9213	1.22	6.2840	1.35
1.7190	0.99	4.1897	1.24	6.5393	1.36
1.9998	1.03	4.4566	1.26	6.7933	1.37
2.2790	1.07	4.7220	1.27	7.0459	1.38
2.5566	1.10	4.9859	1.29	7.2972	1.39
Wt % AA = 20					
0.0986	0.06	2.4685	1.04	6.8789	1.35
0.1968	0.27	2.8316	1.08	7.1923	1.36
0.2948	0.39	3.1905	1.11	7.5023	1.37
0.3925	0.48	3.5452	1.15	7.8090	1.39
0.5869	0.60	3.8958	1.18	8.1124	1.40
0.7802	0.69	4.2425	1.20	8.4126	1.41
0.9723	0.75	4.5851	1.22	8.7096	1.42
1.1633	0.81	4.9239	1.25	9.0034	1.43
1.3531	0.85	5.2589	1.27	9.2942	1.44
1.5418	0.89	5.5902	1.29	9.5820	1.45
1.7293	0.93	5.9177	1.30	9.8667	1.46
1.9158	0.96	6.2416	1.32		
2.1011	0.99	6.5620	1.33		

Table 3.12b Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 30			
0.2893	0.07	2.8169	0.62	10.592	0.94
0.4333	0.17	3.3607	0.66	11.277	0.95
0.5768	0.24	3.8982	0.70	11.951	0.96
0.7200	0.29	4.6930	0.74	12.614	0.98
0.8627	0.33	5.4742	0.78	13.267	0.99
1.1468	0.40	6.2423	0.81	13.910	1.00
1.4293	0.45	6.9976	0.84	14.543	1.01
1.7101	0.50	7.7403	0.86	15.166	1.02
2.2667	0.57	8.4709	0.88		
2.5426	0.59	9.1895	0.90		
		Wt % AA = 40			
0.1907	0.06	2.7934	0.69	9.8619	0.99
0.2542	0.12	3.0952	0.72	10.388	1.00
0.3175	0.18	3.3952	0.74	10.908	1.01
0.4124	0.24	3.6935	0.76	11.423	1.02
0.5071	0.29	3.9902	0.78	11.932	1.03
0.6332	0.34	4.2853	0.79	12.437	1.04
0.7904	0.39	4.5787	0.81	12.936	1.05
0.9471	0.43	4.8706	0.82	13.430	1.06
1.1034	0.47	5.4494	0.85	13.919	1.07
1.2592	0.50	6.0220	0.87	14.644	1.08
1.4146	0.53	6.5883	0.89	15.358	1.09

Table 3.12b Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 40			
1.5695	0.55	7.1486	0.91	16.061	1.10
1.7549	0.58	7.7029	0.93	16.755	1.11
1.9396	0.60	8.2513	0.95	17.438	1.12
2.1849	0.63	8.7938	0.96	18.111	1.13
2.4900	0.66	9.3307	0.98		
		Wt % AA = 50			
0.1590	0.04	1.5672	0.36	13.690	0.68
0.2225	0.07	2.1800	0.39	15.979	0.70
0.2542	0.12	2.7851	0.44	18.146	0.72
0.3175	0.13	3.6784	0.47	20.201	0.74
0.4124	0.17	4.5550	0.51	22.152	0.76
0.5071	0.20	5.6987	0.54	24.007	0.77
0.6330	0.23	7.3622	0.58	25.772	0.79
0.7900	0.26	8.7032	0.61	27.455	0.80
0.9464	0.30	10.260	0.64	30.594	0.81
1.2578	0.32	11.764	0.66	33.464	0.83

Table 3.12b Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 60			
1.0778	0.01	13.566	0.70	41.242	1.00
1.4347	0.09	16.705	0.75	45.927	1.02
2.1452	0.20	19.751	0.80	54.612	1.07
2.8512	0.28	22.710	0.83	62.490	1.11
4.2497	0.38	25.584	0.87	69.668	1.14
6.3148	0.49	31.093	0.92	41.242	0.99
9.6716	0.60	36.304	0.96	45.927	1.02
		Wt % AA = 70			
2.4383	0.13	11.903	0.59	43.731	0.97
3.1640	0.21	15.338	0.67	49.484	1.00
3.8871	0.27	18.713	0.72	55.055	1.03
4.8472	0.33	23.122	0.78	60.453	1.06
6.0408	0.40	28.493	0.85	69.086	1.10
7.2273	0.45	33.714	0.89	77.294	1.13
9.5790	0.53	38.791	0.93	86.626	1.17

Table 3.12c Surface excess of SDS in water + AA at 303 K

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA =0			
0.5600	1.47	2.7399	2.43	4.8286	2.77
0.8376	1.71	3.0059	2.48	5.0836	2.80
1.1138	1.88	3.2704	2.54	5.3372	2.83
1.3885	2.02	3.5336	2.58	5.5896	2.86
1.6617	2.13	3.7953	2.63	5.8406	2.89
1.9334	2.22	4.0557	2.67	6.0903	2.91
2.0237	2.30	4.3147	2.70	6.3387	2.94
2.4725	2.37	4.5723	2.74	6.5859	2.96
		Wt % AA = 10			
0.3089	0.57	3.0052	1.33	6.6525	1.60
0.6158	0.80	3.5847	1.39	6.9217	1.62
0.9209	0.94	4.1574	1.44	7.1894	1.63
1.2241	1.03	4.7233	1.49	7.4556	1.64
1.5255	1.11	5.2826	1.52	7.7202	1.65
1.8250	1.17	5.5597	1.54	7.9834	1.66
2.1228	1.22	5.8353	1.56	8.2450	1.67
2.4187	1.26	6.1093	1.57		
2.7128	1.30	6.3816	1.59		

Table 3.12c Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
Wt % AA = 20					
0.0993	0.08	2.0222	0.88	5.2088	1.13
0.1982	0.27	2.2082	0.91	5.5429	1.15
0.2969	0.37	2.5769	0.95	5.8733	1.17
0.3952	0.45	2.7596	0.97	6.2000	1.18
0.4933	0.51	2.9412	0.98	6.6832	1.20
0.6885	0.60	3.1218	1.00	7.1585	1.22
0.8825	0.66	3.3013	1.01	7.6260	1.24
1.0753	0.72	3.4798	1.03	8.0860	1.25
1.2670	0.76	3.8336	1.05	8.5386	1.27
1.4575	0.80	4.1834	1.08	8.9840	1.28
1.6469	0.83	4.5291	1.10	9.4224	1.29
1.8351	0.86	4.8709	1.12	9.8539	1.30
Wt % AA = 30					
0.1465	0.0377	2.5707	0.691	7.3225	0.929
0.2926	0.195	3.1235	0.735	8.0681	0.951
0.4382	0.287	3.6698	0.772	8.8015	0.971
0.5833	0.353	4.2098	0.803	9.5228	0.989
0.8724	0.444	4.7435	0.83	10.232	1.01
1.1596	0.509	5.2712	0.854	10.930	1.02
1.4452	0.559	5.7928	0.876	11.844	1.04
1.7291	0.6	6.3085	0.895	12.738	1.06
2.0113	0.635	6.8183	0.913	13.614	1.07

Table 3.12c Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
Wt % AA = 40					
0.0732	0.04	2.5741	0.59	10.592	0.81
0.1827	0.18	2.8527	0.61	11.187	0.82
0.2920	0.25	3.1990	0.62	11.775	0.83
0.4012	0.30	3.5431	0.64	12.357	0.83
0.5101	0.34	3.8850	0.65	13.216	0.84
0.6188	0.37	4.2247	0.67	14.060	0.85
0.7272	0.39	4.8976	0.69	14.890	0.86
0.9076	0.43	5.5621	0.71	15.705	0.87
1.0873	0.46	6.2184	0.73	16.507	0.88
1.2664	0.48	6.8664	0.74	17.295	0.88
1.4450	0.50	7.5065	0.76	18.071	0.89
1.6229	0.52	8.1388	0.77	18.833	0.90
1.8003	0.53	8.7634	0.78	19.831	0.91
2.1534	0.56	9.3803	0.79	20.807	0.91
2.3642	0.58	9.9899	0.80		
Wt % AA = 50					
0.3257	0.04	5.2558	0.57	22.592	0.84
0.4230	0.09	6.6954	0.61	26.259	0.87
0.5847	0.15	8.0907	0.65	29.584	0.89
0.7459	0.20	9.7095	0.68	34.026	0.92
1.0666	0.26	11.525	0.71	39.118	0.94

Table 3.12c Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 50			
1.7018	0.35	13.993	0.75	44.437	0.97
2.5460	0.43	16.323	0.78		
3.7698	0.50	18.526	0.80		
		Wt % AA = 60			
1.8052	0.05	16.245	0.82	39.294	1.14
2.6422	0.18	18.460	0.87	43.194	1.17
3.5945	0.29	20.650	0.91	47.954	1.21
4.7785	0.39	22.815	0.94	52.589	1.24
7.1256	0.53	26.017	0.99	57.996	1.27
9.4454	0.63	29.166	1.03	63.239	1.30
11.738	0.71	32.263	1.07		
14.005	0.77	35.309	1.10		
		Wt % AA = 70			
1.8616	0.002	14.427	0.58	44.381	0.89
2.7245	0.11	16.731	0.62	49.250	0.92
3.7062	0.20	20.137	0.67	53.989	0.95
4.9264	0.28	23.484	0.71	59.511	0.98
6.1393	0.34	26.772	0.75	64.860	1.00
7.3447	0.39	30.004	0.78	71.739	1.03
8.5429	0.43	33.181	0.81	79.954	1.06
9.7338	0.47	36.304	0.84	87.771	1.08
12.094	0.53	40.387	0.87	95.219	1.11

Table 3.12d Surface excess of SDS in water + AA at 308 K.

[SDS] x 10^{3}/ mol kg^{-1}	Γ x 10^{6} / mol m^{-2}	[SDS] x 10^{3}/ mol kg^{-1}	Γ x 10^{6} / mol m^{-2}	[SDS] x 10^{3}/ mol kg^{-1}	Γ x 10^{6} / mol m^{-2}
		Wt % AA =0			
0.6098	1.75	3.5530	2.23	5.7880	2.36
1.2123	1.94	3.8380	2.25	6.0603	2.37
1.8078	2.04	4.1214	2.27	6.3311	2.38
2.1029	2.09	4.4031	2.29	6.6004	2.40
2.3963	2.12	4.6833	2.30	6.8681	2.41
2.6880	2.15	4.9618	2.32	7.1344	2.42
2.9780	2.18	5.2388	2.33		
3.2664	2.20	5.5142	2.35		
		Wt % AA = 10			
0.3096	0.60	3.5925	1.02	6.6664	1.12
0.6172	0.72	4.1663	1.04	6.9362	1.13
0.9230	0.79	4.4507	1.06	7.2044	1.14
1.2268	0.84	4.7334	1.07	7.4711	1.14
1.5289	0.87	5.0144	1.08	7.7362	1.15
1.8291	0.91	5.2938	1.08	7.9998	1.15
2.1274	0.93	5.5715	1.09	8.2620	1.16
2.4240	0.95	5.8476	1.10	8.5226	1.17
2.7188	0.97	6.1221	1.11	8.7818	1.17
3.0118	0.99	6.3951	1.12		

Table 3.12d Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 20			
0.1909	0.18	2.2180	0.95	5.5940	1.24
0.3806	0.39	2.5729	0.99	6.2257	1.27
0.5692	0.52	2.9238	1.03	6.5365	1.28
0.7567	0.61	3.2707	1.07	6.8440	1.30
0.9431	0.68	3.6138	1.10	7.1483	1.31
1.1284	0.73	3.9530	1.13	7.4493	1.32
1.3126	0.78	4.2885	1.15	8.3339	1.36
1.4958	0.82	4.6202	1.18	9.3318	1.40
1.6779	0.86	4.9484	1.20	9.7486	1.41
1.8590	0.89	5.2729	1.22	10.159	1.42
		Wt % AA = 30			
0.1537	0.113	3.5590	0.667	9.1947	0.834
0.3069	0.235	4.1268	0.693	9.9445	0.848
0.4597	0.306	4.6878	0.715	10.682	0.861
0.6119	0.357	5.2419	0.735	11.406	0.872
0.9150	0.428	5.7895	0.753	12.119	0.883
1.2162	0.478	6.3305	0.768	12.820	0.893
1.5155	0.516	6.8651	0.783	13.509	0.902
1.8129	0.548	7.3935	0.796	14.187	0.911
2.4021	0.598	7.9156	0.808		
2.9841	0.636	8.4317	0.819		

Table 3.12d Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 40			
0.5512	0.06	3.5179	0.54	9.8780	0.80
0.7158	0.12	3.7823	0.55	10.365	0.82
0.8801	0.18	4.0458	0.57	11.331	0.84
1.0440	0.22	4.3085	0.59	12.284	0.86
1.2077	0.26	4.8313	0.62	13.226	0.88
1.3710	0.29	5.3507	0.64	14.156	0.90
1.5340	0.32	5.8667	0.67	15.075	0.91
1.7508	0.36	6.3794	0.69	16.432	0.93
1.9671	0.39	6.8889	0.71	17.765	0.95
2.1827	0.41	7.3950	0.73	19.074	0.97
2.4515	0.44	7.8980	0.75	20.360	0.99
2.7194	0.47	8.3977	0.76	22.041	1.01
2.9864	0.49	8.8943	0.78		
3.2526	0.52	9.3877	0.79		
		Wt % AA = 50			
1.1049	0.05	6.1402	0.54	20.218	0.88
1.4161	0.12	7.2509	0.59	24.073	0.93
1.7253	0.17	8.6026	0.64	29.200	0.99
2.3380	0.26	10.173	0.69	33.673	1.03
2.9430	0.33	11.691	0.73	38.821	1.07

Table 3.12d Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
Wt % AA = 50					
3.5405	0.38	13.635	0.77	44.223	1.11
4.1306	0.43	15.948	0.82		
5.0024	0.48	18.139	0.85		
Wt % AA = 60					
1.8737	0.0835	15.682	0.679	38.599	0.931
2.7422	0.19	19.130	0.734	42.661	0.959
3.7302	0.276	22.518	0.78	46.634	0.984
4.9584	0.356	25.846	0.819	50.521	1.01
6.1790	0.418	29.117	0.852	54.325	1.03
8.5981	0.51	32.332	0.881	58.966	1.05
12.172	0.608	35.492	0.908	63.485	1.07
Wt % AA = 70					
1.8806	0.01	20.332	0.58	60.028	0.84
2.7522	0.10	23.709	0.62	65.415	0.86
3.7437	0.18	28.120	0.66	72.341	0.88
4.9761	0.25	32.430	0.69	80.607	0.91
7.4184	0.34	36.641	0.72	88.471	0.93
9.8308	0.41	40.758	0.74	95.960	0.95
12.214	0.46	44.783	0.77	109.92	0.98
14.569	0.50	49.691	0.79	122.66	1.00
16.895	0.53	54.466	0.81		

Table 3.12e Surface excess of SDS in water + AA at 313 K.

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA =0			
0.5711	0.30	3.3332	1.89	5.4371	2.33
1.1358	0.92	3.6012	1.96	5.6938	2.37
1.6943	1.28	3.8677	2.02	5.9492	2.41
1.9712	1.41	4.1328	2.08	6.2032	2.44
2.2466	1.53	4.3965	2.13	6.4558	2.48
2.5205	1.63	4.6587	2.19	6.7071	2.51
2.7929	1.73	4.9196	2.24		
3.0638	1.81	5.1790	2.28		
		Wt % AA = 10			
0.3077	0.44	3.5713	1.17	6.3584	1.34
0.6134	0.65	3.8574	1.19	6.6282	1.35
0.9174	0.77	4.1419	1.21	6.8966	1.36
1.2194	0.85	4.4246	1.23	7.1634	1.37
1.5196	0.91	4.7057	1.25	7.4287	1.38
1.8180	0.97	4.9852	1.27	7.6924	1.39
2.1147	1.01	5.2630	1.28	7.9547	1.40
2.4095	1.05	5.5393	1.30	8.2155	1.41
2.7025	1.08	5.8139	1.31		
2.9938	1.11	6.0869	1.32		

Table 3.12e Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 20			
0.3158	0.175	2.6263	1.08	6.1228	1.45
0.4730	0.348	2.9268	1.13	6.6830	1.48
0.6297	0.471	3.2257	1.17	6.9608	1.5
0.7860	0.566	3.5228	1.21	7.5119	1.53
0.9418	0.644	3.8183	1.24	8.0569	1.56
1.0972	0.709	4.1121	1.28	8.5960	1.59
1.4065	0.816	4.4042	1.31	9.1293	1.62
1.7141	0.901	4.6947	1.33	9.6569	1.64
2.0199	0.971	4.9835	1.36	10.179	1.67
2.3240	1.03	5.5563	1.41	10.695	1.69
		Wt % AA = 30			
0.3054	0.1	4.1065	0.72	12.298	0.98
0.6088	0.27	4.6648	0.75	12.993	0.99
0.9104	0.36	5.2164	0.78	13.449	1.00
1.2100	0.43	5.7615	0.80	14.125	1.01
1.5078	0.48	6.3001	0.82	14.789	1.02
1.8037	0.52	7.0961	0.85	15.443	1.03
2.0978	0.56	7.8783	0.90	16.087	1.04
2.3901	0.59	8.6468	0.92	16.929	1.06
2.6806	0.62	9.4022	0.94	17.755	1.07
2.9693	0.64	10.145	0.95	18.563	1.08
3.5413	0.68	11.593	0.97	19.354	1.09

Table 3.12e Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 40			
0.4941	0.08	5.8944	0.62	16.860	0.86
0.6582	0.14	6.4048	0.64	17.743	0.87
0.8219	0.19	6.9120	0.66	18.615	0.88
1.0397	0.24	7.4159	0.68	19.477	0.89
1.2570	0.28	7.9166	0.69	20.329	0.90
1.4736	0.32	8.4142	0.70	21.170	0.91
1.6897	0.35	8.9086	0.72	22.003	0.92
1.9590	0.38	9.3999	0.73	22.825	0.92
2.2274	0.41	9.8881	0.74	24.041	0.94
2.4949	0.43	10.373	0.75	25.237	0.95
2.7616	0.46	11.335	0.77	26.800	0.96
3.2922	0.50	12.284	0.79	28.328	0.97
3.8195	0.53	13.222	0.80	29.823	0.98
4.3433	0.56	14.148	0.82	31.286	0.99
4.8637	0.58	15.063	0.83		
5.3807	0.60	15.967	0.84		
		Wt % AA = 50			
0.8624	0.09	7.9877	0.62	22.350	0.87
1.4289	0.21	10.367	0.68	28.660	0.93
1.9888	0.29	12.623	0.73	32.738	0.96
2.8165	0.37	14.765	0.77	32.738	0.96
4.1646	0.46	16.801	0.80	36.360	0.98

Table 3.12e Continued

[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}	[SDS] x 10^3/ mol kg^{-1}	Γ x 10^6 / mol m^{-2}
		Wt % AA = 50			
5.9886	0.55	18.740	0.82	40.601	1.01
		Wt % AA = 60			
1.8536	0.05	16.664	0.61	49.088	0.89
2.7129	0.14	20.058	0.66	53.817	0.92
3.6904	0.22	23.393	0.70	58.422	0.94
4.9056	0.30	26.671	0.73	64.669	0.96
6.1134	0.35	29.893	0.76	71.538	0.99
8.5074	0.44	34.104	0.80	79.744	1.02
10.873	0.50	39.237	0.83	87.556	1.04
13.210	0.55	44.230	0.86	95.000	1.06
		Wt % AA = 70			
2.7169	0.02	23.431	0.55	71.671	0.82
3.6958	0.10	28.872	0.60	79.896	0.85
4.9129	0.17	34.161	0.64	95.189	0.89
7.3250	0.26	39.303	0.67	109.11	0.92
9.7083	0.33	44.305	0.70	121.84	0.95
12.063	0.39	50.131	0.73	139.02	0.98
15.544	0.45	55.772	0.76	154.23	1.01
18.963	0.50	63.021	0.79		

Table 3.13 Values of Γ_{max} for SDS in SDS + AA + water mixtures at different temperatures

Wt % of EG	T / K	Γ_{max} x 10^6 / mol m^{-2}	Wt % of EG	T / K	Γ_{max} x 10^6 / mol m^{-2}
0	293	3.76	40	293	0.87
0	298	3.80	40	298	1.10
0	303	2.79	40	303	0.98
0	308	2.24	40	308	0.92
0	313	2.08	40	313	1.01
10	293	1.60	50	293	0.74
10	298	1.40	50	298	0.80
10	303	1.52	50	303	0.89
10	308	1.44	50	308	0.90
10	313	1.57	50	313	0.94
20	293	1.25	60	293	0.92
20	298	1.40	60	298	1.10
20	303	1.24	60	303	1.01
20	308	1.14	60	308	0.90
20	313	1.38	60	313	0.86
30	293	0.87	70	293	0.87
30	298	1.00	70	298	1.20
30	303	0.96	70	303	0.90
30	308	0.95	70	308	0.86
30	313	1.04	70	313	0.78

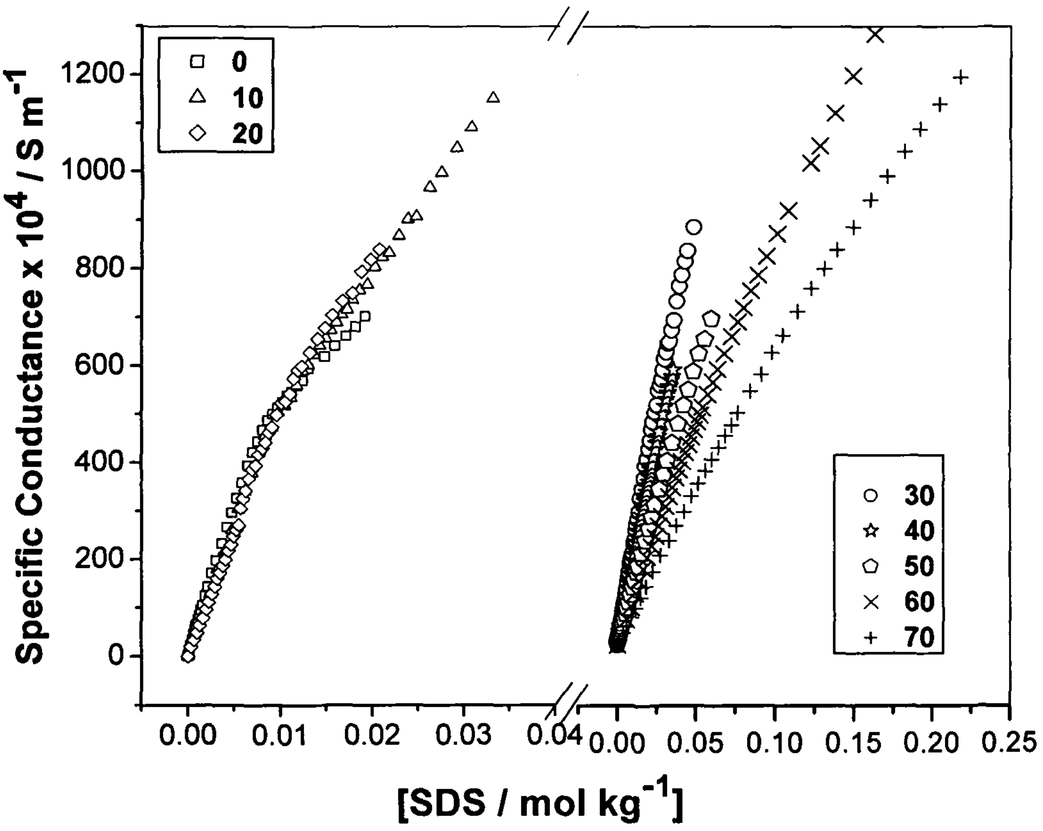

Fig. 3.1a. Specific conductance of SDS at 20 °C as a function of surfactant concentration in water + AA medium containing varying amounts of AA. Numbers in the insets indicate AA %

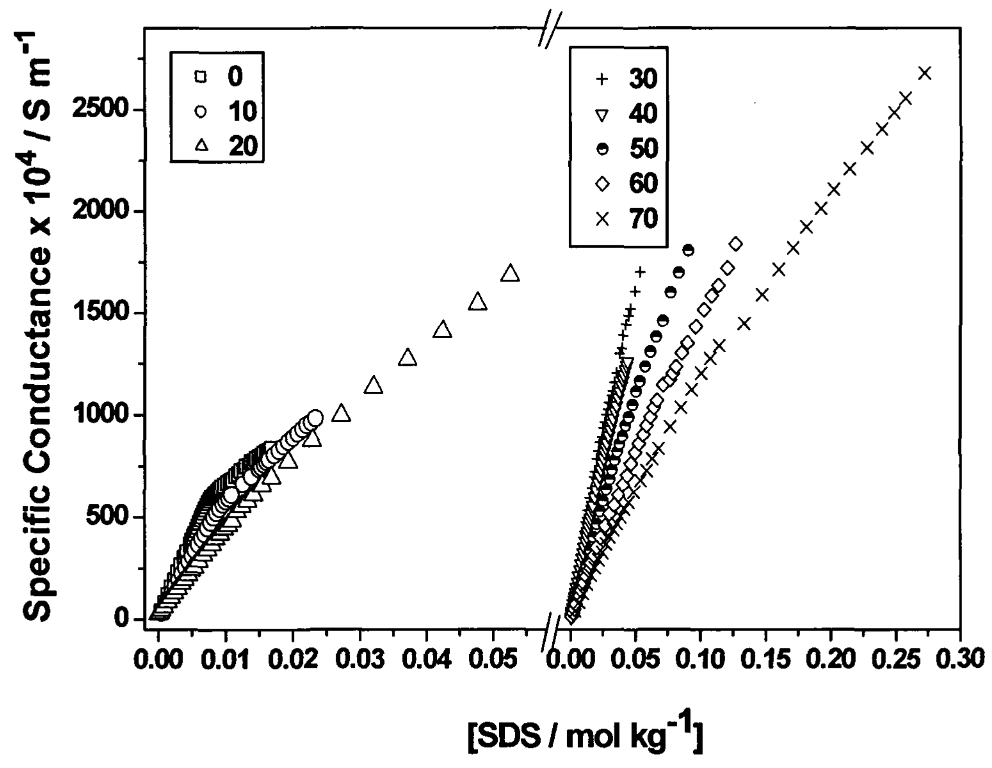

Fig. 3.1b. Specific conductance of SDS at 25 °C as a function of surfactant concentration in water + AA medium containing varying amounts of AA. Numbers in the insets indicate AA %

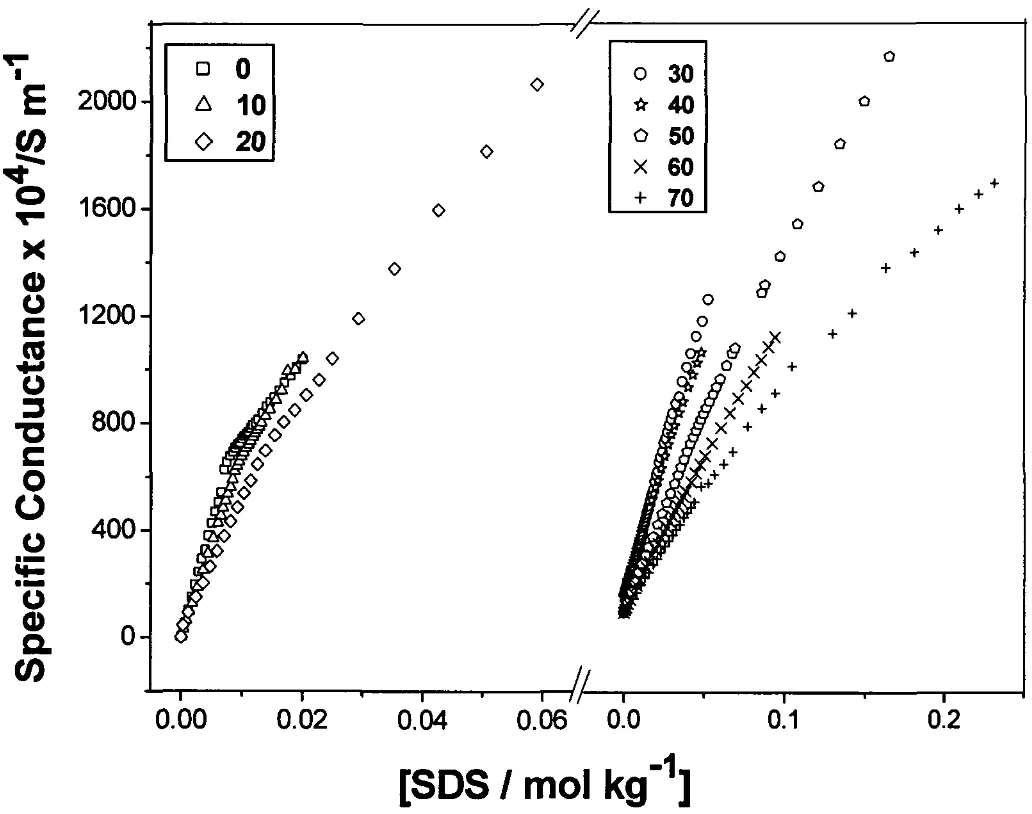

Fig. 3.1c. Specific conductance of SDS at 30 °C as a function of surfactant concentration in water + AA medium containing varying amounts of AA. Numbers in the insets indicate AA %

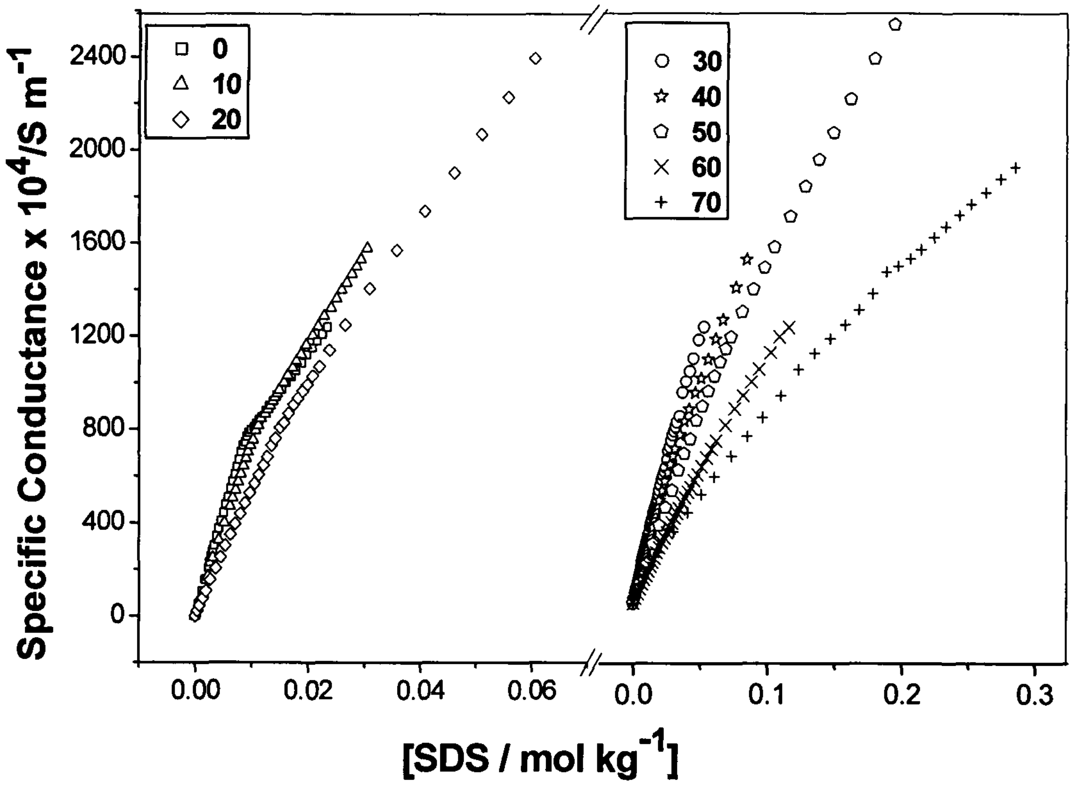

Fig. 3.1d. Specific conductance of SDS at 35 °C as a function of surfactant concentration in water + AA medium containing varying amounts of AA. Numbers in the insets indicate AA %

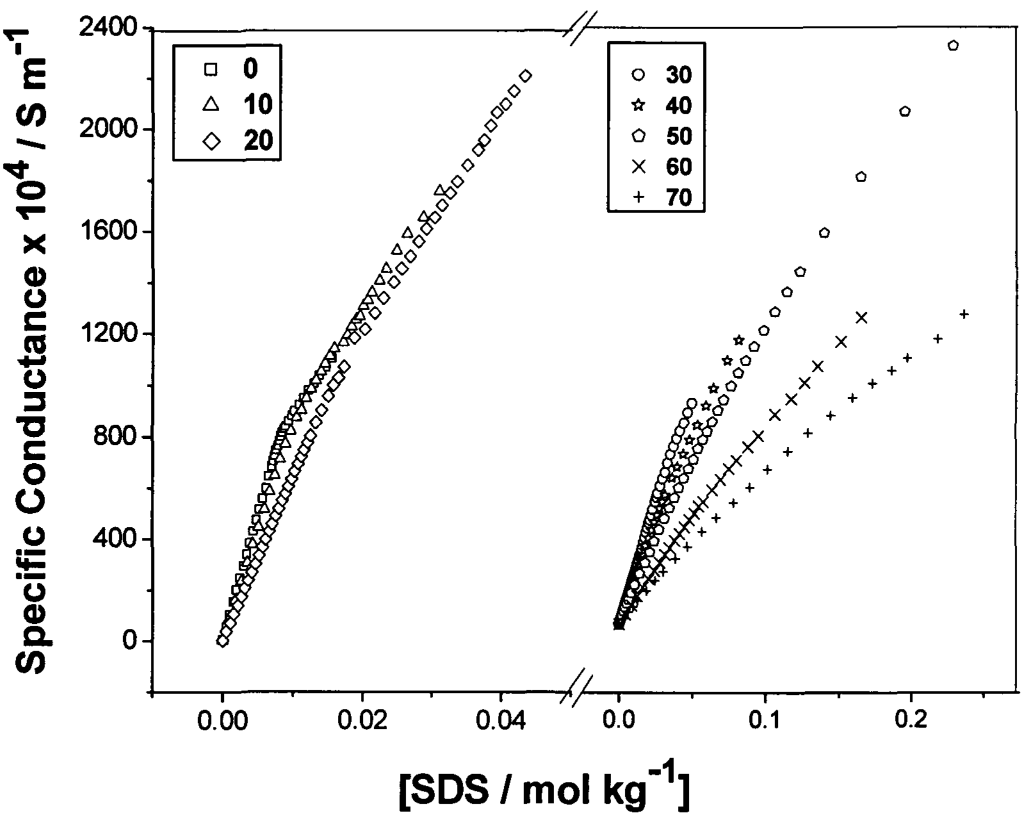

Fig. 3.1e. Specific conductance of SDS at 40 °C as a function of surfactant concentration in water + AA medium containing varying amounts of AA. Numbers in the insets indicate AA %

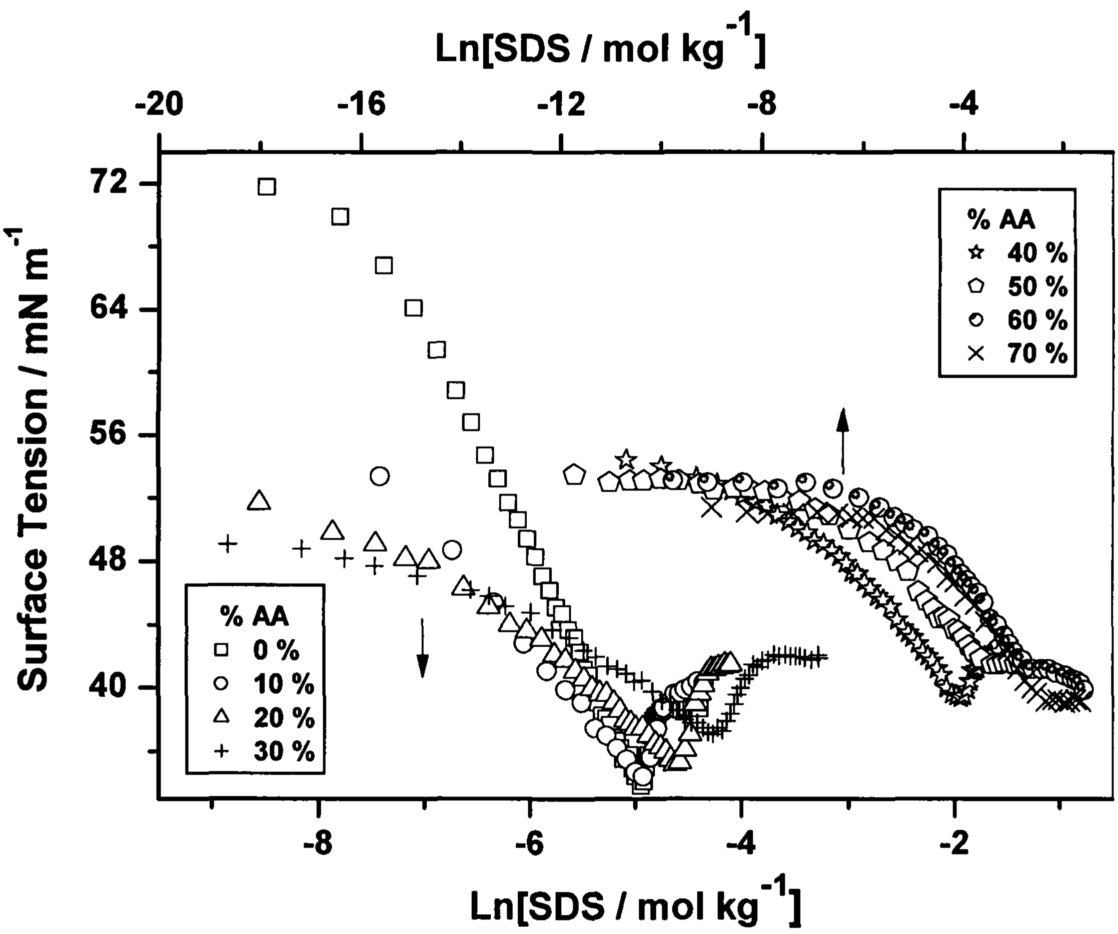

Fig. 3.2a. Surface tensions of SDS at 20 °C as a function of surfactant concentration in water + AA medium containing varying amounts of AA. Numbers in the insets indicate AA %

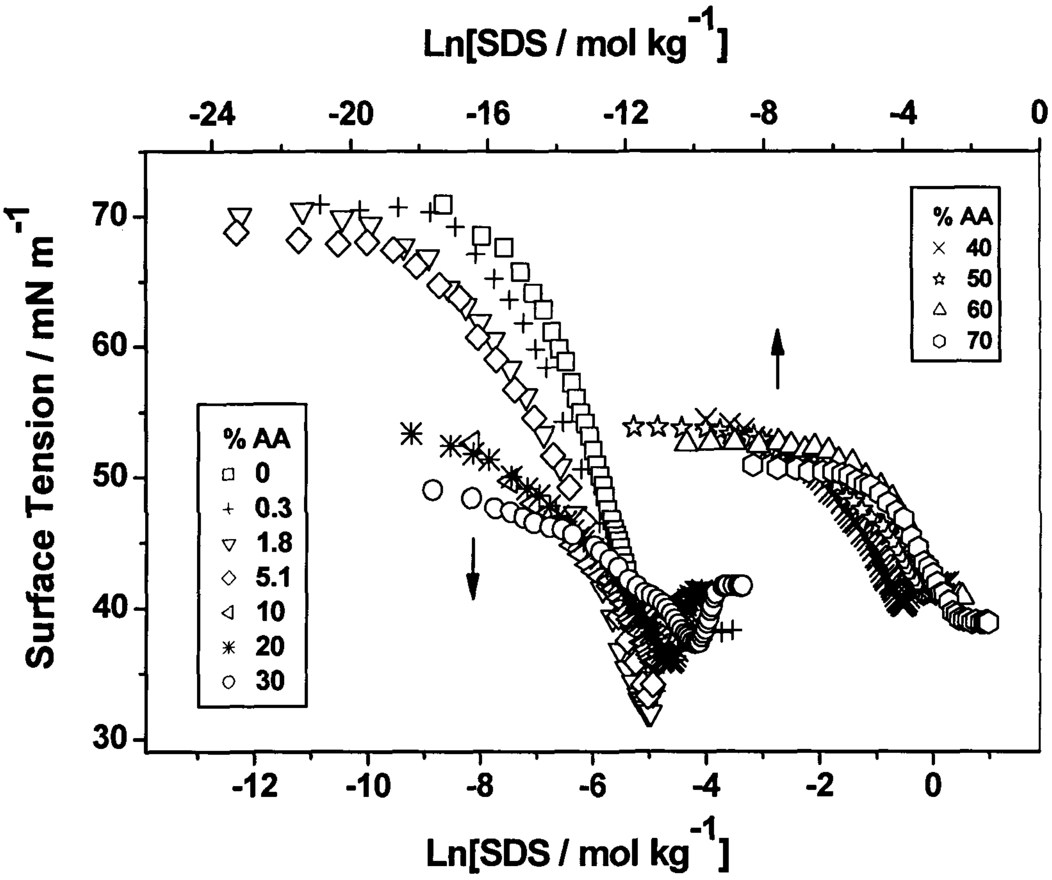

Fig. 3.2b. Surface tensions of SDS at 25 °C as a function of surfactant concentration in water + AA medium containing varying amounts of AA. Numbers in the insets indicate AA %

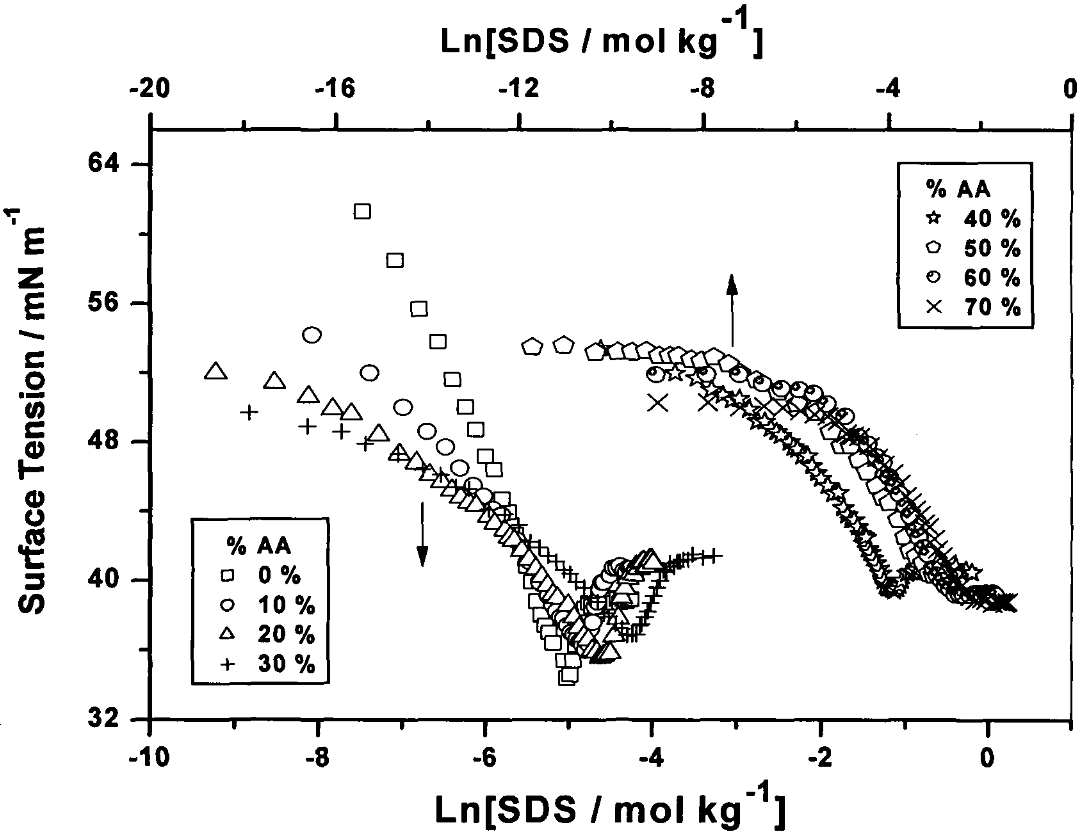

Fig. 3.2c. Surface tensions of SDS at 30 °C as a function of surfactant concentration in water + AA medium containing varying amounts of AA. Numbers in the insets indicate AA %

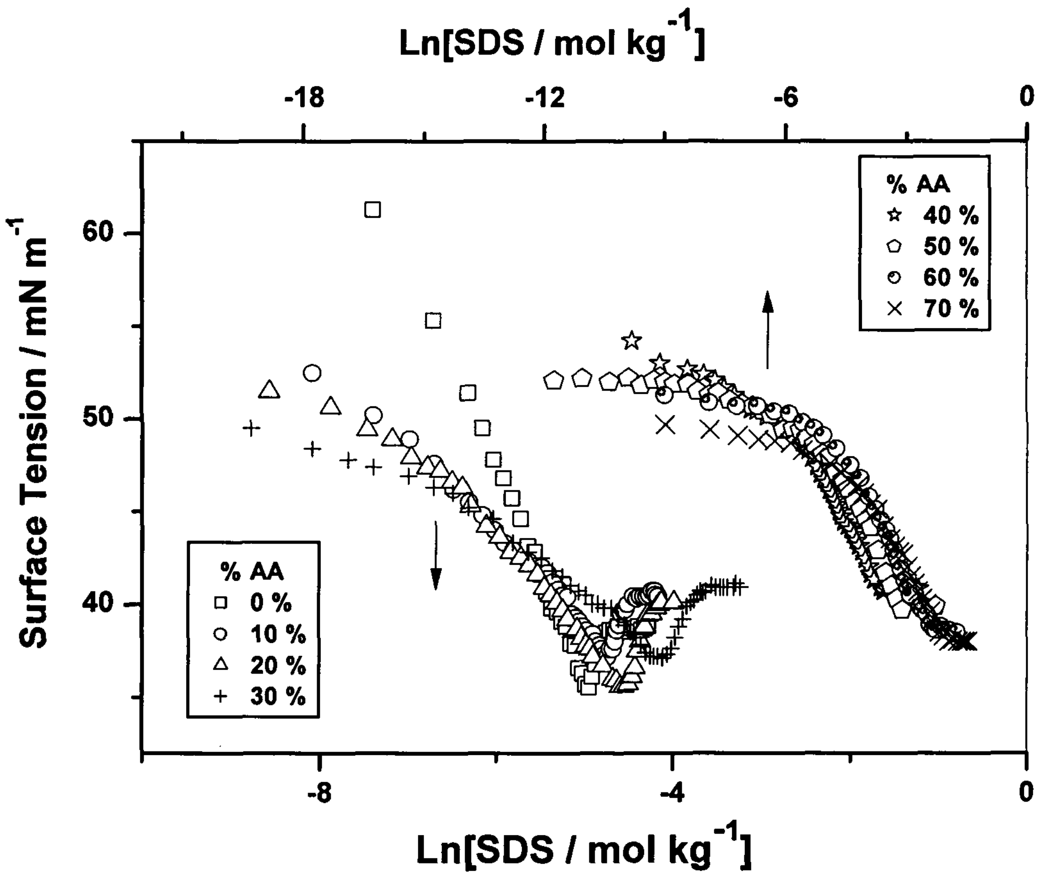

Fig. 3.2d. Surface tensions of SDS at 35 °C as a function of surfactant concentration in water + AA medium containing varying amounts of AA. Numbers in the insets indicate AA %

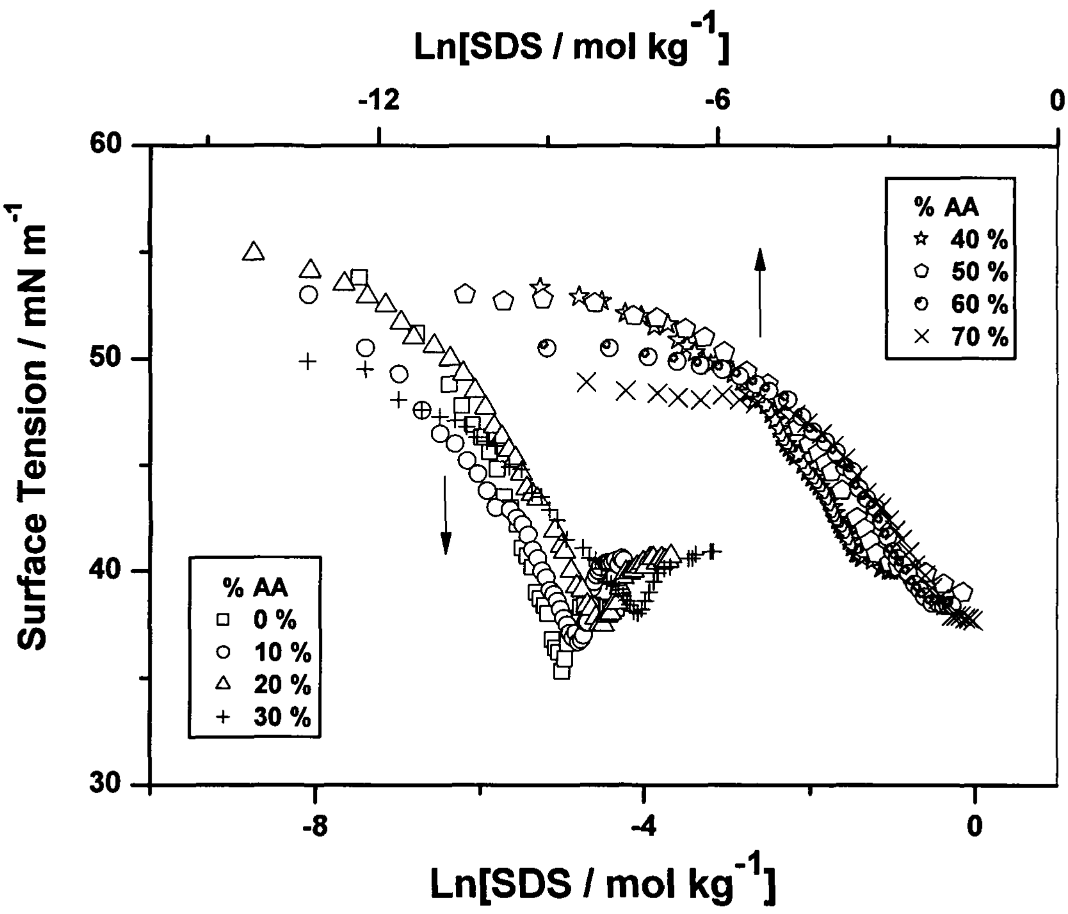

Fig. 3.2e. Surface tensions of SDS at 40 °C as a function of surfactant concentration in water + AA medium containing varying amounts of AA. Numbers in the insets indicate AA %

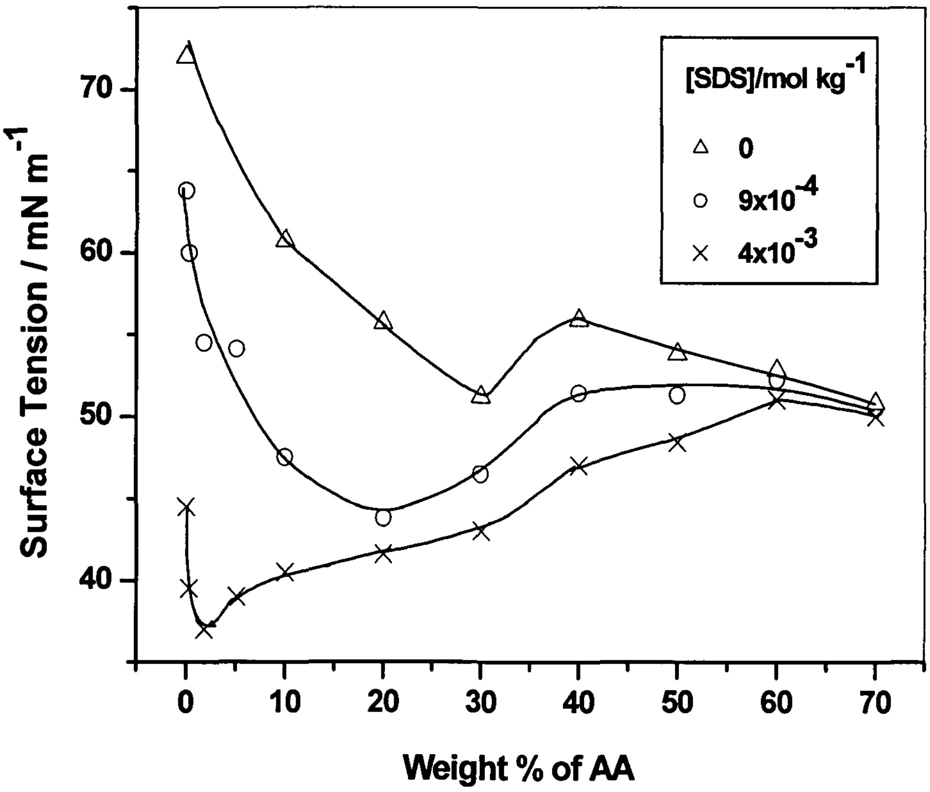

Fig. 3.3 Variation of surface tensions of water and SDS solutions at 25 °C as a function of acetamide concentration.

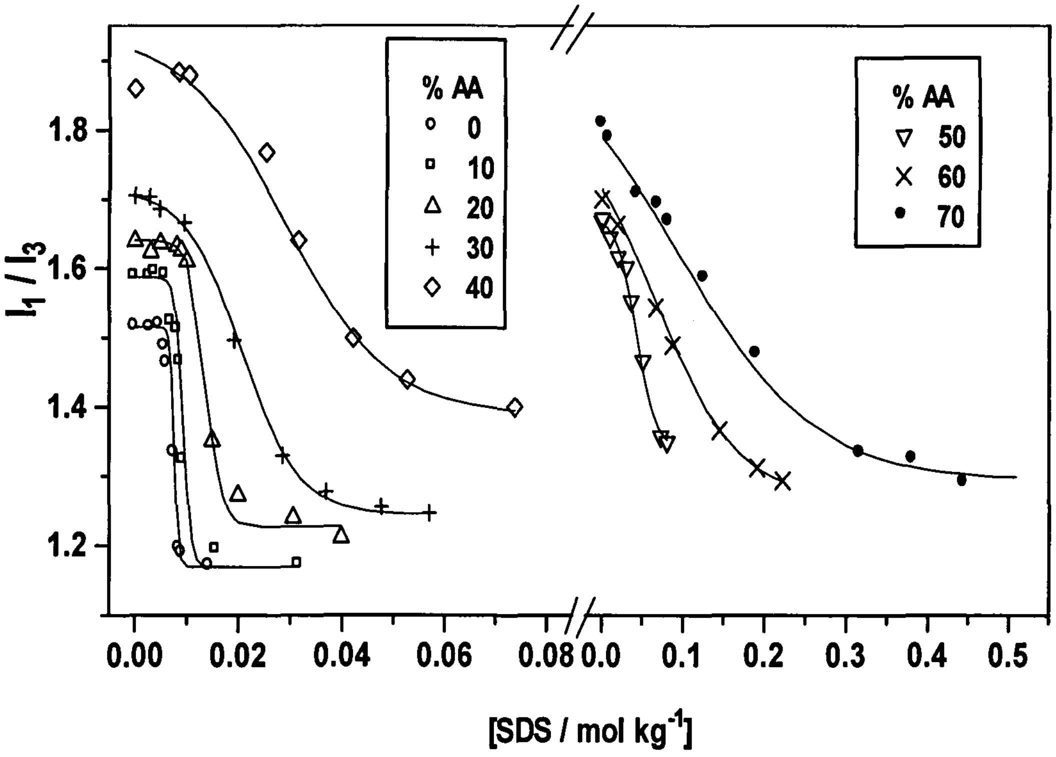

Fig. 3.4 Variation of I_1/I_3 of pyrene with SDS concentration at 25 °C in water + AA media containing varying amounts of AA. Solid lines correspond to calculated values of I_1/I_3 from Eq. (3.1) using parameters listed in Table 3.5.

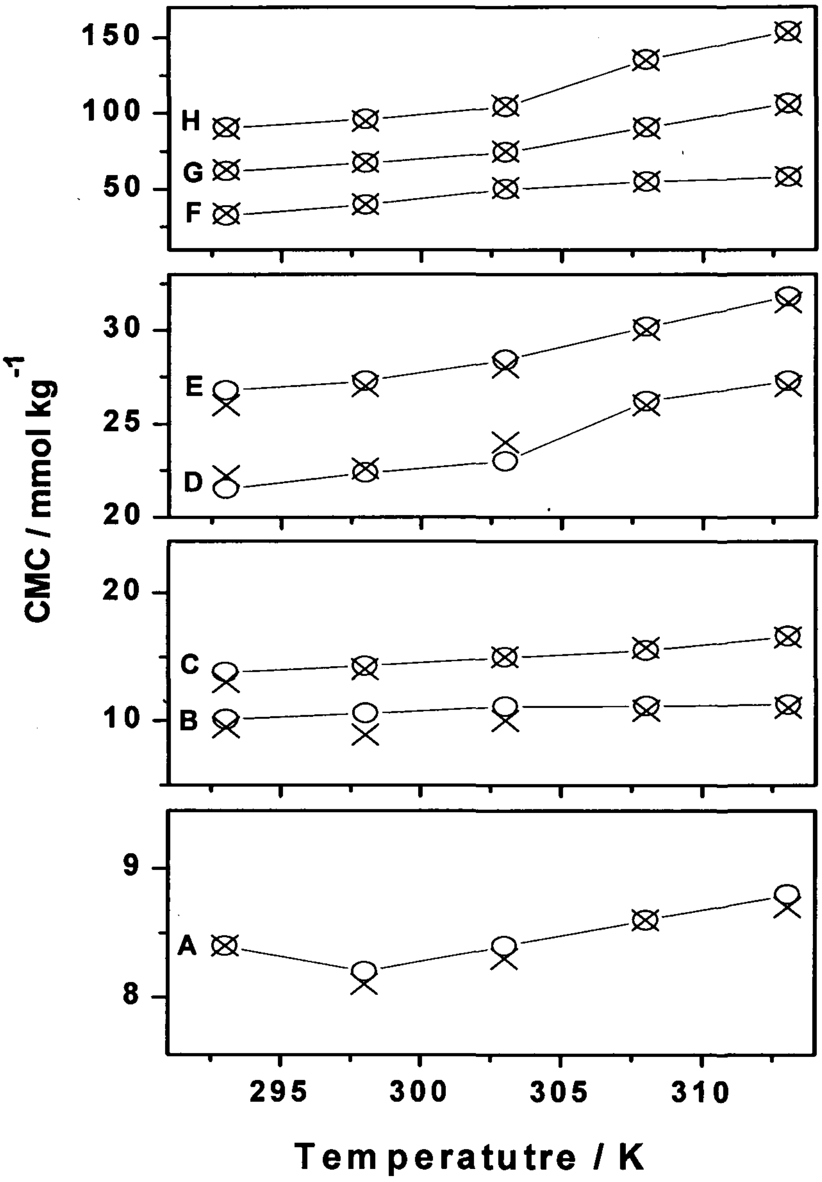

Fig. 3.5 Critical micelle concentrations of SDS in water + AA medium at different temperatures.

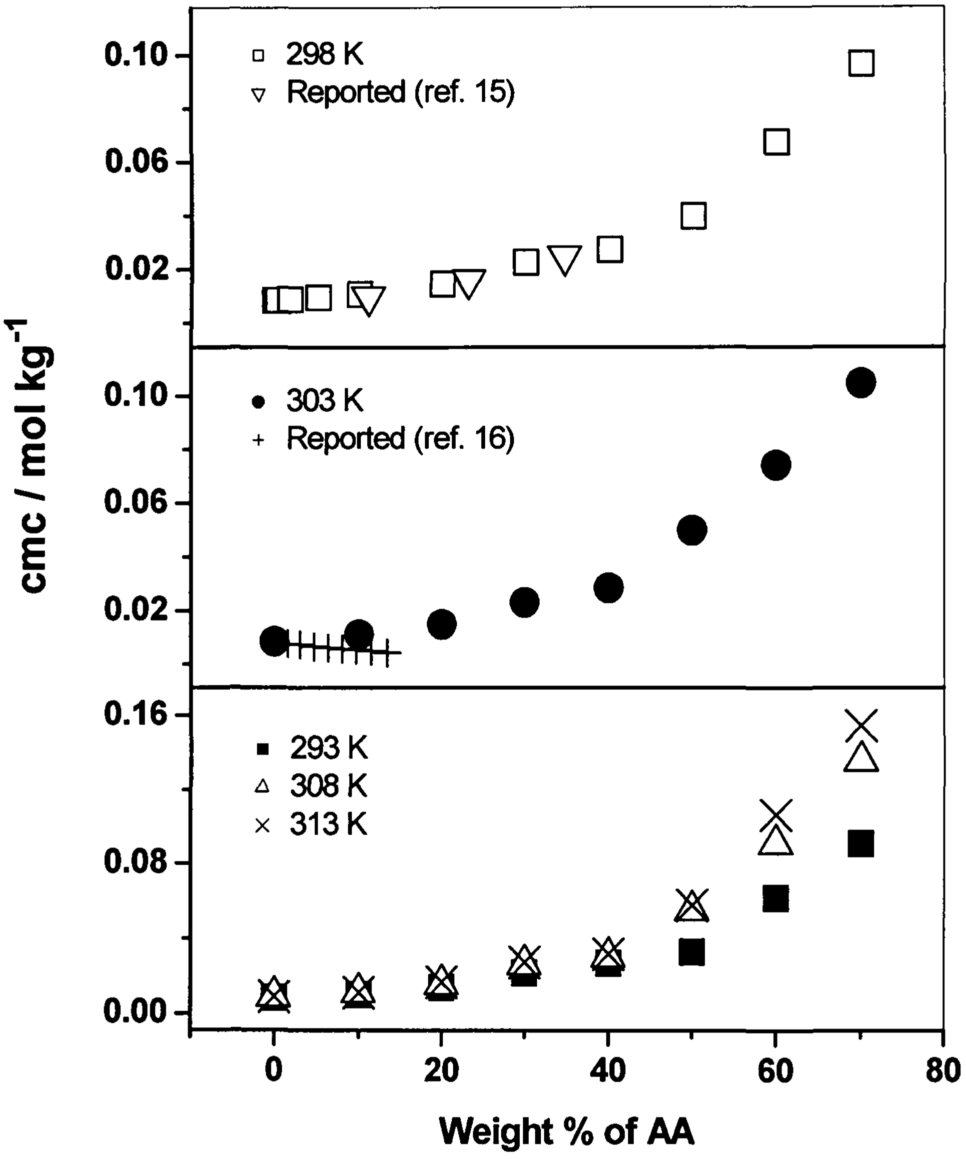

Fig. 3.6. Critical micelle concentrations of SDS in water + AA medium at different temperatures as functions of AA %.

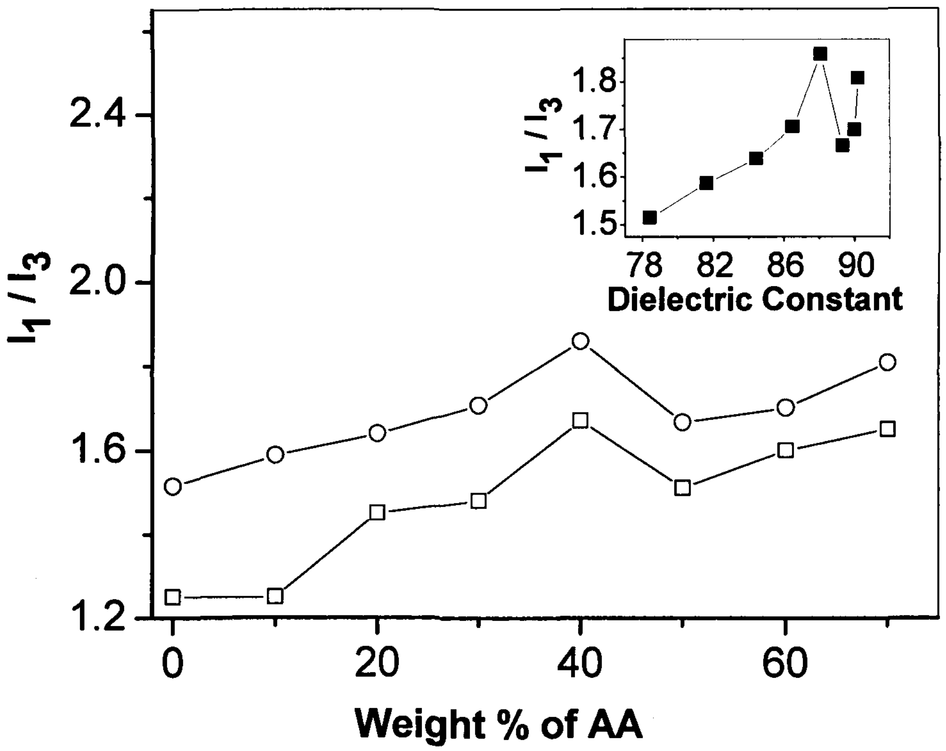

Fig. 3.7. Variation of I_1/I_3 of pyrene with AA concentration in the absence of SDS (open circles) and in the presence of SDS at cmc (open squares) in water + AA medium. Inset shows the variation of I_1/I_3 of pyrene in water + AA medium (solid squares) as a function of dielectric constant (data from ref. 17) of the medium.

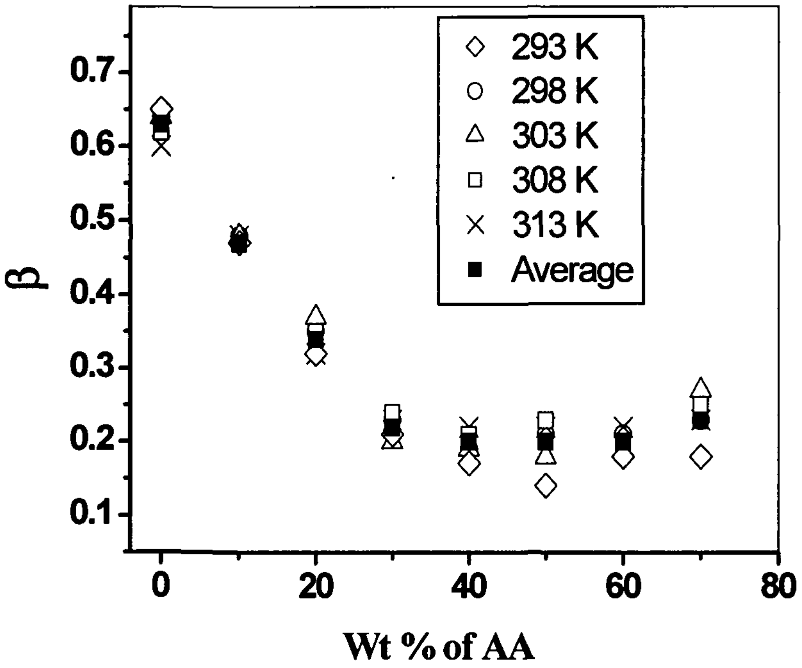

Fig. 3.8 Counter ion binding constant of SDS in water + AA medium.

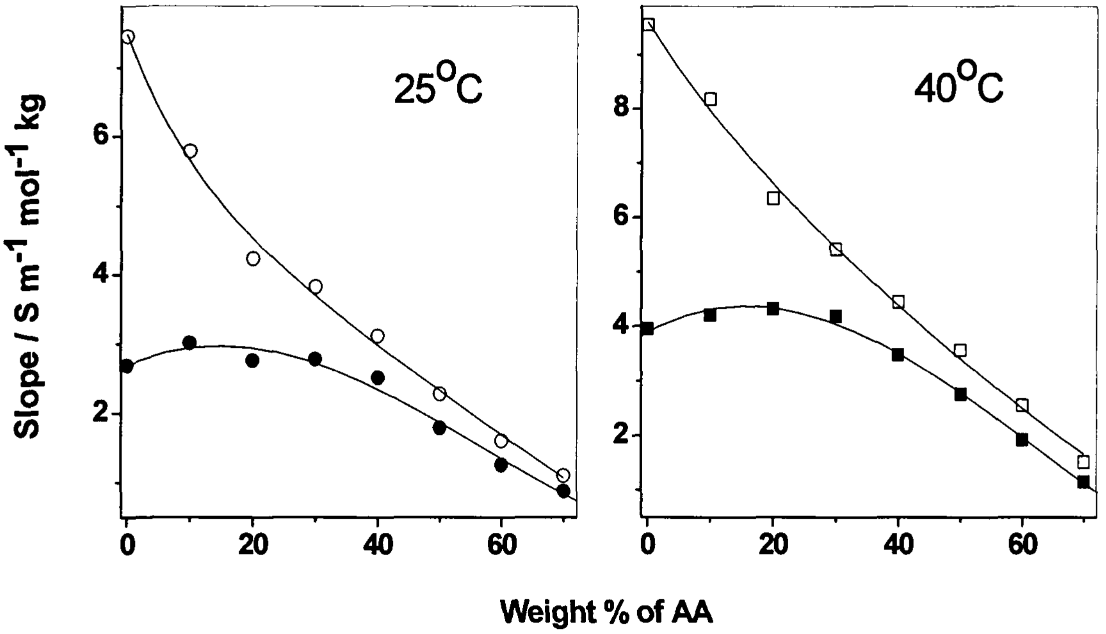

Fig. 3.9. Variation of slopes of specific conductance plots below and above cmc as a function of AA %. Open symbols for slopes below cmc and solid symbols for slopes above cmc.

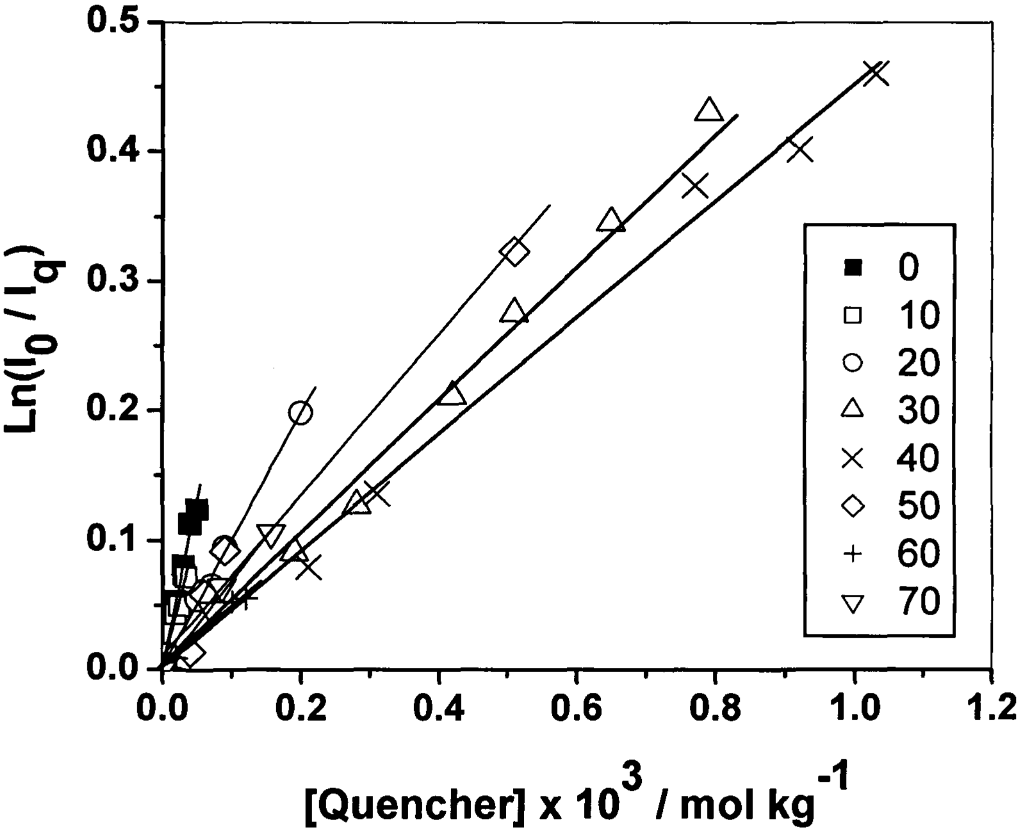

Fig. 3.10. Plots of Ln(I_0/I_q) versus quencher concentration at 25 °C. Numbers in the insets indicate AA %.

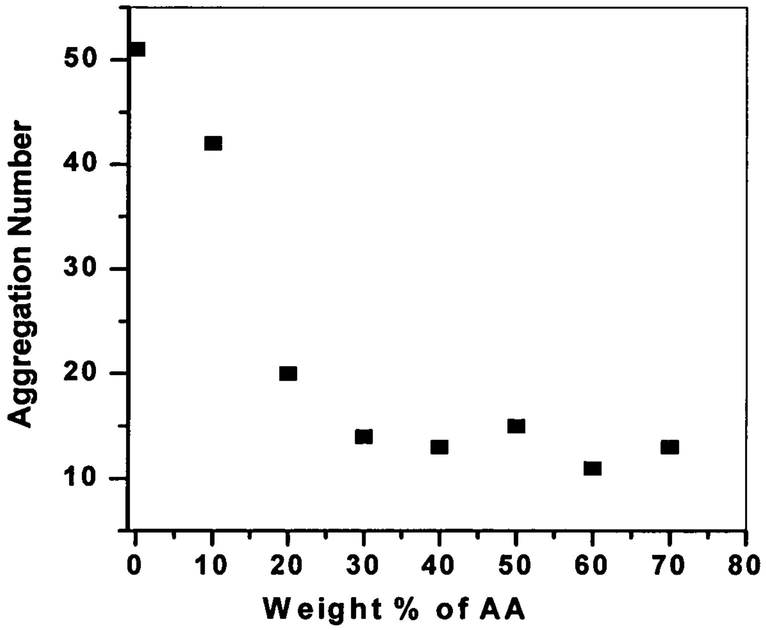

Fig. 3.11. Variation of aggregation number of SDS at 25 °C with AA %.

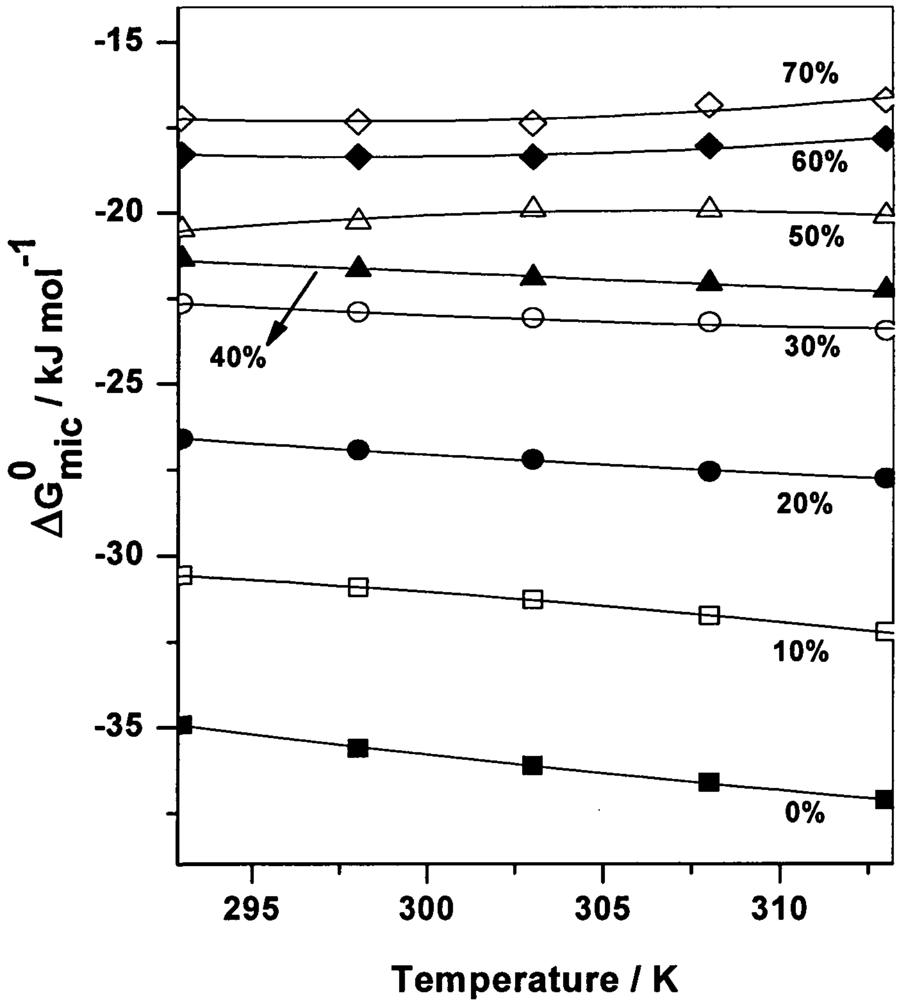

Fig. 3.12. Variation of standard free energy of micellization of SDS in water + AA medium as a function of temperature. Numbers indicate AA %.

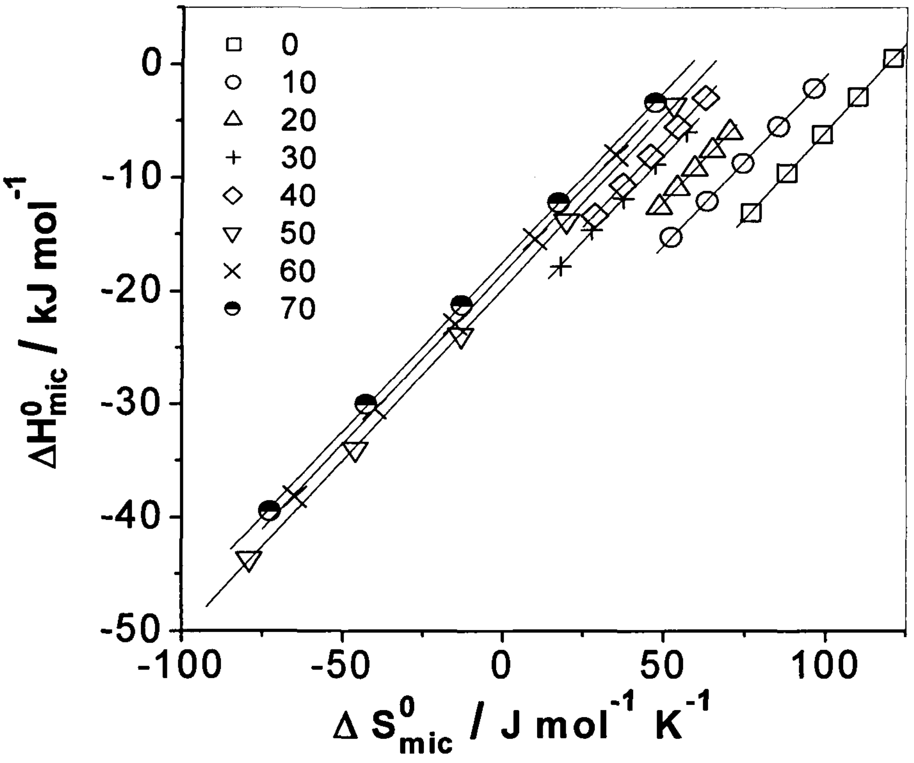

Fig. 3.13. Enthalpy – entropy compensation plots for SDS in water + AA medium. Numbers in the insets indicate AA %.

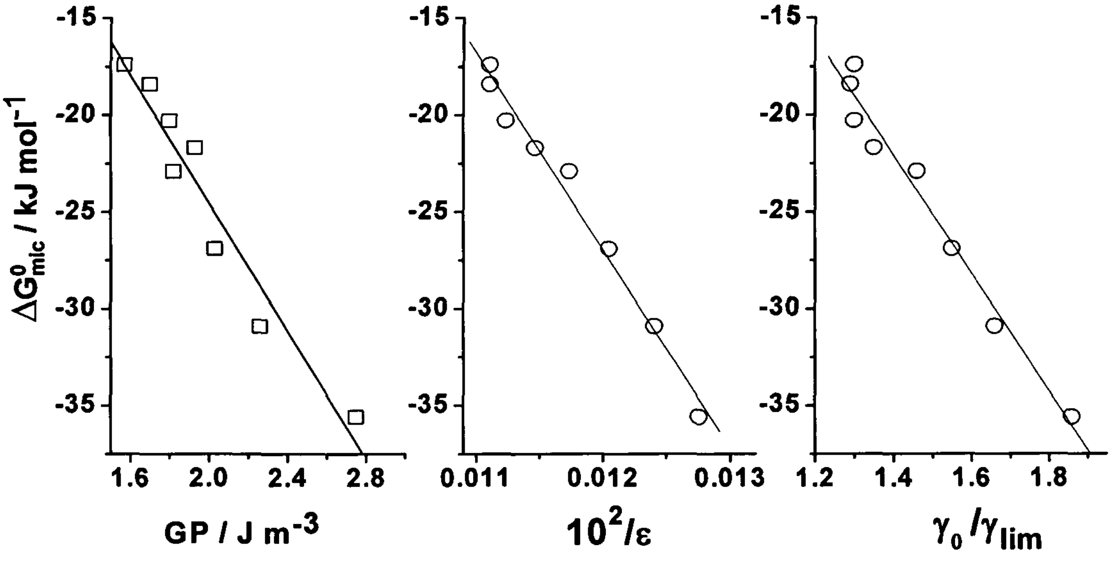

Fig. 3.14. Standard free energy of micellization of SDS in water + AA medium at 25 °C as functions of Gordon parameter, reciprocal of dielectric constant of the medium and γ_0/γ_{lim}.

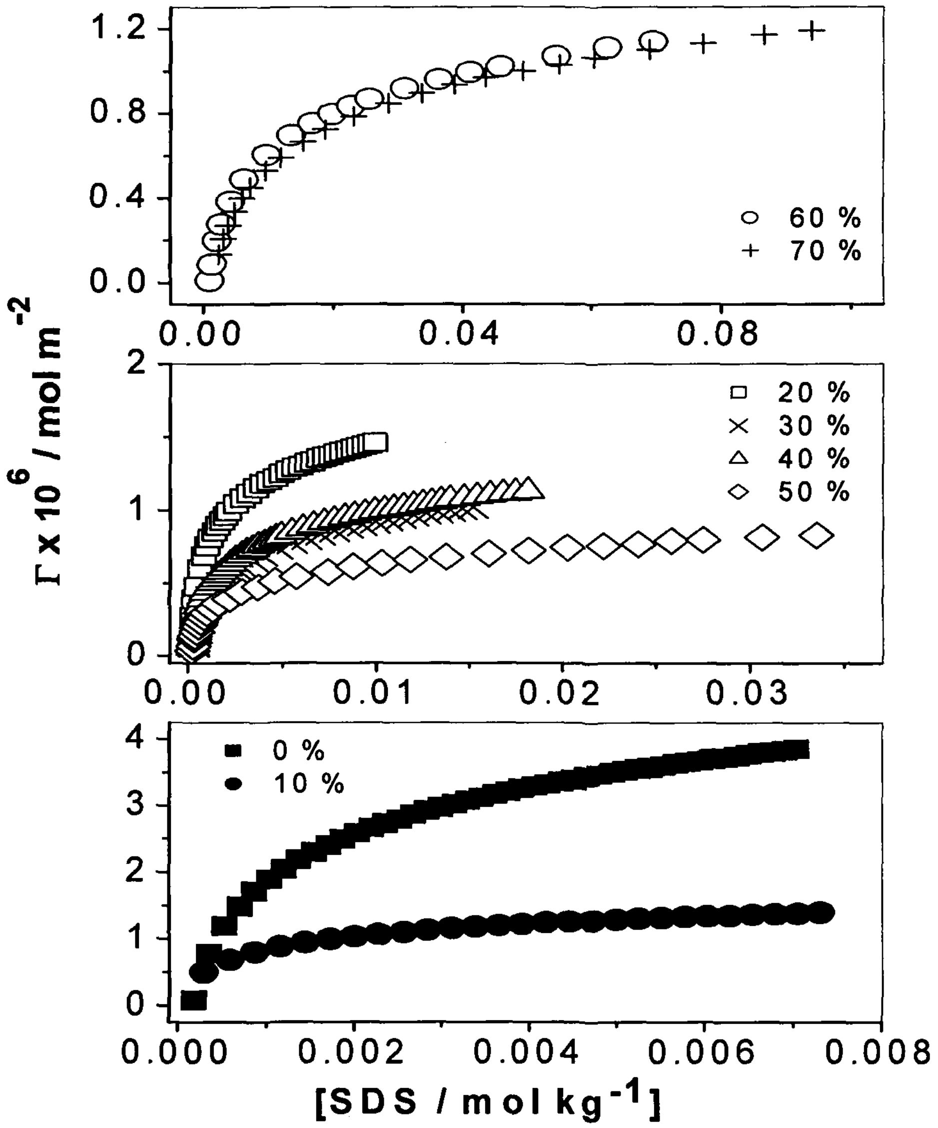

Fig. 3.15. Variation of surface excess with SDS concentration at 25 °C in the different water + AA media. Weight percentages of AA are shown in the insets.

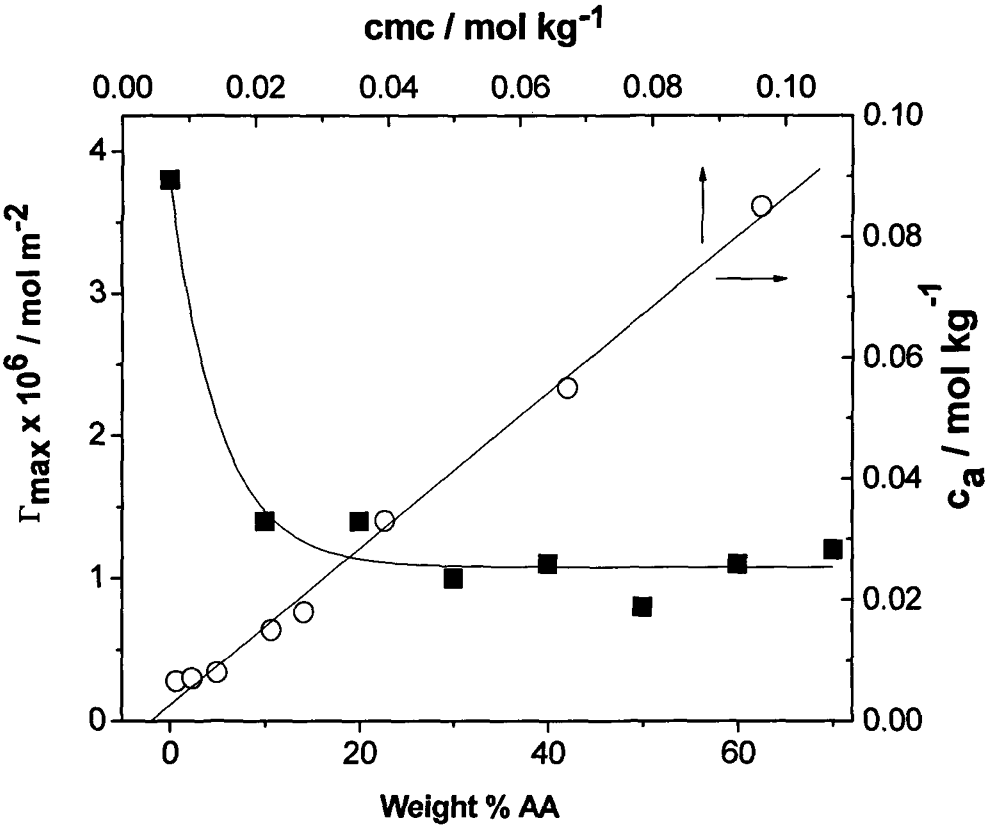

Fig. 3.16. Variation of maximum surface excess of SDS in water + AA medium as a function of AA concentration (solid squares) and of SDS concentration (c_a) at which surface excess becomes maximum with cmc of SDS (open circles) at 25 °C.

CHAPTER IV

Aggregation and Adsorption Properties of Sodium Dioctylsulfosuccinate and Cetylpyridinium Chloride in Water – Ethylene Glycol Mixtures

4.1 Introduction

Importance of solvents on the self-organizing behaviour of amphiphiles has been highlighted in chapters 1 and 3. By mixing solvents of different polarities we can prepare solvent media of varying polarities and by carrying out aggregation and adsorption studies of surfactants in such media we can gather knowledge of fundamental and practical importance. Owing to this reason, micellization characteristics of surfactants in binary mixtures of solvents are being studied with a renewed interest in the past three years.[1-22] The role of solvent on the aggregation phenomenon is so significant that the recent results of Eastoe and coworkers[12] show that aggregation of nonionic surfactants in a mixture of ethylene and propylene glycols can be switched on or off by adjusting the composition of the mixed glycol media.

Water + ethylene glycol (EG) system is a commonly used mixed solvent medium for studying the effect of solvophobicity on aggregation and adsorption behaviours of both ionic and nonionic systems. EG is considered to be a water-like solvent in terms of hydrogen-bonding ability and is an important solvent due to its use as antifreeze and in cryobiology studies. Water + EG system is reported to be a potential medium for removal of SO_2 from flue gas, which is an atmospheric pollutant.[23]

Moulik and coworkers[24,25] studied the micellization behaviour of sodium dioctylsulfosuccinate (AOT) in water + EG media and reported cmc of AOT in EG which is surprisingly lower than that in water, because generally in nonaqueous solvents cmc has higher value than in water.

Micellization of cetylpyridinium chloride (CPC) in EG was studied by Ray[26] at 27.5 °C by measuring surface tension. Rafati et al.[27] and Bakshi[28] studied micellization of CPC in water + EG media at 30 °C up to 50 and 60 % EG, respectively by measuring conductance. Micellization characteristics of CPC in water + EG media in the region of 60 to 100 % EG is still not explored. Moreover, only conductance method has been used till now for studying micellization behaviour of CPC in water + EG media.

Eastoe and coworkers[17] reported recently that the surface excess of a non ionic surfactant is unexpectedly equal in water as well as EG. In the light of the above reported information, it was considered worthwhile to take up investigation of adsorption and aggregation behaviours of AOT and CPC in water + ethylene glycol (EG) media covering the entire range of composition. The results of such a study are presented in this chapter.

4. 2 Experimental Section

AOT (Sigma, > 99 %), CPC (Sigma, > 99 %), EG (SRL, > 99 %) and pyrene (Fluka, > 97 %) were used without further purification. Millipore grade water was used for making samples. Surface tension, conductance, fluorescence emission and uv spectrophotometric measurements were made as described in chapters 2 and 3.

4.3 Results and Discussion

4.3.1 Nature of surface tension isotherms

The experimental values of surface tension of AOT + water + EG systems as a function of AOT concentration at 20, 25, 30, 35 and 40 °C and at varying amounts of EG (0 to 100 weight %.) are given in Table 4.1. The surface tension isotherms are shown in Figs. 4.1 – 4.5. From these figures it is apparent that when the media contain 60 weight % or more of EG, a new break in the surfactant isotherm of AOT occurs much below the cmc. In order to get a more clear view of these breaks, we have re-plotted in Figs. 4.6 and 4.7 the surface tension isotherms at 293 and 298 K using enlarged scales. Such breaks in the surfactant isotherms look similar to those occurring in surfactant – polymer systems due to interaction between surfactant and polymer. In EG + water system, extensive hydrogen bonding has been reported with formation of a probable structure containing 3 EG molecules bonded to 4 water molecules at around 70 % EG.[29] It has also been reported that EG + water medium containing 70 to 90 volume % of EG is best suited for desulfurization due to optimum solubility of SO_2, which is as a result of hydrogen bonding of SO_2 with EG.[23] When the amount of EG in the mixed solvent is 60 % or more, added AOT through oxygen of its C=O and S=O groups may be forming hydrogen bonds with the EG that are sufficient for the manifestation of break in the surface tension isotherm. When such interaction occurs between AOT and EG, the added surfactant molecules may remain in the bulk without going to the air – solution interface causing thereby less change in surface tension. This appears to be responsible for the initial break in the surfactant isotherm below the cmc. UV spectra (Fig. 4.8) of AOT in EG (60 %) + water media when taken as a function of AOT concentration showed red shift of the wavelength of maximum absorption (λ_{max}). This confirms the interaction of AOT with EG through hydrogen bonding since such red shift of λ_{max} owing to hydrogen bonding has been reported in acetic acid + water system.[30]

The experimental values of surface tension of CPC + water + EG systems as a function of EG amount at 25 °C are given in Tables 4.2. The surface tension isotherms are shown in Fig. 4.9 and in these isotherms no breaks occur in the submicellar concentration region unlike the case with AOT. Surface tension isotherms of CPC, on the other hand, exhibit surface tension minima at cmc in water + EG media containing 10 to 70 % EG. The minimum becomes very sharp in 70 % EG + water medium. Normally, surface tension minimum at cmc occurs due to the presence of impurity in the surfactant sample. Since surface tension minimum is not found in either pure water or EG medium, the impurity in CPC seems to be negligible. Therefore, at the moment we are unable to explain the mechanism of evolution of such a surface tension minimum of CPC in water + EG medium.

4.3.2 Critical micelle concentration (cmc) from surface tension and conductance

The cmc values of AOT in EG + water media determined from the surface tension isotherms are given in Table 4.3. With increasing EG content of the medium the value of cmc increases as shown in Fig. 4.10. The present work therefore shows that the cmc of AOT also increases with decrease in the solvophobicity of the medium in accordance with the general trend. However, the cmc values of AOT in EG + water media reported by Moulik et al.[24,25] had unusual trends, viz., (i) cmc increased with EG amount initially and then passed through a maximum at about 63 weight % of EG and (ii) cmc of AOT in EG was less than that in water. The cmc values of AOT in 90 and 100 % EG at 303 K reported by Moulik et al.[24,25] from calorimetry are 3.0 and 1.5 mmol dm^{-3}, respectively. From Fig. 4.11 it is interesting to note that the first low-concentration breaks in the surface tension isotherms of AOT in 90 and 100 % EG at 303 K occur at 2.5 and 1.5 mmol kg^{-1} of AOT. Therefore, we are of the view that, similar to the breaks occurring in surface tension isotherms, inflexions occur in the calorimetry curves of AOT in EG + water media due to hydrogen bonding leading to pseudo-cmc values.

The temperature dependence of cmc is illustrated in Fig. 4.12. Up to 30 % EG, the dependence of cmc on temperature is not significant. Above 30 % EG, cmc considerably increases on increasing the temperature from 20 to 40 °C.

Specific conductance values of AOT in the water + EG media are given in Tables 4.4 and also plotted in Fig. 4.13 – 4.17. As reported earlier,[25,31] specific conductance versus concentration plot of AOT in water does not give proper value of its cmc. In 10 and 20 % EG also the agreement between cmc values derived from surface tension and conductance data are found to be poor. In media containing 30

% or more EG, conductance data of AOT however provide cmc values comparable with those obtained from surface tension data. The values of cmc determined from conductance data are listed in Table 4.3. It may, however, be commented that determining cmc from conductance data alone is difficult since more than one breaks appear in the plot of specific conductance versus concentration. To illustrate this a few representative plots are shown in Fig. 4.18. In such a situation, to choose the correct value of cmc from the conductance plot prior knowledge about the cmc value from other techniques is needed.

The cmc values of CPC in EG + water media at 25 °C determined from the surface tension isotherms are shown in Table 4.5 and Fig. 4.19. When the surface tension isotherm exhibits minimum, the value of cmc is taken to be the concentration corresponding to the surface tension minimum. We could not find reported values of cmc of CPC in EG + water media at 25 °C for comparison. However, the reported values of cmc of CPC at 30 °C up to 60 % EG are shown in Table 4.5. The value of cmc reported by Ray[26] for CPC in EG at 27.5 °C is equal to 0.23 mol dm^{-3}, whereas we obtained at 25 °C a much lower value equal to 0.091 mol kg^{-1}. We repeated the measurement of surface tension of CPC in EG at 25 °C to higher concentration range and these experimental data are shown in Fig. 4.20. From the surface tension isotherm given in Fig. 4.20 it can be seen that there is a second break occurring at 0.247 mol kg^{-1}, which is close to the cmc value reported by Ray.[26] Therefore, CPC appears to have in EG two values for cmc.

Specific conductance values of CPC in water + EG media at 25 °C are given in Table 4.6 and also plotted in Fig. 4.21. The values of cmc determined from conductance data are given in Table 4.5. In the case of CPC also, the plots of specific conductance versus surfactant concentration exhibit more than one break. For CPC in EG, the two breaks observed in the specific conductance versus concentration isotherm (Fig. 4.20) correspond to the two cmc values obtained from the surface tension data.

4.3.3 Cmc of AOT from fluorescence

Values of the ratio I_1/I_3 of the fluorescence emission intensities of pyrene at 25 °C measured in AOT + water + EG media as functions of EG amount and AOT concentration are given in Table 4.7. I_1 and I_3 refer to the intensities of pyrene emission spectra at 374 and 384 nm, respectively. In Fig. 4.22, plots of I_1/I_3 versus AOT concentration are shown. The I_1/I_3 data were fitted to Eq. (4.1) as described in the preceding chapter.

$$I_1/I_3 = \{(A_1 - A_2) /(1 + \exp[(c - c_0)/b])\} + A_2 \qquad (4.1)$$

In Eq. (4.1) c represents AOT concentration, c_0 is the value of c corresponding to the centre of the sigmoid, A_1 and A_2 are the upper and lower limits of the sigmoid, respectively, and b is a term that reflects the range of c where sudden change of I_1/I_3 occurs. The values of the parameters of Eq. (4.1) obtained from the fitting are given in Table 4.8. The cmc of AOT is found to be almost equal to (i) c_0 from 0 to 40 % EG, (ii) $(c_0+b)/2$ from 50 to 80 % EG, and (iii) again c_0 at 90 and 100 % EG. Thus, the empirical correlations suggested by Aguiar et al.[32] that are described in chapter 3 are not applicable in the case of AOT in water + EG media. Therefore, this study also reveals that the characteristics of the parameters of Eq. (4.1) for ionic surfactant, particularly c_0 and b parameters are strongly dependent on the nature of the surfactant as well as on the nature of the solvent.

4.3.4 Counter ion binding

Counter ion binding constant (β) is determined from the conductance data by the slope ratio method. In this method the ratio of the slopes of specific conductance versus concentration plots above (S_2) and below (S_1) cmc is taken as almost equal to 1-β. In water β of AOT could not be determined from the slope ratio method since conductance data of AOT in water do not give correct cmc value as discussed above. In media containing EG 10 % or more, the values of β calculated from slope ratio method are listed in Table 4.9. The other method used for estimating β is the Corrin-Harkins (CH) method. In this method, β is determined from the CH equation, which is of the form

$$\ln(\text{cmc}) = A - \beta \ln(\text{cmc} + c_e) \qquad (4.2)$$

where the intercept A is related to the standard free energy of micellization and c_e is the concentration of the added electrolyte. The basis of this equation is described in chapter 1. To evaluate β from Eq. (4.2), cmc values of a surfactant are to be determined as a function of added electrolyte concentration. While determining β of AOT from the CH method two values for β were reported,[33] a lower value equal to

0.39 when the electrolyte (NaCl) concentration is less than or equal to 0.015 mol kg^{-1} and 0.8 when the electrolyte concentration exceeds 0.015 mol kg^{-1}. Since we are interested here in the value of β of AOT in the absence of NaCl, we chose β = 0.39 for AOT in water. In 10 and 20 % EG, although we could estimate β value from the slope ratio method, we preferred the values of β determined from the CH method since in these two media also the cmc values obtained from conductance method are not in good agreement with those determined from the surface tension data. The experimental values of surface tension of AOT in 10 and 20 % EG media in the presence of NaCl are given in Table 4.10 and the surface tension isotherms are shown in Figs. 4.23 and 4.24. The CH plots are shown in Fig. 4.25 and we have covered only very low concentration region of NaCl since we are only interested in the lower value of β of AOT.

From Table 4.9 it is apparent that the values of β calculated from the slope ratio method do not show any regular trend with increase in EG or temperature. Therefore, in 30 to 100 % EG we took an average value for β of AOT as equal to 0.22 ± 0.07. In mixed solvent media, very weak dependence of β on temperature and amount of non-aqueous solvent has been reported by others also.[34,35] The values of β for CPC in mixed solvent media at 25 °C were also calculated from the slope ratio method and these values are listed in Table 4.9. For both AOT and CPC, the values of β are lower in mixed solvent media than in water, which is a common trend observed in an aqueous organic polar solvent medium. As observed in the preceding chapter, in the present systems of study also β is controlled more by the solvophobicity of the medium. In EG the value of β is almost same for both AOT and CPC.

4.3.5 Thermodynamic parameters of micellization

The values of the standard free energy of micellization per mole of surfactant, ΔG^0_{mic}, were calculated for AOT and CPC in the mixed solvent from the expression,

$$\Delta G^0_{mic} = (1+\beta)RT\ln X_{cmc} \qquad (4.3)$$

where X_{cmc} is cmc in mole fraction unit, R is the gas constant and T is the absolute temperature. The calculated values of ΔG^0_{mic} are presented in Table 4.11. With increasing concentration of EG, ΔG^0_{mic} becomes less favorable to micellization (Fig. 4.26). The effect of temperature on ΔG^0_{mic} of AOT becomes negligible as the EG content in the medium increases (Fig. 4.27).

As described in chapter 3, standard entropy (ΔS^0_{mic}) and enthalpy (ΔH^0_{mic}) changes of micellization per mole of AOT monomer were determined using the following relations

$$\Delta S^0_{mic} = -(\partial \Delta G^0_{mic}/\partial T)_P \qquad (4.4)$$

$$\Delta H^0_{mic} = \Delta G^0_{mic} + T\Delta S^0_{mic} \qquad (4.5)$$

For evaluating ΔS^0_{mic} and ΔH^0_{mic}, a fitting of ΔG^0_{mic} as a function of temperature is required and this approach is known as van't Hoff method.[36] The values of ΔS^0_{mic} and ΔH^0_{mic} obtained thus are listed in Table 4.12 and 4.13. Up to 30 % EG ΔS^0_{mic}

and ΔH^0_{mic} have negligible dependence on temperature. Values of ΔH^0_{mic} indicate that micellization of AOT in water is endothermic, but becomes exothermic above 10 % EG. From calorimetric measurements Moulik and coworkers[36] have found micellization of AOT endothermic in water, exothermic in the range from 5 to 72 % EG and again endothermic above 90 % EG. Values of ΔH^0_{mic} measured directly by calorimetry are reported[36,37] to differ from those determined from the van't Hoff method. In the light of the hydrogen bonding taking place between AOT and EG + water structures as discussed above and the cmc value of AOT reported by Moulik and coworkers[24,25] being lower than in water, a re-look into the calorimetry of micellization of AOT in water + EG media may be needed. ΔS^0_{mic} has been found to have positive values up to 30 % EG, but when the EG content of the medium is 40 % and above it becomes negative also. A similar trend of ΔS^0_{mic} was reported[38] for cetylpyridinium bromide in water + EG media at 298 K above 60 % EG. Negative values of ΔS^0_{mic} were reported for surfactants in water, mixed solvents and pure organic solvents.[24,36,38-41] In chapter 3 we obtained negative values of ΔS^0_{mic} for SDS in water + acetamide media as well. Such negative values of ΔS^0_{mic} is attributed to the decrease in the ordering of solvent molecules along the hydrocarbon tail of the surfactant in the premicellar region. Hydrogen bonding between AOT and solvent molecules in the water + EG medium seems to reduce the solvophobic interaction. At higher contents of EG (≥

40 %), ΔS^0_{mic} becomes either less or more negative with increase in temperature without showing any regularity.

In spite of irregular trends in the variations of ΔS^0_{mic} and ΔH^0_{mic} with temperature and EG content, a very good compensation of enthalpy and entropy occurs for the micellization of AOT in water + EG medium as evidenced by the validity of the enthalpy – entropy compensation relation

$$\Delta H^0_{mic} = \Delta H^*_{mic} + T_c \Delta S^0_{mic} \qquad (4.6)$$

The value of the compensation temperature, T_c, is found to be 299 ± 7 K with lowest value of T_c = 292 K occurring in 100 % EG. The linear plots of ΔH^0_m versus ΔS^0_{mic} are shown in Fig. 4.28. Such plots were not drawn in media having less than 40 % EG due to no dependence of ΔH^0_{mic} and ΔS^0_{mic} on temperature. In applying Eq. (4.6) ΔH^0_{mic} and ΔS^0_{mic} are varied as a function of temperature in a chosen medium.

4.3.6 Surface excess and free energy of adsorption

Surface excess values of AOT and CPC at the air – solvent interface near the cmc, Γ_{cmc}, were calculated from the surface tension data in the concentration range lying below cmc by using the expression

$$\Gamma_{cmc} = -[1/(2RT)][d\gamma/d\ln c] \qquad (4.7)$$

The values of the slope, $d\gamma/d\ln c$, were found out from the linear fit of γ versus lnc. The values of Γ_{cmc} obtained thus are given in Table 4.14 and also shown in

Fig. 4.29. From Fig. 4.29 it is clear that Γ_{cmc} of both AOT and CPC decreases as the EG amount increases in the medium. Decrease in Γ_{cmc} is an indication of decrease in solvophobicity with increase in EG content of the medium. The difference in the values of Γ_{cmc} of AOT and CPC narrows down as the amount of EG increases.

The standard free energy of adsorption, ΔG^0_{ad}, is generally calculated for both nonionic and ionic surfactants from the equation reported by Rosen and Aronson,[42]

$$\Delta G^0_{ad} = \Delta G^0_{mic} - \Pi_{cmc}/\Gamma_{cmc} \qquad (4.8)$$

Π_{cmc} refers to surface pressure at cmc. The values of ΔG^0_{ad} for AOT and CPC obtained from this equation are listed in Table 4.15. ΔG^0_{ad} always has values less than ΔG^0_{mic} and the difference between them is more for AOT than CPC.

4.3.7 Solvophobicity index

In the previous chapter we showed that in SDS + water + acetamide system the limiting surface tension at the cmc (γ_{lim}) shows no dependence on the amount of acetamide. Eastoe and coworkers[17] have also made a similar observation in the case of nonionic surfactants in water + EG media. Based on such observations, we proposed that the ratio of the solvent surface tension (γ_0) to the limiting surface tension, γ_0/γ_{lim}, can be used as a probable new scale to express solvophobicity of a medium towards a particular surfactant. This new scale to express solvophobicity has been tested in Triton X-100 + water + formamide system[43] and is found to work as good as Gordon Parameter (GP) scale. Gordon Parameter is defined as $\gamma_0/V^{1/3}$, where V refers to the molar volume of the medium. The values of $\gamma_0$and γ_{lim} are listed in Tables 4.16 and 4.17, respectively. The values of γ_{lim} for AOT and CPC in water, water + EG and EG media (Table 4.17) are found to be same within ±2 mN m^{-1} with almost no dependence on the amount of EG as observed by Eastoe and coworkers[17] for nonionic surfactants. The values of GP and $\gamma_0/\gamma_{\text{lim}}$ for AOT and CPC in water + EG media at 25 °C are given in Table 4.18 and the plots of ΔG^0_{mic} versus GP and $\gamma_0/\gamma_{\text{lim}}$ are shown in Figs. 4.30 and 4.31. It is clear from Figs. 4.30 and 4.31that $\gamma_0/\gamma_{\text{lim}}$ can also be used as a solvophobicity index for ionic surfactants.

Conclusions

In this chapter we have measured surface tension and conductance of AOT in water + EG media at 20, 25, 30, 35 and 40 °C. Fluorescence emission intensity of pyrene in AOT + water + EG system has been measured at 25 °C. Surface tension and conductance measurements of CPC were made at 25 °C in water + EG media. The amount of EG was varied from 0 to 100 weight % in an interval of 10.

A new break has been found to occur in the surfactant isotherm of AOT far below the cmc when the media contain 60 weight % or more of EG indicating interaction between AOT and EG. This interaction is considered to be due to hydrogen bonding of AOT through oxygen of its C=O and S=O groups with EG. UV spectra of AOT in 60 % EG + water medium also show that interaction takes place between AOT and EG. The present work shows that the cmc of AOT increases with increase in EG content of the medium in accordance with the general trend unlike the reported result.[23,24] Cmc has negligible dependence on temperature in the region where EG ≤ 30 %, but above 30 % EG it increases considerably on increasing the temperature.

In media containing 30 % or more EG, conductance data of AOT provide cmc values comparable with those obtained from surface tension data. But, below 30 % EG the agreement between the cmc values derived from surface tension and conductance data is not good. It is, however, important to note that determining cmc from conductance data alone is difficult since more than one breaks appear in the plot of specific conductance versus concentration.

Surface tension isotherms of CPC do not exhibit any additional break in the submicellar region of the type observed in the case of AOT. On the other hand, surface tension isotherms of CPC exhibit surface tension minima at cmc in water + EG media containing 10 to 70 % EG. The minimum becomes very sharp in 70 % EG + water medium. Since surface tension minimum is not found in either pure water or EG medium, the impurity in CPC does not seem to be the cause of surface tension minima. At the moment, we are unable to explain the mechanism of evolution of such a surface tension minimum of CPC in water + EG medium. For

CPC, cmc data obtained from surface tension and conductance data are in good agreement. In EG, CPC appears to have two values of cmc.

In the range of 30 to 100 % EG, we took an average value for the counter ion binding constant (β) of AOT as equal to 0.22 ± 0.07. In mixed solvent media, β has a very weak dependence on temperature and amount of non-aqueous solvent.

Values of ΔH^0_{mic} indicate that micellization of AOT in water is endothermic, but becomes exothermic in the presence of EG. ΔS^0_{mic} has been found to have positive values up to 30 % EG, but when the EG content of the medium is 40 % and above it becomes negative. In spite of irregular trends in the variations of ΔS^0_{mic} and ΔH^0_{mic} with temperature and EG content, a very good compensation of enthalpy and entropy occurs for the micellization of AOT in water + EG medium.

Γ_{cmc} of both AOT and CPC decreases as the EG amount increases in the medium. The values of γ_{lim} for AOT and CPC in water, water + EG and EG media are found to be same within ± 2 mN m^{-1} with almost no dependence on the amount of EG. It has been demonstrated that the ratio γ_0/γ_{lim} can also be used as a solvophobicity index for ionic surfactants.

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Table 4.1a Surface Tension (γ) Values of AOT in Ethylene glycol-water Mixture at 20° C

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 0			
0	72.8	0.2793	48.9	1.6413	35.6
0.0122	63.9	0.3155	48.0	1.8647	34.4
0.0245	60.8	0.3635	47.2	2.0855	33.4
0.0367	58.5	0.4115	46.5	2.3038	32.2
0.0489	57.6	0.4594	46.1	2.6264	31.2
0.0611	56.3	0.5309	45.2	2.9436	30.7
0.0732	55.5	0.6022	44.2	3.2553	30.3
0.0854	54.8	0.6969	43.0	3.7633	29.7
0.0976	54.2	0.7911	41.8	4.3544	29.3
0.1219	53.3	0.8848	41.1	5.2974	29.0
0.1462	52.1	0.9781	40.3	6.1914	28.9
0.1705	51.4	1.0710	39.6	7.8465	28.6
0.1947	50.5	1.1864	38.8	10.043	28.3
0.2189	49.9	1.3011	37.8		
0.2431	49.6	1.4152	37.2		
		Wt.% EG = 10			
0	68.5	0.3092	49.0	2.1193	32.9
0.0016	68.0	0.3639	47.8	2.1775	32.9
0.0094	64.5	0.4306	46.6	2.3207	32.7
0.0125	64.0	0.4954	45.5	2.3496	32.1
0.0156	63.5	0.5587	44.4	2.4621	31.9
0.0187	62.0	0.6198	43.8	2.5730	31.4

Table 4.1a Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 10			
0.0250	61.4	0.6795	43.2	2.6823	31.6
0.0312	61.0	0.7376	42.2	2.7900	31.4
0.0389	59.9	0.7943	41.7	2.8961	31.0
0.0466	59.2	0.8495	40.9	3.0007	30.5
0.0543	58.8	0.9033	40.6	3.1039	30.4
0.0619	58.3	0.9557	40.0	3.2307	30.4
0.0696	57.8	1.0069	39.5	3.3554	30.4
0.0718	57.1	1.0568	39.2	3.5021	30.3
0.0848	56.6	1.1055	38.8	3.6695	30.1
0.0923	55.7	1.2281	38.2	3.8330	30.0
0.0999	55.8	1.3750	37.2	4.0155	30.2
0.1074	55.5	1.5354	36.3	4.1924	30.1
0.1224	54.2	1.7517	34.8	4.4077	30.0
0.1521	53.2	1.8820	33.8	4.6161	29.9
0.1814	52.5	1.9420	33.3	4.8179	29.5
0.2247	50.8	2.0016	33.3		
0.2673	50.0	2.1193	32.9		
		Wt % EG=20			
0	65.4	0.3361	47.4	2.5702	33.6
0.0100	61.8	0.3654	47.0	2.7379	33.2
0.0200	59.8	0.3947	46.1	2.9037	32.4
0.0300	58.3	0.4433	45.4	3.0676	32.0
0.0399	57.5	0.4918	44.7	3.2296	32.1
0.0499	56.6	0.5401	44.3	3.3898	31.6

Table 4.1a Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 20			
0.0598	55.9	0.5883	43.7	3.5482	31.7
0.0698	55.2	0.6364	43.3	3.7825	31.2
0.0797	54.6	0.6843	43.1	4.0129	31.0
0.0897	54.0	0.7415	42.7	4.3143	30.6
0.0996	53.8	0.7986	42.2	4.6819	30.7
0.1095	53.3	0.8744	41.9	5.0397	30.4
0.1294	52.5	0.9685	41.3	5.7276	30.2
0.1492	51.5	1.0621	40.5	6.3808	29.8
0.1689	51.3	1.1552	39.9	7.5931	29.4
0.1887	50.5	1.3395	38.9	8.6944	29.2
0.2084	49.7	1.5217	37.9	9.6992	28.8
0.2281	49.2	1.7017	37.0	11.052	28.6
0.2478	49.1	1.8795	36.1	12.247	28.5
0.2675	48.8	2.0553	35.2	13.640	28.2
0.2871	48.3	2.2289	34.7	14.847	28.0
0.3067	48.0	2.4006	34.0		
		Wt.% EG = 30			
0	63.1	0.4610	45.2	2.7577	34.1
0.0081	61.9	0.4922	44.8	2.8872	33.7
0.0162	60.2	0.5233	44.6	3.0154	33.3
0.0242	59.4	0.5544	44.2	3.1421	33
0.0323	58.4	0.5931	43.9	3.2676	32.7
0.0404	57.8	0.6317	43.4	3.3917	32.5
0.0484	57.1	0.6779	43.3	3.5145	32.3

Table 4.1a Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 30			
0.0645	56.0	0.7239	42.9	3.6963	31.9
0.0806	54.7	0.7850	42.2	3.8754	31.5
0.0967	54.2	0.8610	41.8	4.0517	31.7
0.1127	52.9	0.9366	41.3	4.2252	31.3
0.1287	52.6	1.0117	41.0	4.4526	31.1
0.1447	51.9	1.0864	40.4	4.6754	31.0
0.1607	51.3	1.2345	39.8	5.0015	30.8
0.1847	50.4	1.3079	39.2	5.3181	30.7
0.2086	49.4	1.4534	38.7	5.7262	30.8
0.2325	48.7	1.5256	38.5	6.2151	30.7
0.2563	48.1	1.6687	38	7.1278	30.4
0.2801	47.7	1.8102	37.3	7.9632	29.8
0.3038	47.3	1.9501	36.7	8.7305	29.5
0.3275	46.7	2.0884	36.3	10.092	29.2
0.3511	46.3	2.2252	35.5	11.530	28.9
0.3747	45.8	2.3605	35.0	12.741	28.9
0.3983	45.8	2.4944	34.7	14.666	28.8
0.4297	45.5	2.6267	34.4	16.128	28.4
		Wt.% EG = 40			
0	59.6	0.7316	43.9	3.7412	34.4
0.0246	57.3	0.8281	43.2	4.1823	33.5
0.0492	55.1	0.9243	42.5	4.6178	32.9
0.0738	53.7	1.0202	42.0	5.2609	32.4
0.0984	52.5	1.1160	41.6	5.8921	31.9

Table 4.1a Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 40			
0.1229	51.9	1.2114	41.3	6.7156	31.2
0.1475	51.0	1.3304	40.6	7.7173	31.1
0.1965	49.8	1.4489	40.2	8.6892	30.6
0.2455	49.2	1.5671	40.0	9.8183	30.2
0.2944	48.3	1.6849	39.8	10.909	29.9
0.3432	47.6	1.9194	39.0	12.305	29.7
0.3920	47.0	2.1523	38.2	13.966	29.3
0.4407	46.3	2.3837	37.3	15.539	29.1
0.4893	45.9	2.6136	36.9	18.446	29.0
0.5379	45.1	2.8420	36.4	21.076	28.8
0.5864	44.9	3.0690	36.0	24.579	28.5
0.6591	44.3	3.2945	35.6	29.479	28.3
		Wt.% EG = 50			
0	57.7	1.3805	41.6	9.7670	31.0
0.0387	55.1	1.5323	41.3	10.774	30.7
0.0774	52.9	1.7217	40.9	12.420	30.3
0.1160	51.3	1.9105	40.2	14.028	30.0
0.1547	50.4	2.2868	39.5	15.908	29.9
0.1933	49.2	2.6611	38.4	17.736	29.5
0.2319	48.6	3.0335	37.7	20.098	29.6
0.3090	47.1	3.4041	37.0	22.933	29.3
0.3861	46.9	3.7728	36.4	25.647	29.1
0.4630	46.2	4.5045	35.2	30.738	28.7
0.5399	45.5	5.2290	34.1	37.636	28.4

Table 4.1a Continued

[AOT] x10^{3} / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^{3} / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^{3} / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 50			
0.6551	44.9	5.9463	33.2	43.775	28.2
0.7701	44.3	6.6564	32.7	50.983	28.0
0.9232	43.6	7.3596	32.2	58.717	27.9
1.0759	42.7	8.0558	31.7		
1.2284	42.0	8.7453	31.5		
		Wt.% EG = 60			
0	55.7	0.4470	45.8	7.8433	34.1
0.0133	55.1	0.4990	45.4	9.3774	33.0
0.0265	54.9	0.5509	45.3	10.873	32.2
0.0530	52.8	0.6027	45.3	12.331	31.8
0.0663	52.3	0.6544	45.2	13.754	31.2
0.0795	52.1	0.7059	44.6	15.143	30.9
0.1059	51.4	0.7830	44.3	16.498	30.7
0.1323	50.6	0.9110	43.1	19.113	30.5
0.1587	50.3	1.6349	42.5	21.609	30.0
0.1851	48.8	1.9775	41.9	23.993	29.8
0.2114	47.7	2.6573	40.5	28.456	29.4
0.2377	47.3	3.3297	39.4	32.553	29.1
0.2640	47.1	3.9951	38.4	36.327	28.9
0.2902	47.0	4.6534	37.5	39.815	28.6
0.3164	46.4	5.3048	36.6	47.479	28.1
0.3556	46.2	5.9494	35.9		
0.3948	45.9	6.9038	34.9		

Table 4.1a Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 70			
0	53.8	1.5590	43.0	14.297	33.3
0.0114	53.4	1.9911	42.1	15.660	32.6
0.0342	52.8	2.4175	41.7	16.952	32.4
0.0683	51.4	2.8381	41.1	18.180	32.0
0.1138	49.3	3.2533	40.4	20.460	31.5
0.1592	48.2	3.6630	39.9	22.532	31.1
0.2273	47.5	4.2677	39.6	24.424	31.1
0.3403	46.5	5.2498	38.5	26.971	30.5
0.4530	45.9	6.2012	37.8	29.224	30.6
0.5653	45.6	7.1232	37.2	31.230	30.4
0.6772	45.2	8.0172	36.6	33.588	30.3
0.7888	44.9	9.0547	35.9	36.119	30.0
0.8999	44.8	10.056	35.3	38.283	29.7
1.1211	43.8	11.337	34.5	41.788	29.6
1.3408	43.4	12.858	33.8	44.504	29.4
		Wt.% EG = 80			
0	51.5	0.8851	44.2	41.263	31.4
0.0296	50.9	1.1782	43.3	44.720	31.3
0.0593	49.4	1.7616	42.8	48.012	31.4
0.0889	48.0	2.3412	42.5	51.150	31.3
0.1185	46.4	2.9171	42.4	57.005	31.1
0.1481	46.3	4.0580	41.0	62.357	30.4
0.1778	45.6	6.8474	40.1	67.270	30.6

Table 4.1a Continued

[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}
Wt.% EG = 80					
0.2073	45.7	11.133	38.4	71.795	30.5
0.2369	45.6	16.204	36.7	77.951	30.4
0.2664	45.7	20.982	35.4	83.455	30.3
0.2960	45.3	25.493	34.4	89.948	30.1
0.3551	45.3	29.758	33.5	96.951	30.2
0.4731	44.8	33.796	33.0	102.96	29.8
0.5910	44.7	37.626	32.7		
Wt.% EG = 90					
0	49.8	0.4634	44.9	12.462	39.0
0.0166	49.5	0.5030	44.5	15.343	38.5
0.0332	49.4	0.5426	44.3	18.140	37.9
0.0498	49.2	0.5954	44.2	23.493	36.8
0.0663	49.2	0.6613	44.0	28.547	36.1
0.0995	48.8	0.7272	43.8	33.326	35.5
0.1160	48.6	0.8589	43.6	42.147	34.5
0.1326	48.6	0.9904	43.2	50.105	33.8
0.1525	48.3	1.3184	42.9	57.319	33.1
0.1724	48.1	1.6454	42.9	63.890	32.6
0.1989	48.1	1.9713	42.5	72.716	32.2
0.2320	47.8	2.6199	41.8	80.501	31.7
0.2651	46.8	3.2645	41.9	91.617	31.5
0.2981	45.6	3.9049	41.7	100.91	31.3
0.3312	45.1	5.1737	41.2	108.78	31.1

Table 4.1a Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt % of EG = 90					
0.3643	46.6	6.4265	40.5	115.55	30.9
0.3973	45.9	8.2764	40.1		
0.4304	45.4	10.092	39.3		
Wt % of EG = 100					
0	48.2	2.0948	41.9	37.806	36.8
0.0263	48.3	2.6148	41.5	46.074	36.1
0.5266	47.9	3.1333	41.5	53.938	35.7
0.8425	47.7	3.7536	41.3	68.566	34.6
0.1264	47.5	4.3718	40.7	81.892	34.1
0.2106	46.5	5.1928	40.8	94.081	33.4
0.3158	45.2	6.2138	40.6	105.27	33.0
0.4209	44.4	8.2386	40.1	120.45	32.8
0.5260	44.2	10.241	39.9	133.96	32.5
0.6310	44.0	13.203	39.4	153.48	32.2
0.8408	43.2	16.116	39.3	169.99	31.8
1.0504	42.9	19.927	38.8	184.14	31.8
1.3644	42.6	24.576	38.0	196.40	31.6
1.6778	42.1	30.880	37.5	209.12	31.3

Table 4.1b Surface Tension (γ) Values of AOT in Ethylene glycol - Water Mixture at 25 °C

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 0			
0	72.0	0.0843	57.8	0.7534	40.6
0.0009	71.2	0.0976	56.7	0.9256	39.1
0.0017	71.0	0.1110	56.0	1.0645	37.9
0.0027	70.4	0.1243	55.0	1.1994	37.2
0.0037	69.9	0.1375	53.9	1.4578	35.3
0.0051	69.4	0.1507	52.8	1.7020	34.2
0.0068	68.8	0.1639	52.1	1.9332	32.8
0.0102	68.0	0.1771	51.5	2.1524	31.7
0.0136	67.6	0.1967	51.0	2.3606	31.2
0.0204	66.1	0.2293	49.0	2.7467	30.4
0.0271	64.8	0.2617	48.6	3.2609	30.1
0.0373	63.4	0.3259	46.9	3.9795	29.7
0.0474	62.0	0.4207	45.4	4.5662	29.1
0.0575	60.8	0.5137	43.8		
0.0709	59.4	0.6049	42.2		
		Wt.% EG = 10			
0	67.2	0.4477	45.0	2.0955	33.5
0.0081	62.1	0.4948	44.4	2.2324	33.1
0.0163	60.5	0.5573	43.4	2.4349	32.5
0.0244	58.6	0.6350	42.6	2.6340	31.6

Table 4.1b Continued

[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}
Wt.% EG = 10					
0.0325	57.7	0.7122	41.8	2.8944	31.1
0.0406	56.8	0.7890	41.2	3.2118	30.9
0.0487	56.1	0.8652	40.6	3.5207	30.6
0.0649	55.4	0.9411	40.0	4.1143	30.1
0.0811	54.0	1.0165	39.5	4.6776	29.7
0.1215	52.6	1.0914	39.0	5.2129	29.5
0.1617	51.2	1.1659	38.3	6.2074	29.3
0.2018	50.0	1.2399	38.0	7.1119	29.3
0.2418	48.8	1.3867	37.3	8.3250	28.6
0.2816	47.5	1.5318	36.1	10.037	28.3
0.3214	46.9	1.6752	35.6	11.450	28.4
0.3610	46.1	1.8169	34.9	12.636	28.1
0.4005	45.3	1.9570	34.0		
Wt % EG = 20					
0	64.5	0.4512	45.3	2.1721	35.0
0.0071	62.5	0.4852	45.0	2.2866	34.5
0.0142	60.8	0.5190	44.7	2.3998	34.2
0.0212	59.4	0.5528	44.3	2.5117	33.7
0.0283	58.6	0.5864	44.0	2.6223	33.3
0.0354	58.2	0.6199	43.7	2.7317	33.0
0.0424	57.3	0.6533	43.1	2.8935	32.5
0.0566	55.8	0.6866	42.9	3.0526	32.2

Table 4.1b Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 20			
0.0707	55.1	0.7265	42.3	3.2091	31.9
0.0847	54.5	0.7662	41.7	3.2091	31.8
0.0988	54.1	0.8057	41.5	3.3630	31.6
0.1128	53.3	0.8451	41.2	3.5644	31.2
0.1268	52.5	0.8844	41.1	3.8100	30.9
0.1408	51.8	0.9495	40.4	4.0492	30.7
0.1548	51.4	1.0141	40.1	4.5093	30.4
0.1688	51.1	1.0784	39.8	5.3622	30.1
0.1897	50.4	1.1424	39.3	6.1360	29.8
0.2106	49.7	1.2059	39.0	6.8411	29.6
0.2314	49.0	1.2690	38.5	7.4863	29.2
0.2522	48.6	1.3318	38.2	8.0789	29.2
0.2799	48.1	1.4561	37.8	8.6251	29.2
0.3144	47.5	1.5790	36.8	9.8202	28.3
0.3488	47.0	1.8204	36.5	10.820	28.5
0.3830	46.6	1.9390	35.8	12.397	28.0
0.4172	45.8	2.0562	35.4		
		Wt.% EG = 30			
0	62.7	0.5747	44.0	2.7325	34.6
0.0106	61.0	0.6259	43.9	2.9106	34.2
0.0213	59.8	0.6770	43.4	3.0867	33.7
0.0319	58.5	0.7279	42.8	3.2607	33.3

Table 4.1b Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 30					
0.0425	57.3	0.7889	42.6	3.4327	32.7
0.0531	56.4	0.8496	42.1	3.6028	32.4
0.0637	55.7	0.9100	41.9	2.9106	31.9
0.0743	54.8	0.9703	41.3	3.9372	32.0
0.0848	54.4	1.0303	41.0	4.1016	31.6
0.0954	53.9	1.0901	40.7	4.3447	31.5
0.1060	53.9	1.1496	40.3	4.7411	31.3
0.1165	53.0	1.2287	39.8	5.1268	31.0
0.1271	52.7	1.3270	39.5	5.7226	30.7
0.1482	51.8	1.4247	39.2	6.4329	30.5
0.1692	50.9	1.5218	38.7	7.7490	30.3
0.1903	50.3	1.6184	38.3	8.9421	30.0
0.2113	49.8	1.7143	37.9	10.287	29.7
0.2323	49.3	1.8097	37.5	11.023	29.4
0.2532	48.7	1.9045	37.0	12.724	28.8
0.2846	48.4	1.9987	36.4	14.293	28.4
0.3159	47.6	2.0923	36.3	15.705	28.0
0.3576	46.6	2.1854	36.1	17.077	28.1
0.3992	45.8	2.2780	36.0	19.507	27.7
0.4406	45.4	2.3699	35.8	20.621	27.7
0.4820	45.2	2.4614	35.4	21.618	27.5
0.5232	44.7	2.5523	35.1		

Table 4.1b Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 40			
0	59.2	0.8512	43.3	4.7207	33.0
0.0246	57.1	0.9712	42.6	5.3611	32.5
0.0492	55.3	1.0908	41.8	5.9897	31.8
0.0737	53.5	1.2100	41.6	6.8100	31.3
0.0983	52.7	1.3289	41.0	7.6105	31.0
0.1228	51.6	1.4709	40.3	8.3921	30.8
0.1473	50.9	1.6125	39.9	9.3432	30.6
0.1963	49.8	1.8003	39.2	10.267	30.5
0.2452	49.1	2.0337	38.7	11.164	30.3
0.2940	47.7	2.2656	37.5	12.037	30.1
0.3428	47.1	2.4960	36.7	13.710	29.7
0.3915	46.3	2.7250	35.9	15.294	29.5
0.4402	45.8	2.9524	35.4	16.796	29.2
0.4888	45.4	3.1784	34.9	18.223	28.9
0.5615	44.9	3.4030	34.5	19.579	28.7
0.6342	44.3	3.8478	33.8	22.100	28.5
0.7308	43.9	4.2870	33.4		
		Wt.% EG = 50			
0	57.4	1.4017	41.8	8.1341	31.7
0.0505	54.7	1.5999	41.1	9.0348	31.5
0.1010	53.5	1.7975	40.5	10.365	31.1
0.1514	51.8	1.9946	40.1	11.671	30.7

Table 4.1b Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 50					
0.2018	50.5	2.2403	39.5	13.376	30.5
0.2522	49.5	2.4852	39.0	15.450	30.2
0.3025	48.6	2.7781	38.4	17.464	29.8
0.3528	47.6	3.0698	37.8	21.321	29.4
0.4031	47.1	3.4570	37.2	24.965	29.0
0.4534	46.5	3.9382	35.9	31.683	28.7
0.5036	45.9	4.4163	35.4	37.735	28.5
0.6039	45.5	4.8914	35.0	45.764	27.9
0.7041	44.9	5.3634	34.2	52.753	27.6
0.8541	44.1	5.8325	33.7	60.776	27.4
1.0038	43.4	6.2986	33.3	69.172	27.2
1.2030	42.7	7.2221	32.2	77.441	27.1
Wt.% EG = 60					
0	55.4	1.9998	42.3	15.513	31.1
0.0161	54.9	2.4369	41.5	17.099	30.7
0.0321	54.7	3.0063	40.3	18.945	30.5
0.0642	53.2	3.4020	39.9	20.730	30.3
0.0963	52.8	3.7951	39.2	23.021	30.0
0.1283	51.6	4.5741	38.4	25.752	29.7
0.1602	50.6	5.3434	37.3	28.345	29.4
0.2081	49.5	6.1032	36.3	33.157	29.2

Table 4.1b Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 60					
0.2558	48.5	6.8536	35.5	37.527	29.0
0.3193	47.6	7.5950	35.0	41.513	28.9
0.3985	47.1	8.3274	34.4	46.877	28.7
0.4774	46.6	9.4094	33.9	51.618	28.5
0.6343	45.9	10.472	33.1	58.402	28.4
0.9450	44.6	11.516	32.3	64.083	28.2
1.2515	43.6	12.542	32.0		
1.5539	43.2	13.881	31.7		
Wt.% EG = 70					
0	53.3	1.8517	42.9	19.578	32.7
0.0311	52.6	2.4610	42.3	22.051	32.0
0.0623	51.8	3.0665	41.6	24.454	31.6
0.1245	48.9	3.6681	41.0	26.788	31.1
0.1867	47.1	4.2658	40.3	29.058	31.1
0.2489	46.4	4.8597	39.7	31.266	30.7
0.3110	46.0	6.0363	38.6	35.505	30.4
0.4042	45.8	7.1982	38.0	39.524	30.0
0.4972	45.5	8.3454	37.7	46.967	29.7
0.6211	44.8	10.040	36.7	62.713	29.6
0.7449	44.8	11.703	35.7	75.341	29.4
0.8685	44.7	14.407	34.4	85.694	29.0
1.2384	43.9	17.031	33.6		

Table 4.1b Continued

[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}
		Wt.% EG = 80			
0	51.4	1.2476	43.2	40.509	32.8
0.0314	50.8	1.5572	42.9	44.497	32.2
0.0627	49.8	1.8659	42.3	48.301	31.7
0.0940	47.9	2.4806	42.1	51.934	31.5
0.1254	46.4	3.6992	41.2	55.405	31.3
0.1567	45.4	4.9037	40.6	61.910	31.1
0.1880	45.5	6.0941	39.6	67.886	30.6
0.2193	45.0	7.8541	39.2	73.397	30.5
0.2506	44.8	10.721	38.5	78.495	30.3
0.3132	44.7	13.507	37.6	89.710	30.2
0.3758	44.4	17.279	36.2	99.154	29.9
0.5007	44.1	22.423	36.2	107.22	29.7
0.6256	43.7	27.298	35.0	114.18	29.5
0.8125	43.5	31.926	34.0		
0.9992	43.5	36.324	33.1		
		Wt % EG = 90			
0	49.4	0.8080	43.6	29.398	35.7
0.0068	49.3	0.9671	43.3	33.654	34.7
0.0136	49.1	1.1255	43.0	39.137	34.1
0.0217	49.1	1.3356	42.9	43.112	33.8
0.0298	49.1	1.5967	42.6	49.490	33.2
0.0407	49.2	2.1134	42.3	55.578	32.7

Table 4.1b Continued

[AOT] x10^3 / mol kg^{-1}	**γ / mN m^{-1}**	**[AOT] x10^3 / mol kg^{-1}**	**γ / mN m^{-1}**	**[AOT] x10^3 / mol kg^{-1}**	**γ / mN m^{-1}**
		Wt % EG = 90			
0.0569	49.1	2.6232	42.0	61.396	32.5
0.0759	49.0	3.8676	41.7	66.960	32.2
0.0948	48.8	5.0711	41.1	77.392	31.8
0.1165	48.7	7.3632	40.5	86.989	31.5
0.1381	48.6	9.5137	40.0	95.848	31.0
0.1651	48.4	13.439	38.8	107.93	30.8
0.2191	48.2	15.035	38.5	118.76	30.6
0.3000	47.1	16.614	37.8	134.51	30.6
0.4075	45.5	18.952	37.4	147.95	30.4
0.5415	44.4	22.013	36.9		
0.6750	43.9	25.753	36.4		
		Wt % EG = 100			
0	47.9	1.9121	42.9	72.358	34.0
0.0195	47.8	2.2868	42.4	84.083	33.9
0.0389	47.5	2.6588	41.9	95.253	33.4
0.0778	47.5	3.0283	41.9	105.91	32.8
0.1166	47.5	3.7599	41.3	125.80	32.4
0.1554	47.5	5.3220	40.5	152.56	32.2
0.1942	47.1	6.8752	40.2	176.18	31.9
0.2717	46.8	9.9555	39.8	203.69	31.7
0.3877	45.8	14.512	39.2	232.93	31.3
0.5806	45.7	18.993	38.4	257.70	30.9

Table 4.1b Continued

[AOT] x10^3 / mol kg^{-1}	**γ / mN m^{-1}**	**[AOT] x10^3 / mol kg^{-1}**	**γ / mN m^{-1}**	**[AOT] x10^3 / mol kg^{-1}**	**γ / mN m^{-1}**
		Wt % EG = 100			
0.7728	44.8	26.298	37.3	278.95	31.0
0.9643	44.4	33.408	36.9	297.37	30.8
1.1552	44.0	41.691	35.9	313.49	30.8
1.3834	43.7	49.717	35.3	327.73	30.6
1.6106	43.3	60.036	34.8		

Table 4.1c Surface Tension (γ) Values of AOT in Ethylene glycol - Water Mixture at 30 °C

[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}
		Wt.% EG = 0			
0	71.5	0.1207	56.3	0.9779	39.3
0.0009	70.4	0.1378	55.2	1.1293	38.1
0.0017	70.3	0.1548	54.5	1.2777	36.9
0.0026	70.2	0.1718	53.2	1.4231	35.7
0.0035	70.0	0.1888	52.7	1.5656	35.0
0.0045	70.0	0.2057	52.0	1.7330	34.2
0.0056	70.0	0.2260	51.0	1.8965	33.1
0.0069	69.6	0.2462	50.1	2.1087	32.2
0.0087	69.5	0.2731	49.9	2.3651	31.1
0.0104	69.2	0.2999	48.5	2.8502	30.4
0.0139	68.5	0.3399	47.4	3.3017	29.9
0.0208	68.0	0.4062	46.3	3.7230	29.3
0.0347	65.7	0.4719	45.4	4.6622	29.2
0.0519	63.0	0.5370	44.2	5.4667	29.0
0.0692	61.7	0.6337	43.3	6.1635	28.8
0.0864	59.7	0.7291	41.9		
0.1035	57.8	0.8546	40.8		
		Wt.% EG = 10			
0	66.5	1.0326	40.1	2.4788	32.4
0.0576	57.8	1.0836	39.3	2.6472	31.9

Table 4.1c Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 10					
0.1148	54.2	1.1342	39.2	2.8118	31.5
0.1716	52.0	1.1846	38.8	2.9728	31.0
0.2280	50.0	1.2346	38.3	3.1303	31.0
0.2841	49.3	1.2844	38.2	3.2844	30.7
0.3398	48.0	1.3338	37.6	3.4725	30.4
0.3951	46.8	1.3830	37.2	3.6557	30.2
0.4501	46.0	1.4318	36.8	4.0081	30.2
0.5048	45.4	1.4803	36.9	4.3430	29.8
0.5591	44.5	1.5766	36.5	4.6617	29.8
0.6130	43.7	1.6716	36.0	4.9653	29.6
0.6666	42.9	1.7656	35.6	5.5315	29.6
0.7199	42.6	1.8584	34.9	6.0488	29.3
0.7728	41.8	1.9502	34.4	6.5233	29.2
0.8777	41.3	2.0409	33.9	6.9600	28.8
0.9297	40.9	2.1749	33.4	7.5537	28.6
0.9813	40.1	2.3067	32.9	8.0842	28.8
Wt % EG = 20					
0	63.9	0.3678	45.6	2.3050	33.8
0.0103	60.4	0.3980	45.3	2.4825	33.2
0.0207	58.9	0.4283	44.7	2.6580	32.7
0.0310	57.3	0.4685	44.4	2.8314	32.5
0.0413	56.5	0.5086	43.8	3.0878	31.8

Table 4.1c Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 20			
0.0516	55.6	0.5586	43.6	3.3399	31.4
0.0619	55.1	0.6084	42.7	3.5877	31.2
0.0722	54.5	0.6581	42.7	3.8314	31.1
0.0825	54.0	0.7570	41.8	4.3067	30.7
0.0927	53.2	0.8062	41.2	4.7667	30.4
0.1030	52.7	0.9042	40.1	5.2120	30.3
0.1235	52.1	1.0016	39.6	5.9234	29.9
0.1440	51.2	1.0983	39.0	6.5991	29.6
0.1645	50.1	1.1946	38.6	7.8530	29.1
0.1849	49.5	1.2902	37.8	8.9922	28.3
0.2053	48.9	1.3852	37.4	10.032	28.6
0.2257	48.6	1.4797	37.2	11.431	28.3
0.2461	48.0	1.5736	36.5	12.667	28.3
0.2664	47.9	1.6669	36.2	14.437	28.4
0.2868	47.4	1.7597	35.8	15.920	28.0
0.3070	46.9	1.9436	35.0		
0.3374	46.3	2.1254	34.5		
		Wt.% EG = 30			
0	61.8	0.4458	45.5	3.7376	32.5
0.0103	60.2	0.5057	44.8	3.8986	32.3
0.0205	58.5	0.5653	44.3	4.1367	31.9
0.0308	57.3	0.6247	43.9	4.4484	31.7

Table 4.1c Continued

[AOT] x10^{3} / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^{3} / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^{3} / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 30			
0.0410	56.3	0.7036	43.4	4.8287	31.3
0.0513	55.5	0.8017	42.6	5.1991	31.0
0.0615	54.7	0.8993	41.9	5.9117	30.7
0.0717	54.1	0.9962	41.3	6.5891	30.4
0.0820	53.5	1.1405	40.7	7.2338	30.0
0.0922	53.0	1.2835	39.9	7.8480	29.7
0.1024	52.4	1.4722	39.3	8.9936	29.4
0.1228	51.3	1.6588	38.1	10.040	29.0
0.1432	50.6	1.8431	37.6	11.001	28.9
0.1635	49.9	2.0253	36.8	11.885	29.0
0.1838	49.6	2.2054	36.6	13.539	28.5
0.2041	49.1	2.3834	35.7	15.026	28.2
0.2244	48.7	2.5595	35.0	17.062	27.9
0.2447	48.2	2.7335	34.8	18.896	27.8
0.2750	47.4	2.9055	33.8	20.558	27.6
0.3053	47.3	3.0757	34.0	22.070	27.6
0.3355	46.7	3.2439	33.4	23.451	27.4
0.3656	46.4	3.4103	33.0	24.719	27.5
0.4058	45.9	3.5748	32.8		
		Wt.% EG = 40			
0	58.5	0.8368	43.5	6.0294	32.4
0.0241	57.2	0.9550	42.8	6.6431	31.6

Table 4.1c Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 40					
0.0483	55.4	1.0962	42.2	7.8404	31.2
0.0724	53.6	1.2370	41.7	8.6167	31.3
0.0965	52.3	1.4239	40.9	9.3765	30.6
0.1206	51.0	1.6563	40.1	10.120	30.4
0.1447	50.3	1.8874	39.7	10.848	30.2
0.1688	49.8	2.1170	39.0	11.560	29.9
0.1928	48.9	2.3453	38.2	12.431	29.7
0.2409	48.4	2.5722	37.6	14.105	29.5
0.2889	47.5	2.7978	37.1	15.698	29.3
0.3368	46.8	3.0221	36.5	18.661	29.2
0.3847	46.1	3.2451	36.3	21.359	29.0
0.4325	45.7	3.6872	35.3	23.826	28.4
0.4803	45.4	4.1241	34.8	27.156	28.6
0.5519	44.9	4.5560	33.9	30.108	28.3
0.6233	44.4	4.9830	33.3	33.500	28.1
0.7184	43.9	5.4051	33.0	33.559	27.9
Wt.% EG = 50					
0	54.2	1.2582	41.9	10.044	30.7
0.0488	51.5	1.4500	41.5	11.733	30.4
0.0975	49.4	1.6890	40.6	13.384	29.9
0.1462	48.0	1.9273	40.0	15.395	29.6
0.1949	47.3	2.2123	39.4	17.351	29.5

Table 4.1c Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 50					
0.2435	46.6	2.4963	38.7	19.627	29.4
0.2922	46.3	2.8733	37.7	21.830	29.0
0.3407	46.0	3.3420	36.9	24.660	28.8
0.3893	45.3	3.8078	36.0	28.033	28.5
0.4863	44.9	4.2708	35.6	31.239	28.3
0.5832	44.5	4.7310	34.4	37.193	27.9
0.6800	44.2	5.6430	33.5	45.134	27.7
0.7767	43.4	6.5442	32.7	52.084	27.5
0.9214	43.2	7.4347	32.0	60.106	27.3
1.0659	42.6	8.7508	31.3	68.552	27.2
Wt.% EG = 60					
0	54.9	0.4751	46.5	10.015	33.7
0.0160	54.2	0.5533	45.7	11.871	32.6
0.0320	54.1	0.6313	45.2	12.729	32.4
0.0479	53.4	0.7864	44.6	13.545	31.8
0.0639	53.2	0.9405	44.0	14.322	31.5
0.0958	51.9	1.2456	43.4	15.063	31.5
0.1276	51.2	1.5465	42.8	16.444	31.3
0.1594	49.6	1.9905	42.0	17.655	30.9
0.1912	48.9	2.4256	41.2	19.978	30.7
0.2229	48.7	2.9926	40.3	22.205	30.2
0.2546	48.5	3.6809	39.4	26.396	29.7

Table 4.1c Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 60			
0.2862	48.3	4.3475	38.6	32.096	29.5
0.3178	47.7	5.6196	37.2	37.193	29.3
0.3651	47.3	6.8162	36.0	44.587	29.1
0.4123	47.0	7.9437	35.0	50.873	28.6
		Wt.% EG = 70			
0	52.8	1.0051	44.4	13.203	34.8
0.0297	52.5	1.1813	43.7	14.715	34.5
0.0594	51.9	1.3571	43.5	16.199	34.1
0.0891	50.7	1.5326	43.3	17.656	33.6
0.1188	49.9	1.7661	42.8	19.087	33.1
0.1485	49.3	2.0570	42.4	20.955	32.5
0.1782	48.5	2.3470	42.2	23.227	32.1
0.2078	47.9	2.6937	41.8	25.434	31.6
0.2375	47.7	3.0391	41.3	29.662	31.1
0.2671	47.4	3.4973	40.8	31.688	30.9
0.2967	46.9	4.0668	40.3	33.658	30.6
0.3560	46.5	4.6326	40.1	35.575	30.5
0.4152	46.2	5.1946	39.9	37.441	30.4
0.4744	46.0	5.7530	39.1	41.027	30.2
0.5335	45.5	6.8588	38.4	44.431	29.8
0.5926	45.5	7.4063	38.0	50.748	29.8
0.6516	45.3	7.9503	37.8	56.484	29.4

Table 4.1c Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 70			
0.7106	45.0	9.0278	37.1	64.162	29.3
0.7696	44.9	10.092	36.6	70.909	28.9
0.8285	44.6	11.142	36.0	80.504	28.6
0.8874	44.7	12.179	35.7		
		Wt.% EG = 80			
0	50.8	1.2402	43.0	38.063	32.5
0.0156	50.2	1.8558	42.4	40.719	32.1
0.0311	49.6	2.4684	41.9	43.309	31.7
0.0623	48.0	3.0780	41.7	45.836	31.6
0.0934	45.6	4.2883	40.7	49.913	31.1
0.1245	45.3	6.0818	39.4	53.831	31.0
0.1556	45.0	9.0137	38.8	57.598	31.0
0.1868	44.6	11.876	37.0	64.715	30.6
0.2179	44.6	14.672	37.0	71.326	30.4
0.2490	44.5	17.402	36.0	77.480	30.2
0.2800	44.2	20.070	35.5	83.226	30.1
0.3111	44.2	22.678	35.1	96.045	29.6
0.3733	43.8	25.730	34.5	107.04	29.5
0.4975	43.7	28.702	33.8	116.56	29.2
0.6215	43.8	32.543	33.4	126.45	29.1
0.9312	43.3	35.339	33.0		

Table 4.1c Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt % EG = 90					
0	48.9	0.6092	43.2	20.449	36.8
0.0123	48.5	0.7299	42.8	22.457	36.5
0.0246	48.6	0.9702	42.8	25.744	36.1
0.0368	48.4	1.4461	42.2	28.958	35.4
0.0491	48.5	1.9162	41.8	32.722	34.9
0.0638	48.5	2.3804	41.6	36.390	34.5
0.0785	48.2	3.0661	41.4	41.135	34.3
0.0981	48.3	3.7393	41.3	46.846	33.8
0.1226	48.1	4.6181	40.8	52.326	33.1
0.1593	47.8	5.6873	40.5	62.644	32.5
0.1960	47.5	6.7254	40.3	72.188	31.9
0.2449	46.8	8.7137	39.6	85.234	31.4
0.2936	46.7	12.371	38.8	96.961	31.0
0.3424	46.5	15.656	38.1	110.87	30.6
0.4153	45.3	17.041	37.6	125.96	30.4
0.4882	44.9	18.414	37.0	139.00	30.1
Wt % EG = 100					
0	47.5	7.2875	40.9	79.554	33.7
0.0195	47.6	8.9633	40.3	90.313	33.3
0.0390	47.4	11.221	39.6	110.73	32.7
0.0779	47.4	13.683	39.5	129.79	32.0
0.1557	47.3	16.595	38.9	147.63	31.5

Table 4.1c Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt % EG = 100			
0.3885	46.6	21.931	38.3	172.35	31.5
0.5817	46.9	28.899	37.5	194.89	31.3
0.8510	46.3	34.864	36.7	222.05	31.0
1.1573	45.5	37.379	36.4	252.05	31.1
1.5377	45.0	42.352	36.1	288.08	30.7
2.2908	44.8	47.250	35.6	322.57	30.6
3.4014	44.1	53.269	35.1	334.02	30.6
4.4897	43.0	61.506	34.6		
5.9071	41.8	70.662	34.2		

Table 4.1d Surface Tension (γ) Values of AOT in Ethylene glycol - Water Mixture at 35 °C

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 0			
0	70.4	0.0820	56.8	1.2923	35.7
0.0017	69.4	0.0956	55.2	1.4133	34.9
0.0034	68.2	0.1092	53.9	1.5329	33.9
0.0055	67.1	0.1228	53.0	1.7097	33.1
0.0075	66.6	0.1364	52.3	1.8835	32.5
0.0096	65.7	0.1567	51.6	2.1666	31.4
0.0117	64.9	0.1770	50.4	2.4419	30.8
0.0137	64.1	0.2039	49.6	2.7097	30.4
0.0158	63.4	0.2376	49.3	2.9703	30.0
0.0178	64.0	0.2845	47.8	3.4710	29.6
0.2056	63.2	0.3379	46.0	3.9461	29.2
0.0240	62.7	0.4042	45.2	4.3975	28.9
0.0274	62.0	0.4701	43.7	5.2362	28.6
0.0315	61.3	0.5357	42.8	5.9989	28.5
0.0356	60.9	0.6656	41.1	6.6954	28.3
0.0411	60.5	0.7939	39.8	7.6339	28.1
0.0479	59.7	0.9208	38.4	8.4645	28.0
0.0547	59.2	1.0461	37.5	9.6550	27.7
0.0684	57.4	1.1699	36.6	10.654	27.6

Table 4.1d Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 10			
0	66.1	0.5465	44.0	2.9613	31.5
0.0123	61.6	0.6063	43.4	3.3779	30.9
0.0246	60.3	0.6659	42.5	3.8854	30.7
0.0369	59.0	0.7253	41.6	4.3788	29.8
0.0492	57.3	0.7964	41.1	4.8587	29.9
0.0615	56.8	0.8672	40.7	5.3256	29.4
0.0738	55.8	0.9377	39.9	6.2226	29.3
0.0983	54.1	1.0080	39.5	7.0736	28.8
0.1228	53.2	1.0780	38.8	8.6512	28.9
0.1595	51.7	1.1942	37.9	10.749	28.4
0.1961	50.6	1.3096	37.2	12.578	27.9
0.2448	49.6	1.4244	36.7	14.189	27.5
0.3055	47.9	1.6518	35.2	16.058	27.0
0.3660	46.7	2.0987	34.0	18.037	27.1
0.4264	45.3	2.3181	33.2		
0.4865	45.0	2.6426	32.5		
		Wt % EG = 20			
0	63.0	0.4480	43.7	2.0752	34.2
0.0097	60.6	0.4761	43.3	2.1591	34.1
0.0193	58.7	0.5136	42.8	2.2426	33.8
0.0290	57.2	0.5509	42.6	2.3255	33.5
0.0386	56.2	0.5882	42.3	2.4080	33.1

Table 4.1d Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 20			
0.0483	55.2	0.6254	41.9	2.4900	32.7
0.0579	54.4	0.6625	41.7	2.6526	32.4
0.0676	53.5	0.7087	41.0	2.8134	32.0
0.0772	53.0	0.7548	40.9	2.9724	31.8
0.0868	52.5	0.8008	40.7	3.2075	31.6
0.0964	51.8	0.8466	40.4	3.4387	31.3
0.1060	51.4	0.8922	40.2	3.8155	30.8
0.1156	51.1	0.9378	39.8	4.1822	30.7
0.1348	50.4	1.0284	39.1	4.8866	30.2
0.1540	49.5	1.1186	38.8	5.5549	29.9
0.1731	48.6	1.2081	38.0	6.1899	29.8
0.1922	48.3	1.2972	37.6	7.3690	29.3
0.2208	47.3	1.3857	36.9	8.4410	28.8
0.2494	46.8	1.4737	36.7	9.4199	28.7
0.2779	46.1	1.5611	36.2	10.317	28.7
0.3064	45.4	1.6481	35.8	11.143	28.7
0.3348	45.0	1.7345	35.4	11.905	28.7
0.3632	44.6	1.8204	35.0	13.576	28.5
0.3915	44.3	1.9058	34.8	14.978	28.0
0.4197	43.8	1.9908	34.6	16.388	27.6

Table 4.1d Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 30			
0	61.0	0.5382	44.6	3.3538	32.9
0.0090	60.1	0.5901	43.8	3.4950	32.7
0.0180	58.6	0.6505	43.3	3.6347	32.2
0.0269	57.6	0.7106	43.1	3.7730	32.0
0.0359	56.7	0.7789	42.6	3.9098	31.8
0.0449	55.6	0.8554	42.1	4.1793	31.6
0.0538	54.9	0.9569	41.5	4.4432	31.4
0.0717	53.9	1.0409	40.8	4.7019	31.0
0.0896	52.6	1.1244	40.4	4.9554	30.9
0.1074	51.8	1.2074	39.9	5.2040	30.7
0.1253	51.1	1.3720	39.1	5.5565	30.8
0.1431	50.9	1.5348	38.1	6.2514	30.1
0.1697	49.9	1.6958	37.6	6.9332	30.2
0.1964	49.0	1.8549	37.0	7.7675	29.8
0.2229	48.3	2.0123	36.5	8.5825	29.5
0.2495	48.0	2.1679	36.1	10.158	29.0
0.2848	47.5	2.3219	35.6	11.663	28.9
0.3200	47.0	2.4741	35.2	14.484	28.6
0.3551	46.8	2.6247	34.7	17.075	28.4
0.3989	45.8	2.7737	34.3	19.465	28.1
0.4426	45.3	3.0668	33.6	22.721	27.9
0.4861	45.0	3.2111	33.2	27.415	26.9

Table 4.1d Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 40					
0	57.8	1.1747	42.1	8.1631	31.4
0.0297	56.3	1.3195	41.6	8.9039	31.0
0.0594	54.2	1.4639	41.0	9.6321	30.6
0.0891	52.2	1.6366	40.6	10.584	30.3
0.1187	51.2	1.8087	39.9	11.746	30.2
0.1484	50.4	2.0372	39.4	12.876	29.9
0.1780	49.2	2.3212	38.6	13.976	29.6
0.2076	48.2	2.6035	37.9	15.047	29.4
0.2372	47.6	2.8842	37.4	16.297	29.2
0.2963	46.8	3.1631	37.0	17.508	29.1
0.3554	46.4	3.4404	36.4	19.067	29.0
0.4144	45.8	3.7161	35.8	20.931	28.7
0.4733	45.4	3.9901	35.2	22.706	28.4
0.0532	45.0	4.5333	34.4	26.017	28.3
0.5909	44.6	5.0701	33.6	29.041	28.2
0.6789	44.1	5.6006	33.4	31.814	27.9
0.7668	43.7	6.1250	32.5	34.367	27.8
0.8837	43.1	6.6433	32.1		
1.0294	42.7	7.4097	31.5		

Table 4.1d Continued

[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}
Wt.% EG = 50					
0	56.3	1.6257	41.8	9.6354	32.1
0.0513	54.8	1.8266	41.5	10.979	31.4
0.1026	52.5	2.0269	41.1	12.299	31.0
0.1539	50.8	2.2766	40.5	14.022	30.6
0.2051	49.7	2.5254	40.0	16.118	30.0
0.2563	48.2	2.8230	39.4	18.153	29.6
0.3074	47.8	3.1194	38.9	22.052	29.2
0.3585	47.1	3.5129	38.2	25.738	28.8
0.4096	46.5	4.0020	37.4	29.226	28.6
0.5117	45.8	4.4879	36.5	32.534	28.4
0.6136	45.0	4.9707	36.1	38.659	28.1
0.7663	44.7	5.4504	35.6	46.790	27.8
0.9186	44.0	5.9272	35.0	53.872	27.6
1.0707	43.6	6.8717	34.0	62.006	27.4
1.2225	43.0	7.8044	33.2	70.523	27.2
1.4244	42.5	8.7255	32.4	77.633	26.9
Wt.% EG = 60					
0	54.3	0.7792	45.4	12.274	33.7
0.0158	54.0	0.9319	44.8	13.803	33.0
0.0317	53.8	1.2343	44.5	15.546	32.2
0.0633	52.4	1.5326	43.6	17.666	31.7
0.0949	51.5	1.8270	42.8	19.739	31.1

Table 4.1d Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 60					
0.1894	49.6	2.1175	42.5	22.267	30.7
0.2208	48.9	2.5462	42.0	24.726	30.0
0.2522	48.2	2.9665	40.9	29.450	29.9
0.2836	48.6	3.5745	40.7	33.932	29.7
0.3149	48.3	4.1789	39.5	38.190	29.4
0.3617	47.8	5.3768	39.3	42.239	29.1
0.4085	46.9	6.5604	37.8	49.774	28.9
0.4707	46.5	7.7301	36.9	56.638	28.7
0.5482	46.2	8.8861	35.9	64.083	28.6
0.6255	45.8	10.595	34.9		
Wt.% EG = 70					
0	52.3	1.8726	42.2	22.273	32.7
0.0315	51.8	2.1811	42.0	24.696	32.2
0.0630	50.2	2.4887	41.6	27.050	31.7
0.0945	48.3	3.1008	41.4	29.339	31.1
0.1259	47.7	3.7090	40.8	31.563	30.9
0.1574	46.4	4.3133	40.3	34.154	30.6
0.1889	45.6	5.2124	39.8	36.660	30.4
0.2203	45.6	6.1030	38.9	39.880	30.1
0.2517	45.2	7.2770	38.2	43.720	29.9
0.3146	45.0	8.4363	37.4	47.369	29.7
0.3774	44.8	9.5810	36.6	54.148	29.5

Table 41.d Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 70					
0.5029	44.6	10.711	36.5	63.190	29.3
0.6282	44.2	11.828	35.8	71.106	28.9
0.7534	44.0	13.476	35.4	82.314	28.6
0.9408	43.6	15.095	34.6	91.595	28.4
1.2524	43.1	17.208	34.2	99.406	28.3
1.5630	42.7	19.778	33.4		
Wt.% EG = 80					
0	50.0	2.2372	42.0	32.844	33.6
0.0078	49.9	2.9347	41.7	35.442	33.1
0.0157	49.9	3.6099	41.2	37.995	32.8
0.0314	49.6	4.2639	40.9	40.504	32.5
0.0470	49.5	5.5122	40.5	42.970	32.0
0.0783	49.2	6.6867	40.1	45.394	32.0
0.1095	48.9	7.7939	39.3	47.778	31.7
0.1563	47.8	8.8391	38.9	50.121	31.5
0.2030	48.3	10.764	38.4	52.425	31.4
0.2496	48.0	12.495	38.1	54.691	31.3
0.3116	47.6	19.126	37.6	56.920	31.1
0.3888	46.4	20.270	37.0	59.114	30.9
0.4658	45.7	21.405	36.4	63.396	30.6
0.6189	44.7	22.533	36.0	67.543	30.4
0.7710	43.9	23.652	35.7	75.459	30.2

Table 4.1d Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt % EG = 80			
0.9221	43.7	24.763	35.6	82.908	30.0
1.0722	43.3	25.866	35.2	93.292	29.7
1.2212	42.6	27.505	34.8	102.83	29.5
1.5164	42.3	30.198	34.1		
		Wt % EG = 90			
0	48.7	0.8107	45.6	23.650	36.4
0.0068	48.2	0.9709	44.8	25.624	36.1
0.0136	48.5	1.1305	44.0	28.855	35.6
0.0218	48.3	1.3423	43.0	33.259	35.3
0.0327	48.0	1.6056	42.6	38.128	34.3
0.0464	48.2	1.8671	42.1	43.982	33.9
0.0600	47.9	2.1270	42.1	49.593	33.6
0.0764	47.9	2.6417	41.6	54.975	33.2
0.0981	48.1	3.4017	40.9	65.107	32.5
0.1199	48.0	4.1473	40.8	74.477	31.7
0.1362	48.0	5.1200	40.6	83.167	31.3
0.1634	48.1	6.3024	40.4	91.247	31.2
0.1906	47.8	7.4493	40.1	98.781	31.1
0.2177	47.4	9.6429	39.1	112.42	30.6
0.2720	47.4	11.712	38.6	127.21	30.4
0.3533	46.9	15.518	38.0	139.98	30.3
0.4343	46.3	18.937	37.2	151.11	30.1

Table 4.1d Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt % EG = 90					
0.5422	46.1	20.299	37.0	160.91	30.0
0.6767	45.9	21.648	36.7	169.59	29.9
Wt % EG = 100					
0	47.3	3.7976	40.8	44.028	35.5
0.0278	47.0	4.3256	41.3	54.568	34.6
0.0555	46.9	5.3711	40.7	67.263	33.9
0.1110	46.7	6.4027	40.7	79.453	33.4
0.2219	46.7	7.9249	40.2	91.168	32.8
0.3880	46.5	9.9084	39.5	113.28	32.4
0.5537	46.3	12.317	39.4	143.51	31.3
0.8291	46.0	15.108	38.8	179.13	31.1
1.2131	45.7	19.535	37.9	217.53	30.7
1.6497	44.2	23.702	37.4	256.50	30.5
2.1922	43.4	27.632	37.1	299.30	30.3
2.7309	42.5	34.855	36.2		
3.2661	41.1	41.338	35.6		

Table 4.1e Surface Tension (γ) Values of AOT in Ethylene glycol - Water Mixture at 40 °C

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 0					
0	69.8	0.1749	49.5	1.9778	31.7
0.0012	68.1	0.2037	48.6	2.1725	31.1
0.0025	66.5	0.2420	47.9	2.3629	30.6
0.0039	65.8	0.2897	46.8	2.5490	30.1
0.0059	65.1	0.3371	45.6	2.7669	29.9
0.0078	64.0	0.3843	44.7	2.9791	29.8
0.0098	63.2	0.4780	43.2	3.2537	29.5
0.0122	62.3	0.5707	42.0	3.5840	29.3
0.0157	61.8	0.6626	41.0	3.9007	29.1
0.0196	60.5	0.7535	40.0	4.4969	28.9
0.0245	59.9	0.8435	39.3	5.0480	28.8
0.0294	59.3	0.9327	38.4	5.8006	28.6
0.0391	57.9	1.0429	37.4	6.4765	28.3
0.0538	56.4	1.1518	36.8	7.4620	28.0
0.0732	54.9	1.2807	35.9	8.3043	27.5
0.0975	53.2	1.4498	34.5	9.0326	27.5
0.1218	51.7	1.6157	33.5	9.6685	27.3
0.1459	50.6	1.7785	32.7		
Wt.% EG = 10					
0	65.1	0.8406	40.2	4.6894	29.4

Table 4.1e Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 10			
0.0171	61.2	1.0056	38.8	5.3953	29.3
0.0342	58.3	1.1697	37.4	6.0819	28.6
0.0512	57.6	1.3328	36.8	7.4003	28.4
0.0682	55.7	1.4950	35.6	8.6504	27.9
0.1022	53.3	1.6561	34.8	10.966	27.5
0.1362	51.9	1.8163	34.0	13.064	27.1
0.1702	50.6	1.9756	33.0	15.867	26.6
0.2210	48.9	2.1339	32.6	18.324	26.6
0.2718	47.7	2.2913	31.8	21.164	26.2
0.3393	46.5	2.4478	31.4	23.026	25.8
0.4235	45.0	2.6033	31.4	24.697	25.7
0.5074	43.5	2.9117	30.6	28.003	26.0
0.5911	42.3	3.2166	30.2	28.212	25.7
0.6745	42.1	3.6673	30.1		
0.7577	41.1	4.1103	29.6		
		Wt % EG = 20			
0	62.3	0.3004	46.2	2.3477	33.7
0.0072	60.4	0.3287	46.0	2.5224	33.0
0.0145	59.0	0.3568	45.4	2.6941	32.8
0.0217	57.8	0.3919	44.9	2.8631	32.3
0.0290	57.1	0.4269	44.5	3.0293	32.1
0.0362	56.3	0.4756	44.0	3.1929	31.8

Table 4.1e Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 20					
0.0434	55.5	0.5242	43.4	3.3539	31.4
0.0506	54.8	0.5657	43.1	3.5124	31.3
0.0578	54.2	0.6345	42.5	3.6684	31.3
0.0650	53.8	0.7029	41.4	3.9230	31.0
0.0722	53.3	0.7709	41.2	4.1712	30.9
0.0866	52.1	0.8385	40.7	4.4131	30.6
0.1010	51.4	0.9056	40.4	4.6491	30.4
0.1154	50.7	0.9724	40.0	5.1039	29.9
0.1297	50.1	1.1048	39.1	5.5372	29.6
0.1440	49.9	1.2356	38.5	6.7228	29.3
0.1583	49.5	1.3649	37.9	7.7615	29.0
0.1726	49.1	1.4928	37.1	8.9613	28.7
0.1940	48.3	1.6191	36.5	10.226	28.7
0.2154	47.9	1.8059	35.8	11.288	28.8
0.2438	47.1	1.9896	35.1	12.193	28.6
0.2722	46.6	2.1702	34.4	12.972	28.5
Wt.% EG = 30					
0	60.4	0.7437	43.0	3.8283	32.7
0.0095	59.4	0.8341	42.5	4.0445	32.3
0.0191	58.3	0.9240	41.7	4.2571	32.0
0.0286	57.3	1.0133	41.3	4.5354	31.8
0.0381	56.4	1.1020	41.0	4.8077	31.6

Table 4.1e Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 30			
0.0476	55.4	1.1902	40.6	5.1401	31.1
0.0571	54.8	1.2779	40.2	5.4639	30.5
0.0667	54.5	1.3651	39.6	6.0870	30.3
0.0761	53.7	1.4517	39.2	6.6794	30.2
0.0950	52.4	1.5378	38.8	7.2434	30.0
0.1140	51.9	1.6234	38.5	7.7810	29.7
0.1329	51.2	1.7085	38.1	8.7838	29.5
0.1800	50.4	1.7930	37.7	9.7007	29.3
0.2083	49.5	1.9607	37.3	10.542	29.0
0.2458	48.8	2.1264	36.5	11.885	28.9
0.2833	48.0	2.2901	35.9	13.175	28.6
0.3300	47.3	2.4520	35.5	14.417	28.4
0.3765	46.1	2.6120	35.3	16.763	28.3
0.4229	45.5	2.7701	35.0	18.943	28.0
0.4692	45.0	2.9264	34.6	20.975	28.1
0.5153	44.5	3.0810	34.1	22.872	28.0
0.5613	44.1	3.2338	33.8	25.200	27.9
0.6162	43.7	3.3845	33.5		
0.6710	43.3	3.6084	33.1		
		Wt.% EG = 40			
0	57.0	1.2266	42.0	8.4962	31.5
0.0310	55.7	1.3777	41.5	9.2638	31.3

Table 4.1e Continued

[AOT] x10^3/ mol kg^{-1}	**γ/ mN m^{-1}**	**[AOT] x10^3/ mol kg^{-1}**	**γ/ mN m^{-1}**	**[AOT] x10^3/ mol kg^{-1}**	**γ/ mN m^{-1}**
		Wt.% EG = 40			
0.0621	53.7	1.5284	41.0	10.018	30.9
0.0931	52.4	1.7086	40.5	11.004	30.5
0.1240	51.0	1.8881	40.0	12.205	30.1
0.1550	50.1	2.1263	39.6	13.372	29.8
0.1860	49.0	2.4225	38.5	14.507	29.7
0.2169	48.2	2.7168	38.1	15.611	29.5
0.2478	47.8	3.0092	37.4	16.686	29.0
0.2787	47.3	3.2998	37.0	17.733	28.9
0.3095	46.8	3.5886	36.4	18.952	28.8
0.3404	46.4	3.8757	35.9	20.135	28.8
0.3712	46.0	4.1609	35.7	21.656	28.6
0.4328	45.4	4.4444	35.1	23.474	28.5
0.4944	45.3	4.7262	34.6	25.205	28.5
0.5558	44.9	5.0062	34.5	26.855	28.3
0.6172	44.5	5.2845	34.5	29.935	28.2
0.7091	43.9	5.8360	33.6	32.752	28.0
0.8008	43.5	6.3809	33.3	37.721	27.9
0.9228	43.1	6.9192	32.6	41.966	27.8
1.0750	42.7	7.7148	32.1		
		Wt.% EG = 50			
0	55.5	0.0954	43.3	9.4279	32.6

Table 4.1e Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 50			
0.0436	53.7	1.1259	43.0	10.575	31.9
0.0872	51.6	1.2977	42.6	12.076	31.3
0.1308	49.0	1.5119	42.1	13.910	30.8
0.1743	48.0	1.7255	41.6	15.698	30.2
0.2178	47.3	2.1509	40.7	19.142	29.8
0.2613	46.7	2.5740	39.9	22.422	29.3
0.3047	46.2	2.9949	39.2	28.534	29.0
0.3482	45.8	3.4134	38.6	34.113	28.8
0.3916	45.6	4.2436	37.4	41.626	28.2
0.4350	45.6	5.0648	36.4	48.270	27.8
0.4783	45.3	5.8772	35.5	56.019	27.6
0.5650	45.0	6.6811	34.7	62.733	27.4
0.6516	44.7	7.4763	33.8		
0.7812	44.2	8.2631	33.1		
		Wt.% EG = 60			
0	53.3	0.9214	44.0	14.117	32.8
0.0157	53.1	1.2204	43.4	14.956	32.4
0.0313	52.9	1.5155	42.8	15.788	32.1
0.0626	51.4	1.8068	42.2	17.023	31.7
0.1094	49.4	2.0942	41.8	18.242	31.3
0.1561	48.1	2.5185	41.3	20.238	30.8
0.2028	47.2	2.9346	40.5	22.192	30.5

Table 4.1e Continued

[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[AOT] x10^3/ mol kg^{-1}	γ/ mN m^{-1}
Wt.% EG = 60					
0.2493	46.4	3.6106	39.9	24.105	30.2
0.2958	46.1	4.2658	39.2	25.978	30.1
0.3421	45.7	5.5171	38.3	29.610	30.0
0.4038	45.6	6.6954	37.3	33.096	29.8
0.4653	45.3	7.8070	36.8	39.667	28.9
0.5573	44.9	8.8574	35.6	42.767	28.7
0.6489	44.6	9.8514	34.9		
0.7704	44.3	11.688	33.5		
Wt.% EG = 70					
0	51.6	0.7922	43.3	18.034	34.2
0.0248	50.6	0.9893	42.8	22.028	33.0
0.0497	48.6	1.2842	42.7	25.843	32.2
0.0745	47.2	1.5781	42.3	29.491	31.5
0.0994	46.7	1.9687	41.9	32.982	30.8
0.1242	45.5	2.4547	41.4	36.328	30.6
0.1490	45.2	2.9383	40.9	39.536	30.3
0.1738	45.2	3.8980	40.0	45.573	29.7
0.1986	45.3	4.8482	39.4	51.151	29.4
0.2482	44.6	5.7889	39.1	56.322	29.4
0.2978	44.3	6.7201	38.5	61.128	29.3
0.3474	44.2	8.0998	37.8	65.607	29.2
0.3969	44.1	9.4593	37.1	69.790	29.2

Table 4.1e Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 70			
0.4959	43.7	11.681	36.1	77.381	29.0
0.6442	43.6	13.849	35.2	84.088	28.9
		Wt.% EG = 80			
0	49.5	1.6435	44.9	46.786	36.8
0.0331	48.8	1.9691	43.2	48.736	36.5
0.0662	48.5	2.6171	42.8	51.925	36.1
0.0993	48.6	3.9010	42.8	55.039	35.4
0.1324	48.4	5.1688	42.2	58.681	34.9
0.1721	48.5	6.4206	41.8	62.222	34.9
0.2118	48.5	8.2693	41.6	66.797	34.5
0.2647	48.2	10.084	41.4	72.289	34.3
0.3307	48.3	12.452	41.3	77.544	33.1
0.4298	48.1	15.332	40.8	87.407	32.5
0.5287	47.8	18.127	40.3	96.491	31.9
0.6605	47.5	23.477	39.6	108.84	31.4
0.7921	46.8	33.306	38.8	119.89	31.0
0.9235	46.7	42.123	38.1	132.91	30.6
1.1204	46.5	43.472	37.6	146.95	30.4
1.3168	45.3	44.807	37.0	159.01	30.1
		Wt % EG = 90			
0	47.5	0.8684	45.0	26.595	35.9

Table 4.1e Continued

[AOT] x10^3 / mol kg^{-1}	**γ / mN m^{-1}**	**[AOT] x10^3 / mol kg^{-1}**	**γ / mN m^{-1}**	**[AOT] x10^3 / mol kg^{-1}**	**γ / mN m^{-1}**
		Wt % EG = 90			
0.0073	47.6	1.0969	44.5	28.520	35.8
0.0176	47.6	1.3807	43.6	31.047	35.5
0.0293	47.4	1.9425	44.1	34.755	35.2
0.0439	47.5	2.4965	42.5	38.368	34.7
0.6431	47.8	3.0973	42.2	43.041	34.0
0.0877	47.2	3.9021	41.2	48.664	33.6
0.1169	47.2	4.6909	40.7	59.238	32.7
0.1460	47.3	5.7183	40.3	69.001	32.3
0.1897	47.3	6.7190	39.8	82.319	31.8
0.2334	47.3	7.9339	39.6	97.976	31.1
0.2915	47.1	10.251	38.7	114.80	30.5
0.3496	46.8	12.428	38.4	129.20	30.3
0.4075	46.9	14.479	37.8	146.17	30.1
0.4943	46.1	18.241	37.3	156.50	29.9
0.5809	46.0	21.609	36.6		
0.6962	45.8	24.643	36.2		
		Wt % EG = 100			
0	46.8	5.1650	41.3	69.276	33.5
0.0281	46.7	5.9507	41.4	82.239	32.9
0.0674	47.0	6.9861	41.1	100.76	32.3
0.1122	47.0	8.5136	40.1	118.24	31.9
0.1683	46.8	10.504	39.9	140.09	31.2

Table 4.1e: Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt % EG = 100					
0.2803	46.7	12.921	39.3	160.43	30.9
0.4480	46.5	15.263	38.6	188.44	30.7
0.6711	46.5	17.977	38.5	213.81	30.5
1.1154	46.0	20.593	37.7	244.15	30.3
1.6674	44.7	23.937	37.2	277.38	30.0
2.2156	44.0	27.902	36.8	306.35	29.9
2.7600	43.0	35.186	36.2	331.82	29.7
3.3008	42.4	41.722	35.4	341.17	29.7
3.8379	42.2	48.824	34.8	354.39	29.6
4.3715	41.6	58.524	34.0		

Table 4.2 Surface Tension (γ) Values of CPC in Ethylene glycol - Water Mixture at 25 °C

[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 0					
0	72.1	0.1461	63.2	1.1150	42.2
0.0033	72.0	0.2108	59.8	1.2704	42.0
0.0081	71.4	0.2914	56.9	1.5784	41.9
0.0163	70.8	0.3878	53.5	2.0334	41.8
0.0260	70.3	0.4838	51.1	2.4802	41.9
0.0358	69.7	0.5795	48.5	3.0636	41.9
0.0488	68.9	0.6748	46.5	3.7738	41.8
0.0650	68.0	0.8014	44.2	5.1341	41.8
0.0975	65.8	0.9587	42.4		
Wt.% EG = 10					
0	68.1	0.1452	58.0	1.2928	41.6
0.0056	66.8	0.1785	56.5	1.4983	41.8
0.0112	64.5	0.2228	55.5	1.8016	41.8
0.0168	62.9	0.2781	54.0	2.0991	41.9
0.0224	62.9	0.3331	52.0	2.5822	41.6
0.0291	62.5	0.3989	51.1	3.0502	41.6
0.0359	62.3	0.4645	49.4	3.9437	41.5
0.0448	61.4	0.5514	48.0	5.5776	41.3
0.0560	61.3	0.6595	46.3	8.9475	40.8
0.0672	60.9	0.7668	44.5	10.593	40.7

Table 4.2 Continued

[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 10					
0.0895	59.9	0.9265	42.4		
0.1118	59.2	1.0845	41.4		
Wt.% EG = 20					
0	64.5	0.2778	52.5	2.5813	41.3
0.0022	63.1	0.3327	51.5	3.0498	41.4
0.0056	62.3	0.3985	50.8	3.5932	41.6
0.0112	61.9	0.4639	49.6	4.1172	41.8
0.0179	60.5	0.5508	48.1	4.7874	42.0
0.0246	60.2	0.6588	46.7	5.5826	41.8
0.0336	59.6	0.7660	45.0	7.0454	41.4
0.0448	59.3	0.8725	44.0	8.3597	41.5
0.0671	57.9	0.9784	43.1	9.5469	41.2
0.0894	57.5	1.0835	41.8	11.127	40.9
0.1117	57.0	1.2917	40.3	13.335	40.7
0.1450	55.5	1.4972	40.1	15.136	40.4
0.1783	54.4	1.8005	40.8	17.900	40.1
0.2226	53.7	2.0980	40.9		
Wt % EG = 30					
0	61.7	0.2451	53.4	2.4753	40.4
0.0039	59.9	0.3060	51.3	2.8843	41.1
0.0077	59.4	0.3818	50.6	3.4177	41.0

Table 4.2 Continued

[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 30					
0.0154	59.3	0.4574	49.6	4.1930	41.6
0.0231	59.0	0.5478	48.8	5.4234	41.5
0.0308	58.7	0.6378	47.5	7.6757	41.6
0.0400	58.4	0.7572	46.5	9.6872	41.3
0.0492	58.1	0.9057	45.3	11.495	41.3
0.0615	57.4	1.0531	43.9	13.886	41.2
0.0769	57.0	1.1996	42.9	15.962	41.3
0.0922	56.6	1.3451	42.1	18.337	40.9
0.1229	55.9	1.4896	41.5	20.815	40.6
0.1535	55.0	1.7758	40.2	22.876	40.5
0.1994	54.2	2.0583	40.0		
Wt.% EG = 40					
0	59.2	0.8025	50.3	6.4706	40.9
0.0052	58.6	0.9965	48.8	7.6753	41.0
0.0103	58.6	1.1879	47.7	9.2680	41.1
0.0206	58.4	1.3768	46.3	10.649	41.3
0.0412	57.6	1.5633	45.4	12.229	40.9
0.0617	57.2	1.7473	44.9	12.693	41.0
0.0925	56.8	1.9290	44.1	13.153	40.7
0.1232	56.3	2.1972	42.9	13.837	40.8
0.1640	56.2	2.4604	42.1	14.513	40.8
0.2047	55.9	2.8036	41.3	15.622	40.9

Table 4.2 Continued

[CPC] x10^{3} / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^{3} / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^{3} / mol kg^{-1}	γ / mN m^{-1}
Wt.% EG = 40					
0.2555	54.6	3.2208	41.0	16.711	41.0
0.3060	54.2	3.6254	40.8	17.779	40.5
0.3665	53.9	4.0180	41.1	18.828	40.6
0.4267	53.3	4.3992	40.9	20.868	40.4
0.5066	52.5	5.1289	40.9	26.567	40.0
0.6059	51.6	5.8183	40.9		
Wt.% EG = 50					
0	57.8	0.7517	50.1	4.4877	40.8
0.0138	56.6	0.9534	48.7	5.0717	41.9
0.0415	56.4	1.2201	46.5	5.7561	42.0
0.0830	55.7	1.5632	45.2	6.5328	42.4
0.1381	55.3	1.9540	43.6	7.3930	42.4
0.2070	54.6	2.4032	42.0	8.3273	42.5
0.2893	53.5	2.9080	40.8	9.3264	42.7
0.3851	52.9	3.2807	40.1	11.210	42.5
0.4942	52.4	3.6484	40.1	13.780	42.4
0.6165	51.2	4.0113	40.4	17.497	42.5
Wt.% EG = 60					
0	55.4	0.7515	48.2	6.8460	39.8
0.0084	54.2	1.0803	47.1	7.7910	40.5
0.0169	54.1	1.4869	46.0	8.8365	41.0
0.0270	52.8	1.9684	44.1	10.060	41.6

Table 4.2 Continued

[CPC] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[CPC] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[CPC] x10^3/ mol kg^{-1}	γ/ mN m^{-1}
		Wt.% EG = 60			
0.0388	52.6	2.4432	42.9	11.582	41.9
0.0523	52.5	2.9113	41.9	13.367	41.7
0.0675	52.1	3.3728	40.8	15.397	41.9
0.0843	52.3	3.8280	40.1	17.649	41.7
0.1348	51.8	4.2769	39.8	20.366	41.5
0.2188	52.0	4.7197	39.7	22.981	41.7
0.3360	50.9	5.3007	39.1	27.926	41.7
0.5028	49.9	6.0125	39.1	32.525	41.8
		Wt.% EG = 70			
0	52.7	2.1718	44.5	15.069	40.4
0.0133	52.7	3.1885	42.5	17.024	40.6
0.0400	52.1	4.1865	41.1	18.901	40.8
0.0800	51.5	5.1662	40.5	20.705	41.0
0.1333	51.1	6.1281	39.5	24.110	41.0
0.2397	50.8	7.3063	35.3	28.763	41.2
0.3989	50.2	8.6858	33.2	32.945	41.0
0.6104	49.2	10.029	34.5	37.904	41.0
0.8738	48.7	11.553	38.0		
1.3967	46.6	13.239	40.1		
		Wt.% EG = 80			
0	51.5	2.5643	49.9	19.232	41.3
0.0324	51.7	3.1977	49.2	21.991	41.9

Table 4.2 Continued

[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% EG = 80			
0.0971	51.8	4.4557	48.1	25.223	41.3
0.1940	51.7	6.3204	46.7	28.888	40.6
0.3232	51.4	8.1590	45.8	32.945	41.1
0.5168	51.2	9.9721	44.6	37.347	41.1
0.7745	51.0	11.760	43.8	42.051	41.0
1.0958	50.8	13.524	42.4	50.907	41.0
1.4805	50.4	15.263	42.3	62.968	40.9
1.9916	50.2	16.979	42.1	77.118	40.4
		Wt % EG = 90			
0	50.5	4.0008	49.2	45.239	42.5
0.0338	50.5	5.9579	48.9	49.870	41.9
0.1691	50.5	9.1577	48.2	54.319	41.6
0.4054	50.2	13.512	46.7	58.595	41.6
0.6750	50.1	18.905	45.8	62.709	41.4
1.0112	49.8	24.643	44.6	70.486	41.2
1.4806	50.0	30.130	43.3	77.715	41.1
2.0817	49.7	35.382	42.9		
2.7465	49.5	40.414	42.3		
		Wt % EG = 100			
0	47.8	12.961	46.4	94.940	39.7
0.1264	47.8	14.922	46.3	110.78	39.6

Table 4.2 Continued

[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt % EG = 100			
0.2528	47.8	17.360	45.4	129.72	39.5
0.5055	47.8	19.785	45.1	164.98	39.3
1.0105	47.8	23.398	44.5	197.13	39.2
1.7669	47.7	26.981	43.4	240.36	39.1
2.5220	47.8	31.712	42.8	278.54	38.9
3.5268	47.8	36.392	42.4	323.01	38.4
4.5294	47.8	41.022	42.2	370.30	38.4
6.0290	47.4	47.873	41.6	410.36	38.2
7.5236	47.2	54.616	41.1	451.01	38.2
8.7652	46.9	61.251	40.7	485.36	38.1
10.003	46.6	69.937	40.5	523.64	38.1
11.485	46.3	80.543	39.9	562.46	37.7

Table 4.3. Values of cmc of AOT in EG + water media at different temperatures determined from surface tension and conductance data (cmc values from conductance are in parentheses)

% EG	Temperature				
	293 K	298 K	303 K	308 K	313 K
	cmc / mmol kg^{-1}				
0	2.74	2.61	2.61	2.48	2.24
10	3.00 (5.00)	2.88 (5.00)	3.00 (5.00)	3.00 (5.00)	3.00 (4.20)
20	3.20 (4.40)	3.10 (5.00)	3.50 (5.50)	3.50 (4.80)	3.50 (4.90)
30	4.10 (4.00)	4.30 (4.70)	4.50 (5.00)	5.00 (5.50)	5.30 (5.80)
40	6.70 (6.80)	7.10 (7.20)	7.50 (7.80)	8.20 (8.60)	12. 2 (11.4)
50	9.10 (9.30)	9.10 (9.00)	11.1 (12.6)	13.6 (15.0)	16.6 (17.0)
60	12.3 (12.0)	16.2 (17.0)	20.2 (20.0)	22.4 (24.0)	24.7 (25.0)
70	22.4 (23.5)	27.3 (27.0)	30.2 (30.0)	35.1 (34.0)	43.7 (43.0)
80	45.5 (43.0)	50.3 (50.0)	55.0 (56.0)	67.2 (67.0)	82.1 (82.0)
90	80.5 (80.0)	86.3 (85.0)	99.3 (100.0)	110.8 (110.0)	122.5 (122.0)
100	110.8 (110.0)	122.5 (125.0)	135.3 (135.0)	149.6 (150.0)	165.3 (165.0)

Table 4.4a Specific Conductance (κ) Values of AOT in Ethylene glycol - Water Mixture at 20 °C

[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}
		Wt.% EG = 0			
0	1.1030	0.8966	55.588	2.4787	147.94
0.0109	1.7405	1.0727	66.084	2.6103	155.46
0.0218	2.5181	1.2342	75.685	2.7288	162.56
0.0380	3.5956	1.3830	84.345	2.8361	168.76
0.0540	4.7003	1.5205	92.374	2.9338	174.55
0.0806	6.4902	1.6479	99.748	3.0230	180.25
0.1069	7.9833	1.7663	106.50	3.1801	189.40
0.1587	11.176	1.8766	113.22	3.4296	203.39
0.2094	14.415	1.9797	119.04	3.6594	217.11
0.3076	20.241	2.0761	124.62	3.8304	227.27
0.4925	31.421	2.1666	129.96		
0.7040	44.069	2.3317	139.48		
		Wt.% EG = 10			
0	2.0931	1.3674	71.430	3.1411	159.35
0.0242	3.3285	1.4742	76.745	3.3206	168.35
0.0483	4.3168	1.5798	81.992	3.4969	177.60
0.0724	5.5645	1.6845	86.872	3.6701	185.73
0.0965	6.8337	1.7881	92.045	4.0075	202.31
0.1444	8.8355	1.8908	96.714	4.4923	225.02
0.1921	11.549	1.9925	101.93	4.9533	246.78

Table 4.4a Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG =10			
0.2397	14.439	2.0932	106.98	5.5338	273.10
0.3106	17.285	2.1930	112.57	6.2094	302.72
0.3811	20.834	2.2918	116.98	6.8354	330.35
0.4744	25.578	2.3897	121.84	7.9586	378.12
0.5900	31.464	2.4867	126.29	9.7987	456.78
0.7045	37.333	2.5828	131.33	11.854	538.98
0.8177	43.077	2.6780	136.35	13.364	595.93
0.9299	49.152	2.7723	140.75	14.520	638.24
1.0409	55.188	2.8658	145.94	15.942	690.19
1.1508	60.533	2.9584	150.09		
1.2597	65.718	3.0502	154.60		
		Wt.% EG = 20			
0	2.4780	1.0261	46.900	4.4240	163.00
0.0468	4.3407	1.1193	50.306	4.6564	168.87
0.0933	6.1600	1.2125	53.444	5.1210	182.17
0.1400	8.9306	1.3057	56.427	5.5854	194.37
0.1866	10.708	1.3990	59.673	6.0496	206.45
0.2333	12.604	1.5387	65.618	6.5136	218.93
0.2799	14.664	1.6785	70.488	6.9774	229.95
0.3266	16.597	1.8649	77.376	7.4410	240.68
0.3732	18.915	2.0046	82.591	8.3677	260.77
0.4199	21.013	2.1443	87.044	9.2936	279.25

Table 4.4a Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 20					
0.4665	22.888	2.2840	91.244	10.681	305.42
0.5132	24.873	2.4237	97.078	12.067	329.18
0.5598	27.090	2.6100	103.68	13.912	361.04
0.6064	28.887	2.7962	108.93	16.214	394.01
0.6531	30.799	2.9358	114.74	18.511	424.34
0.6997	33.189	3.0754	119.22	20.803	450.03
0.7463	34.828	3.2150	122.92	23.091	494.65
0.7930	36.982	3.3546	128.49	27.652	532.92
0.8396	39.169	3.5406	134.73	32.195	564.67
0.8862	41.236	3.7267	141.38	36.719	589.83
0.9328	42.854	3.9592	148.39	45.712	635.99
0.9794	44.659	4.1916	155.40	54.633	670.48
Wt.% EG = 30					
0	1.6289	1.6347	61.956	4.2768	150.58
0.0701	4.2907	1.7666	66.369	4.5151	157.30
0.1400	7.0518	1.8979	70.640	4.7512	164.90
0.2097	10.073	2.0285	74.911	4.9852	173.68
0.2792	13.144	2.1585	79.364	5.2170	180.39
0.3486	15.610	2.2879	83.260	5.4467	187.90
0.4178	18.267	2.4167	88.333	5.6744	194.49
0.4868	20.964	2.5449	92.502	5.9561	201.79
0.5557	23.521	2.6724	96.601	6.2347	211.84

Table 4.4a Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 30			
0.6244	25.967	2.7994	101.13	6.5102	218.12
0.6929	28.613	2.9257	105.88	6.7826	224.18
0.7613	31.140	3.0514	110.23	7.0521	234.42
0.8294	33.716	3.1766	114.49	7.3186	242.30
0.8974	36.016	3.3011	118.81	7.5823	250.84
0.9653	38.737	3.4251	123.29	7.8433	257.48
1.1005	43.542	3.5485	127.38	8.3564	270.36
1.2350	48.259	3.7325	133.09	8.8588	284.97
1.3689	52.592	3.9152	139.22		
1.5021	57.198	4.0966	144.91		
		Wt.% EG = 40			
0	1.5613	8.4387	202.61	31.869	607.69
0.1110	3.7595	8.8794	211.23	32.649	618.77
0.2216	6.7650	9.3147	219.82	33.404	630.05
0.3320	9.2877	9.7446	227.35	34.135	642.46
0.4420	11.451	10.169	236.58	34.843	653.22
0.6612	17.321	10.589	244.78	35.529	661.53
0.8791	23.246	11.003	252.39	36.194	672.81
1.0959	28.787	11.413	260.54	37.154	686.96
1.3114	34.316	11.898	270.30	38.073	701.42
1.5257	40.146	12.376	279.12	38.952	714.34
1.7389	45.506	13.002	292.38	39.794	726.24

Table 4.4a Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 40					
1.9509	51.294	13.770	306.11	40.602	737.01
2.1618	56.627	14.519	319.92	41.377	747.67
2.3715	62.370	15.250	331.49	42.122	759.05
2.5800	67.825	15.968	343.16	42.838	769.72
2.8908	75.628	16.668	357.55	43.527	779.15
3.1990	83.535	17.353	369.75	44.190	789.30
3.6061	93.143	18.679	392.63	44.829	799.15
4.0089	103.09	19.950	414.16	45.445	808.79
4.4074	112.05	21.168	433.90	46.233	820.68
4.8017	121.48	22.336	452.82	46.985	831.76
5.1918	130.86	23.459	473.29	47.878	842.63
5.6738	141.74	24.538	491.03	48.722	854.73
6.1495	153.29	25.577	507.91	50.282	878.32
6.6191	163.29	27.062	532.63	51.689	899.03
7.0828	173.20	28.467	554.37	52.966	915.95
7.5405	183.60	29.799	575.70	55.194	943.84
7.9924	190.42	31.062	594.57		
Wt.% EG = 50					
0	1.4829	7.8961	162.19	16.458	295.69
0.3433	8.4113	8.2395	169.12	17.121	304.43
0.6866	16.605	8.5828	174.90	17.953	314.66

Table 4.4a Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 50			
1.0299	24.084	8.9261	181.40	18.808	325.57
1.3732	31.643	9.2694	187.14	20.385	343.60
1.7165	39.057	9.6127	192.88	22.084	363.72
2.2286	50.094	9.9560	198.54	23.783	382.53
2.7429	61.774	10.299	205.22	25.482	402.68
3.0898	68.563	10.643	210.85	27.180	418.41
3.2657	71.628	10.986	215.72	28.879	434.45
3.4376	74.815	11.329	220.76	30.578	450.93
3.6095	77.719	11.673	225.88	33.541	484.43
3.7814	81.604	12.016	231.56	36.895	507.98
4.1197	88.837	12.359	236.46	40.249	541.46
4.4630	96.253	12.703	242.00	43.603	567.87
4.8063	102.86	13.046	247.64	46.958	595.39
5.1496	109.48	13.389	252.70	50.312	616.02
5.4300	116.37	13.733	257.63	54.644	652.34
5.8363	123.66	14.076	262.57	59.612	685.33
6.1796	130.01	14.419	267.24	65.409	724.58
6.5229	136.43	14.762	272.43	72.678	771.02
6.8662	143.00	15.106	277.38	80.754	809.56
7.2095	150.22	15.449	281.19		
7.5528	156.37	15.943	288.87		

Table 4.4a Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 60					
0	1.3503	5.4962	99.936	10.517	189.02
0.1916	4.1951	5.6708	103.41	10.836	194.61
0.3826	8.1715	5.8449	106.16	11.153	197.95
0.5729	11.728	6.0186	109.44	11.626	205.81
0.7627	15.525	6.1916	112.08	12.095	212.49
0.9519	18.860	6.3642	115.71	12.867	222.99
1.1405	22.219	6.5363	118.17	13.629	233.68
1.3285	25.695	6.7078	120.96	14.380	243.76
1.5159	29.036	6.8788	124.72	15.121	252.16
1.7028	32.443	7.0493	127.43	15.851	263.82
1.8890	35.876	7.2194	130.69	16.571	271.52
2.0747	38.727	7.3889	134.30	17.282	280.88
2.2598	41.895	7.5579	137.57	17.983	289.73
2.4443	45.805	7.7264	140.83	19.358	307.07
2.6283	49.677	7.8944	143.81	20.696	322.90
2.8117	52.194	8.0619	146.45	22.000	338.36
2.9945	55.694	8.2289	150.15	23.270	352.10
3.1768	58.982	8.3955	154.78	24.509	366.18
3.3585	62.432	8.5615	154.81	25.716	378.69
3.5396	65.386	8.7270	157.26	26.894	392.31
3.7202	68.593	8.8921	161.49	28.044	405.18
3.9002	72.498	9.0567	163.75	29.165	417.55

Table4.4a Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 60					
4.0797	74.856	9.2208	166.47	31.330	439.81
4.2587	78.417	9.3844	169.36	33.395	462.04
4.4371	81.654	9.5476	172.41	35.368	483.25
4.6149	84.548	9.7103	175.15	37.254	500.97
4.7922	87.826	9.8725	178.93	39.060	520.72
4.9690	90.760	10.034	181.68	40.790	537.62
5.1453	94.108	10.196	184.08	42.448	553.40
5.3210	96.719	10.356	186.45	44.040	571.00
Wt.% EG = 70					
0	1.3284	5.4987	75.344	19.227	231.08
0.2267	3.7194	5.7116	78.358	20.124	238.80
0.4528	7.0143	5.9239	81.256	21.011	246.37
0.6784	10.129	6.1357	83.742	21.888	254.87
0.9033	13.302	6.5578	88.931	22.756	263.28
1.1277	16.347	6.9778	93.879	23.614	270.32
1.3515	19.189	7.3957	98.964	25.301	283.63
1.5748	21.834	7.8116	103.85	26.951	296.95
1.7975	24.889	8.2255	108.36	28.567	311.62
2.0196	26.771	8.6373	113.14	30.148	323.45
2.2411	30.581	9.0472	118.06	31.695	335.70
2.4622	33.347	9.4551	122.89	33.211	344.31
2.6826	36.428	9.8609	127.33	34.695	356.05

Table 4.4a Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 70					
2.9025	39.411	10.265	132.01	36.149	368.55
3.1218	42.561	10.667	136.58	37.574	378.18
3.3406	45.576	11.067	140.96	38.970	388.27
3.5589	48.015	11.465	145.79	40.339	397.71
3.7766	51.680	12.059	156.32	41.681	406.77
3.9937	55.039	12.648	165.68	42.997	416.80
4.2103	57.867	13.621	176.17	44.288	426.20
4.4264	60.856	14.583	185.89	45.554	434.88
4.6419	63.855	15.534	194.60	46.796	443.31
4.8569	66.561	16.473	204.29	48.015	452.09
5.0714	68.899	17.402	213.04	49.212	460.21
5.2853	72.407	18.320	220.84		
Wt.% EG = 80					
0	1.0076	7.0954	61.545	26.742	202.23
0.1291	2.2514	7.4545	64.696	28.642	214.51
0.2581	3.4926	7.8123	67.414	30.500	225.34
0.3868	4.7755	8.1687	70.233	32.316	237.78
0.5154	5.9209	8.6417	73.626	34.092	247.53
0.6439	6.8652	9.1124	77.572	35.830	258.78
0.7721	8.0371	9.5807	81.821	37.531	265.82
0.9002	9.4366	10.047	85.486	39.195	274.61
1.0281	10.628	10.510	88.375	40.825	288.63

Table 4.4a Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 80					
1.1559	12.174	10.971	92.130	42.421	297.50
1.2834	13.198	11.545	96.278	43.984	305.55
1.5381	15.592	12.115	100.73	45.515	313.38
1.7921	17.736	12.681	105.87	47.015	321.33
2.0454	20.166	13.243	109.75	48.486	328.17
2.2981	22.417	13.803	113.49	49.927	338.49
2.5500	24.34293	14.358	117.50	52.036	348.65
2.8014	26.40381	14.911	121.72	54.085	358.55
3.0520	28.93687	15.460	126.00	56.075	375.36
3.3021	30.80042	16.006	129.92	58.010	378.94
3.5514	33.0838	16.548	133.67	59.892	388.96
3.8001	34.92218	17.623	141.17	61.722	397.90
4.1720	38.23348	18.685	148.48	64.086	410.03
4.5424	40.35879	19.734	155.75	66.367	418.93
4.9114	44.381	20.771	162.74	68.570	430.24
5.2789	47.822	21.795	169.67	70.698	438.09
5.6450	50.031	22.808	176.83	72.756	446.68
6.0097	53.551	23.808	183.87	75.234	458.55
6.3730	56.188	24.797	191.24	77.612	468.49
6.7349	58.665	25.775	196.60		

Table 4.4a Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 90					
0	0.5487	47.664	244.05	127.90	547.70
1.0427	5.6099	56.213	283.43	133.93	564.20
3.1162	16.708	64.473	319.77	142.65	587.69
6.1970	34.995	72.458	353.78	151.01	613.50
10.251	58.747	80.182	385.35	161.63	646.18
15.233	82.996	87.657	414.21	171.69	669.00
20.122	104.65	94.895	442.51	181.23	694.26
24.923	132.07	101.91	470.26	190.30	716.20
29.636	156.60	108.70	488.26	198.93	740.01
34.265	178.25	115.30	506.54	209.14	770.25
41.054	212.96	121.69	527.53		
Wt.% EG = 100					
0	0.3861	41.663	121.61	136.97	322.76
1.0071	2.3228	44.319	128.68	143.33	332.80
2.0113	5.6158	46.953	136.64	149.55	342.77
3.0124	8.4365	50.431	144.26	155.62	354.01
4.0107	12.448	53.871	153.03	161.55	362.55
5.0060	16.292	57.274	159.56	167.36	371.99
5.9983	19.364	60.640	166.32	173.03	379.16
6.9878	22.986	63.970	174.17	178.58	387.13
7.9744	26.152	68.082	184.86	184.01	396.98
8.9580	30.534	72.140	190.29	189.32	406.63

Table 4.4a Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 100					
9.9388	32.481	76.144	204.37	194.53	414.66
11.892	37.371	80.097	212.64	199.62	426.28
13.834	46.365	83.998	219.94	204.60	435.36
15.764	52.719	87.848	227.09	209.49	442.98
17.683	57.642	92.404	238.10	218.96	457.22
19.592	63.425	96.890	247.76	228.07	472.77
22.434	71.650	101.31	257.44	236.82	482.84
25.251	79.361	105.66	265.16	245.23	496.89
28.045	86.375	109.95	272.73	253.34	507.57
30.815	93.174	115.56	285.80	261.15	522.89
33.561	101.66	121.07	294.17	272.34	534.58
36.285	108.19	126.47	304.03		
38.985	115.20	131.77	312.52		

Table 4.4b Specific Conductance (κ) Values of AOT in Ethylene glycol - Water Mixture at 25 °C

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
			Wt.% EG = 0		
0	1.2101	0.8850	62.892	2.1370	148.40
0.0649	5.5929	0.9187	65.333	2.2525	155.66
0.1292	10.180	0.9522	67.920	2.3663	163.49
0.1932	14.543	0.9856	70.231	2.4785	170.54
0.2567	19.020	1.0188	72.186	2.5892	178.26
0.3197	23.326	1.0520	74.873	2.6984	183.73
0.3824	26.178	1.1014	78.349	2.8326	193.10
0.4357	31.309	1.1506	81.969	2.9648	202.74
0.4711	33.869	1.2157	86.227	3.0946	211.92
0.5063	36.450	1.2965	91.495	3.3479	228.79
0.5414	39.008	1.3764	96.637	3.5930	245.12
0.5764	41.529	1.4557	101.98	3.8302	260.04
0.6112	43.906	1.5342	107.07	4.0600	287.35
0.6459	46.361	1.6120	111.64	4.2826	303.27
0.6805	48.723	1.6890	117.20	4.4985	315.16
0.7149	51.221	1.7654	123.17	4.7079	327.81
0.7492	53.591	1.8411	128.27	4.9111	339.29
0.7833	55.998	1.9161	133.79	5.1083	355.04
0.8174	58.404	1.9904	138.45	5.2999	369.36
0.8513	60.817	2.0640	143.60	5.5772	385.44

Table 4.4b Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
			Wt.% EG = 10		
0	2.0727	0.8234	46.405	2.6897	152.95
0.0423	4.5511	0.9032	50.810	2.8627	162.86
0.0845	6.7043	0.9825	55.244	3.0334	173.26
0.1266	9.1566	1.06135	59.901	3.6944	201.39
0.1685	11.901	1.13976	61.443	4.6247	253.33
0.2104	13.658	1.21773	65.775	5.4885	299.22
0.2521	16.030	1.33386	72.086	6.5484	354.84
0.2937	18.117	1.44901	78.813	7.7451	415.79
0.3351	19.804	1.56321	85.225	8.8195	466.39
0.3765	21.738	1.67645	91.465	9.7896	513.28
0.4177	23.798	1.82599	99.571	10.670	554.06
0.4998	27.500	1.97388	107.353	12.206	621.33
0.5814	32.635	2.15648	123.180	13.502	680.28
0.6625	37.320	2.33661	132.464	14.610	719.74
0.7432	42.048	2.51432	143.249	17.143	809.94
			Wt.% EG = 20		
0	2.4780	1.4051	73.176	3.7599	183.40
0.0411	4.8302	1.5157	78.218	3.8816	189.08
0.0821	7.4373	1.6253	83.250	4.0020	194.28
0.1229	9.6712	1.7340	88.414	4.1211	199.66
0.1636	11.962	1.8418	93.486	4.2391	205.07
0.2042	14.185	1.9487	98.204	4.3558	210.18

Table 4.4b Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 20					
0.2447	16.228	2.0547	103.17	4.4714	215.45
0.2851	18.044	2.1598	108.14	4.6142	220.86
0.3253	20.328	2.2640	112.83	4.7553	227.36
0.3654	22.538	2.3673	118.23	4.8946	233.12
0.4054	24.808	2.4698	123.85	5.0321	238.42
0.4851	28.852	2.5715	128.17	5.3023	248.01
0.5642	32.908	2.6723	132.36	5.5659	259.92
0.6429	36.695	2.7723	137.28	5.8233	267.46
0.7212	40.658	2.8715	141.50	6.0746	279.87
0.7990	44.369	2.9699	146.96	6.3201	288.95
0.8763	48.296	3.0675	151.22	6.5599	296.80
0.9532	51.942	3.1643	155.96	6.7943	305.62
1.0296	55.595	3.2604	160.28	7.2475	322.94
1.1056	59.450	3.3873	165.96	7.6811	340.51
1.1811	62.666	3.5128	171.38	8.0962	357.76
1.2936	67.992	3.6370	177.47	8.4940	375.36
Wt.% EG = 30					
0	2.1670	1.9674	83.777	4.6218	186.44
0.0599	4.8415	2.0788	88.038	4.8229	193.74
0.1197	7.7477	2.1898	92.451	5.0225	201.17
0.1794	10.443	2.3003	96.976	5.2205	207.59
0.2389	13.148	2.4104	101.29	5.4170	214.26

Table 4.4b Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt. % EG = 30					
0.2983	15.830	2.6291	110.00	5.9016	231.21
0.3575	18.522	2.7379	114.30	6.1404	239.84
0.4167	20.465	2.8461	118.51	6.3770	247.45
0.4757	23.263	2.9540	122.63	6.6113	255.13
0.5346	25.976	3.0614	127.15	6.8434	263.52
0.5934	28.660	3.1684	130.57	7.0734	269.41
0.7105	33.581	3.2749	135.42	7.3012	278.69
0.8272	38.437	3.3810	139.37	7.5269	285.84
0.9434	43.065	3.4867	143.93	7.7505	293.26
1.0591	47.431	3.5919	148.18	8.0162	301.10
1.1743	52.156	2.5200	105.41	5.6604	221.17
1.2890	56.518	3.6968	151.22	8.2789	310.33
1.4032	61.276	3.8533	157.65	8.6248	320.03
1.5170	65.841	4.0090	164.09	9.0501	334.07
1.6303	70.274	4.1634	169.62	9.4679	346.47
1.7431	74.657	4.3171	175.35	9.8783	361.09
1.8555	79.019	4.4699	180.88		
2.5200	105.41	5.6604	221.17		
Wt.% EG = 40					
0	2.8880	4.6121	133.26	9.2219	250.19
0.4029	14.102	4.9756	143.19	9.6563	261.56
0.8023	25.390	5.3361	153.27	10.086	272.09

Table 4.4b Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 40					
1.1981	36.584	5.6936	162.82	10.722	287.47
1.5906	47.482	6.0482	172.25	11.245	298.19
1.9797	59.344	6.3998	181.68	11.761	310.89
2.3654	70.214	6.7486	191.13	12.271	322.03
2.7479	80.838	7.0946	200.23	12.774	333.60
3.1271	91.667	7.4377	207.87	13.761	353.21
3.5030	101.91	7.8910	219.60	14.724	374.94
3.8758	111.85	8.3394	230.78	15.663	393.02
4.2455	123.25	8.7830	241.44		
Wt.% EG = 50					
0	1.8912	10.102	243.11	15.767	350.71
0.2742	7.7608	10.346	247.31	15.995	354.73
0.5476	14.096	10.589	252.63	16.222	357.38
1.0918	27.052	10.832	256.51	16.449	361.37
1.6327	40.142	11.074	262.31	16.675	366.16
2.1703	53.246	11.315	268.03	16.900	369.96
2.7046	68.371	11.555	272.69	17.124	374.39
3.2356	83.048	11.795	276.52	17.348	379.20
3.7635	95.112	12.034	283.93	17.794	386.26
4.8097	121.58	12.272	289.73	18.238	394.33
5.3281	133.76	12.510	292.71	18.679	402.70
5.8434	147.05	12.747	298.20	19.118	408.69

Table 4.4b Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 50					
6.3556	159.40	12.983	302.32	19.554	419.63
6.8648	172.94	13.219	306.59	19.988	420.64
7.3709	184.11	13.454	310.30	20.420	427.66
7.8741	195.79	13.688	315.03	20.849	436.97
8.1246	200.28	13.922	318.17	21.276	443.54
8.3743	206.50	14.155	322.52	21.700	450.36
8.6233	212.13	14.387	325.64	22.333	461.65
8.8716	218.25	14.619	330.91	22.960	471.97
9.1191	224.19	14.850	335.22	23.582	487.31
9.3660	228.22	15.080	339.51	24.200	498.13
9.6120	232.61	15.310	342.90	25.015	512.43
9.8574	237.97	15.539	346.63	25.822	527.30
Wt.% EG = 60					
0	1.4678	5.6223	123.55	14.532	290.52
0.3917	9.3188	5.9787	131.65	14.836	295.44
0.7810	16.680	6.3329	139.02	15.288	304.62
0.9746	21.699	6.6849	145.98	15.588	312.22
1.1677	25.396	7.0348	152.29	15.886	316.09
1.3601	29.594	7.3825	159.12	16.182	320.22
1.5519	33.885	7.7282	165.63	17.060	332.62
1.7432	38.023	8.0717	172.31	17.781	342.59
1.9338	42.075	8.4132	178.67	18.492	351.16

Table 4.4b Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-11}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 60					
2.1238	46.420	8.7527	184.97	21.242	370.52
2.3131	51.030	9.0901	191.33	22.562	388.93
2.5019	54.784	9.4255	197.61	23.848	406.59
2.6901	59.316	9.7589	204.99	25.101	423.50
2.8777	62.999	10.090	210.94	26.322	439.80
3.0647	67.501	10.420	217.12	27.513	454.99
3.2512	71.740	10.747	223.29	28.675	469.34
3.4370	75.220	11.073	228.74	29.808	484.89
3.6223	79.712	11.397	235.24	30.913	499.10
3.8069	83.405	11.718	241.17	33.046	524.26
3.9910	87.583	12.038	247.20	35.081	550.57
4.1745	92.540	12.356	252.46	37.025	574.65
4.3575	97.063	12.673	258.14	38.883	577.48
4.5399	100.36	12.987	263.56	40.661	619.36
4.7217	105.12	13.300	269.47	42.364	639.80
4.9029	108.93	13.610	274.33	43.997	651.94
5.0836	113.28	13.919	279.69		
5.2637	117.23	14.227	284.54		
Wt.% EG = 70					
0	1.5311	10.959	153.35	22.673	296.49
0.4459	8.2297	11.355	158.71	23.538	305.28
0.8897	15.054	11.750	163.67	24.395	314.25

Table 4.4b Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 70			
1.3315	21.375	12.144	169.42	25.243	323.23
1.7712	27.725	12.535	174.25	26.082	331.38
2.2090	33.931	12.925	179.61	26.913	339.09
2.6447	40.083	13.313	184.50	27.736	347.77
3.0784	45.698	13.699	189.50	28.551	355.64
3.5102	52.253	14.084	194.57	29.357	363.25
3.9400	58.490	14.467	199.46	30.156	370.67
4.3678	63.918	14.849	204.20	30.947	378.28
4.7937	70.196	15.229	208.77	31.730	385.62
5.2177	76.174	15.607	213.70	32.506	389.38
5.6398	82.141	15.984	218.44	34.035	406.04
6.0600	87.901	16.359	223.21	35.536	418.94
6.4783	93.059	16.732	228.39	37.008	432.60
6.8947	99.130	17.104	233.04	38.453	444.52
7.3093	104.61	17.474	237.80	39.871	456.20
7.7220	110.37	17.843	241.83	41.264	467.44
8.1329	116.26	18.210	246.03	42.631	478.72
8.5419	121.80	18.758	252.91	43.974	489.55
8.9492	127.18	19.302	258.70	45.293	500.44
9.3547	132.45	19.843	265.70	46.589	512.71
9.7583	137.93	20.381	271.36	47.862	521.49
10.160	143.02	21.093	279.15	49.113	532.49
10.560	148.20	21.799	286.76	50.343	542.35

Table 4.4b Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG =80					
0	1.0862	11.067	112.21	40.453	341.23
0.0690	2.0186	11.679	117.81	41.314	347.50
0.1380	2.9475	12.287	122.83	42.165	353.01
0.2757	4.5292	12.891	128.20	43.007	357.94
0.4133	6.7716	14.086	138.44	44.663	369.67
0.5507	8.1861	15.266	148.82	45.478	373.04
0.6879	9.7336	16.431	158.71	47.081	385.88
0.8249	11.307	17.581	168.56	48.649	395.27
0.9617	12.959	18.716	177.68	50.941	409.12
1.0983	14.101	19.836	186.83	52.429	419.09
1.3709	17.908	20.942	195.59	53.886	426.80
1.6428	20.932	22.034	204.19	55.314	436.15
1.9139	23.774	23.113	213.82	56.713	444.89
2.1842	26.278	24.178	221.25	58.085	453.46
2.4538	29.364	25.230	229.15	60.091	464.82
2.7226	32.233	26.269	237.56	62.039	476.08
3.1244	36.483	27.296	245.35	63.932	486.54
3.5246	40.622	28.309	253.34	66.373	499.12
3.9230	44.776	29.311	260.97	68.144	511.24
4.3198	49.061	30.301	267.95	70.431	527.96
4.8464	53.833	31.279	275.61	73.176	536.71
5.3700	59.360	32.245	282.17	75.802	549.40

Table 4.4b Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 80					
6.0204	64.917	33.200	289.43	78.316	560.58
6.6664	71.542	34.144	296.12	80.726	573.36
7.3080	77.472	35.076	300.33	83.039	587.05
7.9452	83.331	35.998	309.65	85.258	598.53
8.5781	88.778	36.910	315.69	87.391	609.61
9.2067	94.949	37.811	322.37	89.443	622.49
9.8310	100.61	38.701	329.33		
10.451	106.61	39.582	334.51		
Wt.% EG = 90					
0	0.5632	10.886	70.666	43.567	244.62
0.2239	2.6020	11.520	75.700	47.065	264.66
0.4474	4.8213	12.152	78.881	50.494	286.13
0.6708	7.1300	12.781	85.284	53.854	293.64
0.8938	7.4784	13.617	87.862	57.148	318.63
1.1167	10.244	14.450	92.090	60.379	325.23
1.3392	12.228	15.279	96.238	63.547	338.68
1.5615	14.089	16.104	101.50	66.655	350.26
2.0054	16.424	16.926	106.52	69.704	364.79
2.4482	20.004	17.947	115.25	72.696	373.24
2.8901	23.939	18.964	118.50	77.081	398.56
3.3309	25.696	19.975	122.06	81.346	419.09
3.7707	28.850	20.980	127.81	85.497	422.43

Table 4.4b Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 90					
4.2096	31.387	22.179	135.36	89.537	438.43
4.6474	34.163	23.370	142.58	93.471	451.30
5.0842	37.053	24.947	149.98	97.303	464.01
5.5201	39.578	26.899	159.69	101.04	482.85
5.9549	42.364	28.829	167.75	104.68	493.52
6.3888	45.135	30.740	179.53	108.23	503.49
7.0378	48.665	32.630	187.71	111.69	517.49
7.6845	52.947	34.501	196.81	116.18	528.26
8.3291	56.581	36.352	207.79	120.52	549.10
8.9716	60.900	38.184	224.84	125.76	562.09
9.6118	64.001	39.997	230.93		
10.250	68.189	41.791	235.82		
Wt.% EG = 100					
0	0.6153	68.220	248.39	214.77	604.25
0.4217	2.0539	80.064	284.51	222.80	619.48
1.2626	5.4249	92.559	320.46	230.31	634.11
2.9354	13.987	105.50	356.53	239.29	651.55
5.4215	25.460	118.72	391.39	247.58	665.18
8.2879	37.605	129.90	418.17	256.09	682.13
11.520	51.355	140.37	445.36	263.93	691.93
15.100	65.349	150.18	468.67	277.91	712.48

Table 4.4b Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 100			
19.011	80.947	159.41	488.87	290.00	732.64
24.750	103.68	168.10	507.35	305.36	758.46
31.441	128.13	176.29	526.59	321.92	784.82
38.637	154.14	191.36	556.56	335.23	811.08
47.297	185.32	199.65	574.45		
57.226	215.59	207.44	590.29		

Table 4.4c Specific Conductance (κ) Values of AOT in Ethylene glycol - Water Mixture at 30 °C

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 0					
0	1.4715	1.2992	107.45	3.3084	256.52
0.0536	5.7785	1.3686	113.16	3.4518	267.07
0.1069	10.549	1.4374	117.71	3.5926	278.95
0.1599	15.358	1.5057	123.13	3.7307	289.84
0.2125	19.742	1.5734	128.52	3.8663	298.69
0.2649	24.056	1.6406	133.45	3.9994	309.16
0.3169	28.478	1.7073	137.86	4.1623	320.72
0.3688	33.066	1.7953	143.34	4.3217	334.03
0.4202	37.415	1.8608	147.59	4.4775	345.65
0.4714	41.642	1.9257	152.24	4.6300	356.21
0.5223	46.164	1.9901	157.19	4.7791	367.08
0.5729	50.098	2.0540	162.63	4.9250	377.40
0.6233	54.055	2.1175	167.63	5.0679	388.06
0.6733	57.960	2.1804	171.46	5.3448	408.55
0.7231	61.813	2.3048	177.68	5.6104	425.79
0.7726	66.202	2.3867	183.94	5.8655	443.84
0.8218	70.035	2.4678	191.05	6.1106	460.03
0.8707	74.003	2.5481	197.87	6.3464	475.51
0.9194	77.550	2.6275	203.98	6.5733	490.74
0.9678	81.976	2.7062	208.67	6.7918	504.09
1.0159	85.211	2.7841	216.26	7.0025	518.17

Table 4.4c Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 0					
1.0638	89.647	2.8612	221.72	7.2057	532.53
1.1114	93.138	2.9376	228.47	7.4017	545.65
1.1587	96.625	3.0320	235.29	7.5911	557.65
1.2058	100.16	3.1252	243.41		
1.2526	104.09	3.2174	250.57		
Wt.% EG = 10					
0	2.6349	0.7806	54.163	3.6818	240.45
0.0254	4.8147	0.8736	60.246	4.0036	261.37
0.0508	6.3840	0.9657	65.500	4.4612	289.01
0.7605	7.8549	1.0794	72.730	4.8913	314.31
0.1013	9.6527	1.1918	79.850	5.4261	345.44
0.1515	12.434	1.3027	87.170	6.0391	379.93
0.2014	15.560	1.4122	93.140	6.5982	410.59
0.2511	19.306	1.6271	106.97	7.5808	463.57
0.3005	22.514	1.8368	120.65	8.4164	508.41
0.3497	24.981	2.0414	133.58	9.1356	543.71
0.3986	27.937	2.2411	146.16	9.7613	574.96
0.4472	31.157	2.4361	160.20	10.311	603.57
0.4956	34.386	2.6270	172.93	10.796	627.42
0.5677	39.337	2.8130	185.50	11.229	647.40
0.6392	44.772	2.9940	197.36	11.618	684.23
0.7102	49.031	3.3460	219.50	12.285	701.68

Table 4.4c Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-11}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 20					
0	2.6525	2.7360	137.12	6.3168	278.29
0.0685	5.6741	2.8726	143.65	6.4871	284.22
0.1370	9.8812	3.0092	149.54	6.8275	295.07
0.2054	13.491	3.1458	155.62	7.5079	315.49
0.2739	17.611	3.2824	161.63	8.1880	334.55
0.3424	21.427	3.4189	167.47	8.8676	352.74
0.0445	27.041	3.5555	172.86	9.5469	370.80
0.5477	32.811	3.6920	178.64	10.226	387.93
0.6504	38.081	3.8285	185.64	11.243	411.73
0.7531	43.244	3.9650	190.78	12.260	433.41
0.8557	48.715	4.1015	196.59	13.614	461.64
0.9584	53.982	4.2379	201.72	15.304	491.95
1.0610	59.003	4.3744	206.96	16.991	519.42
1.1636	64.198	4.5108	212.63	20.359	569.95
1.2662	69.209	4.6472	217.88	23.716	612.56
1.3688	74.272	4.7836	223.55	27.063	651.92
1.5056	80.906	4.9200	228.81	30.401	685.90
1.6424	87.754	5.0563	233.97	33.728	713.30
1.7791	93.780	5.1927	237.89	37.045	737.95
1.9159	99.989	5.3290	244.12	40.352	763.92
2.0526	106.35	5.4653	249.41	43.650	786.44
2.1893	112.40	5.6357	255.35	50.215	826.21

Table 4.4c Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt. % EG = 20			
2.3260	118.91	5.8060	261.11	56.742	849.64
2.4627	125.29	5.9763	266.43	63.230	873.79
2.5993	131.03	6.1466	272.17	69.679	906.25
		Wt.% EG = 30			
0	3.8547	2.0650	102.50	4.5288	210.86
0.1045	9.0757	2.1570	106.68	4.7231	219.36
0.2084	14.175	2.2484	111.04	4.9148	226.80
0.3116	19.246	2.3393	115.00	5.2906	240.91
0.4141	24.801	2.4297	119.36	5.6566	255.48
0.5161	29.896	2.5195	123.44	6.0131	268.82
0.6174	34.972	2.6088	127.21	6.3605	282.73
0.7180	39.913	2.6976	131.58	6.6992	295.69
0.8181	44.648	2.7859	135.26	7.3517	320.47
0.9175	49.274	2.8737	139.41	7.9729	342.30
1.0164	53.829	3.0044	145.09	8.5650	363.23
1.1146	58.557	3.1340	150.83	9.1301	381.16
1.2123	63.082	3.2625	156.58	9.9309	409.08
1.3093	67.748	3.3899	161.98	10.680	435.61
1.4058	72.161	3.5162	167.67	11.383	458.43
1.5016	76.615	3.6414	173.01	12.255	486.75
1.5970	80.815	3.7657	178.10	13.252	517.50
1.6917	85.238	3.8888	183.88	14.664	558.69

Table 4.4c Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 30					
1.7859	89.327	4.0110	189.30	16.172	628.08
1.8795	93.791	4.1321	194.61		
1.9725	98.153	4.3318	203.15		
Wt.% EG = 40					
0	3.0073	3.1461	123.86	6.0838	228.23
0.2407	11.498	3.2585	127.85	6.2937	235.46
0.4801	19.477	3.3706	131.71	6.5025	242.90
0.5993	24.746	3.4824	136.05	6.7104	249.09
0.7183	29.977	3.5940	139.54	6.9172	254.45
8.3690	34.309	3.7052	142.91	7.1230	261.12
9.5521	39.649	3.8162	146.31	7.3279	266.61
1.0732	44.547	3.9269	151.76	7.5317	274.16
1.1909	48.552	4.0373	155.74	7.7346	279.77
1.3083	53.253	4.1475	160.13	7.9365	286.98
1.4254	58.462	4.2573	163.69	8.1374	292.61
1.5422	63.682	4.3669	168.16	8.3374	298.53
1.6587	68.317	4.4762	171.87	8.5364	302.79
1.7749	72.901	4.5853	175.20	8.7344	308.53
1.8908	77.536	4.6940	178.58	8.9316	314.82
2.0063	82.335	4.8025	182.66	9.1277	320.08
2.1216	86.704	4.9108	186.98	9.3230	326.59
2.2366	90.416	5.0187	190.33	9.5173	330.94

Table 4.4c Continued

[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}
		Wt.% EG = 40			
2.3513	94.579	5.1264	194.65	9.7108	336.68
2.4658	98.671	5.2339	199.18	9.9992	343.23
2.5799	102.79	5.3410	203.24	10.286	350.53
2.6937	107.63	5.4479	207.33	10.570	358.32
2.8072	111.44	5.5546	210.92	10.853	364.24
2.9205	115.83	5.6609	214.55	11.133	367.14
3.0334	119.96	5.8729	221.68	11.596	382.02
		Wt.% EG = 50			
0	1.6158	6.4317	188.64	14.268	386.83
0.1680	6.0743	6.7385	196.94	14.678	396.34
0.3356	11.587	7.0439	206.09	15.085	405.91
0.5028	17.520	7.3480	214.39	15.758	418.83
0.6697	21.682	7.6508	222.69	16.424	430.20
0.8361	26.058	7.9523	231.51	17.084	449.22
1.0022	30.432	8.2524	238.52	17.737	461.58
1.1679	35.234	8.5513	246.53	18.383	472.06
1.3332	39.546	8.8489	255.12	19.022	486.78
1.4982	44.988	9.1452	262.17	19.656	501.59
1.6627	49.340	9.4402	270.00	20.283	513.54
1.8269	53.114	9.7339	276.65	20.904	525.38
1.9907	63.312	10.026	285.18	21.519	536.81
2.1542	67.086	10.318	292.44	22.128	551.17

Table 4.4c Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 50					
2.3173	71.204	10.608	299.51	22.731	565.24
2.6423	81.280	10.896	308.64	23.919	584.66
2.9659	90.446	11.184	315.91	25.085	630.29
3.2881	99.794	11.470	321.34	26.229	635.45
3.6088	109.41	11.755	327.85	27.351	654.57
3.9281	118.89	12.039	333.44	28.453	676.32
4.2459	127.42	12.322	343.96	29.535	696.15
4.5623	135.67	12.604	347.45	30.597	718.61
4.8774	146.01	12.884	354.41	31.639	737.93
5.1910	154.72	13.163	361.56	32.663	756.55
5.5032	162.93	13.441	367.67	33.669	774.25
5.8141	171.74	13.718	374.46	34.658	792.16
6.1236	179.98	13.994	381.28		
Wt.% EG = 60					
0	1.8863	8.1130	193.22	15.385	349.41
0.4558	10.870	8.5101	202.43	15.906	358.05
0.9083	20.524	8.9044	212.11	16.422	368.42
1.3573	30.783	9.2960	218.70	16.933	378.76
1.8031	40.810	9.6849	228.51	17.606	387.29
2.2455	51.410	10.071	237.02	18.436	405.85
2.6847	61.481	10.455	249.01	19.253	418.91
3.1206	72.437	10.836	254.92	20.056	433.65

Table 4.4c Continued

[AOT] x10^{3}/ mol kg^{-1}	**κ x 10^{4} / S m^{-1}**	**[AOT] x10^{3}/ mol kg^{-1}**	**κ x 10^{4} / S m^{-1}**	**[AOT] x10^{3}/ mol kg^{-1}**	**κ x 10^{4} / S m^{-1}**
Wt.% EG = 60					
3.5534	81.207	11.214	262.86	20.848	447.45
3.9830	99.235	11.590	269.78	21.626	459.50
4.4095	100.56	11.963	279.24	22.393	472.08
4.8329	112.32	12.333	286.40	23.149	483.17
5.2532	127.11	12.701	294.70	23.893	495.21
5.6706	137.61	13.067	302.70	24.625	504.56
6.0849	146.93	13.430	311.69	25.347	518.09
6.4963	157.00	13.791	318.67	26.058	528.51
6.9048	166.91	14.149	324.95	26.759	539.24
7.3104	175.77	14.505	331.92	27.449	549.86
7.7131	184.88	14.859	341.06	28.130	559.67
Wt.% EG = 70					
0	1.4883	12.669	212.34	57.062	775.13
0.2935	7.1054	14.545	241.88	60.884	815.06
0.7326	15.568	16.661	274.80	64.589	852.73
1.3161	26.871	19.004	308.28	68.184	889.07
2.0424	39.588	21.564	344.79	73.378	939.03
2.9093	54.770	25.318	400.69	78.350	986.55
3.9145	70.822	30.172	466.63	84.655	1044.2
5.0551	91.172	36.007	539.33	92.060	1110.8
6.3280	111.84	40.499	593.01	98.984	1172.7
7.7297	135.02	44.844	643.02	105.47	1229.4

Table 4.4c Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 70					
9.2564	158.89	49.049	688.61	111.56	1283.1
10.904	185.18	53.119	733.25		
Wt.% EG = 80					
0	1.2281	8.7392	103.90	33.026	332.34
0.1325	2.9692	9.1014	107.97	33.934	339.62
0.2649	4.8284	9.5821	111.77	34.833	346.76
0.3970	6.4494	10.060	117.73	35.721	354.06
0.5290	8.4408	10.536	123.06	36.600	361.79
0.6608	10.069	11.245	129.48	37.469	369.80
0.7925	11.684	11.832	136.51	38.328	376.60
0.9239	13.485	12.415	142.24	40.019	391.21
1.0552	15.376	12.994	148.04	41.674	404.61
1.1863	17.471	13.570	153.95	43.294	418.35
1.3172	19.092	14.142	159.60	44.879	431.16
1.5785	22.308	14.710	165.00	46.432	443.25
1.8391	25.578	15.275	170.11	47.953	454.51
2.0990	28.410	15.836	175.61	49.443	466.50
2.3582	*31.661*	*16.393*	*181.03*	*50.902*	*478.09*
2.6166	34.984	16.948	187.23	52.333	488.60
2.8744	37.831	17.498	192.04	53.736	500.20
3.1315	40.836	18.046	196.60	55.111	510.64
3.3880	44.554	18.590	204.18	56.459	520.20

Table 4.4c Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 80			
3.6437	47.321	19.131	208.13	57.782	529.67
3.8987	50.379	20.202	218.09	59.079	539.74
4.2800	54.386	21.260	228.50	60.352	547.99
4.6598	58.415	22.306	237.38	61.601	557.25
5.0380	62.954	23.339	247.11	62.828	565.41
5.4148	67.102	24.360	256.97	64.031	573.66
5.7900	71.109	25.368	266.39	65.213	581.42
6.1638	75.851	26.365	275.34	66.374	588.66
6.5361	80.019	27.350	283.07	67.514	596.52
6.9069	83.966	28.323	293.61	68.634	604.08
7.2762	88.426	29.286	301.54	69.734	611.62
7.6441	92.070	30.237	308.69	70.815	618.16
8.0106	96.077	31.177	316.20	71.878	625.92
8.3756	100.14	32.107	324.94	72.922	631.96
		Wt.% EG = 90			
0	0.6481	75.810	514.63	208.08	1078.0
0.5737	5.7506	84.567	562.87	218.18	1111.8
1.7180	15.270	93.053	605.75	227.81	1141.3
3.4266	30.370	101.28	647.40	237.00	1169.6
5.6905	49.391	109.26	685.29	245.78	1197.1
8.4975	71.353	117.01	721.40	256.23	1228.1
11.833	95.426	124.52	755.63	266.13	1264.7

Table 4.4c Continued

[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}
Wt.% EG = 90					
15.679	123.79	131.82	787.65	277.33	1302.1
20.018	156.51	138.92	818.00	289.58	1336.0
24.826	194.95	145.81	847.69	302.57	1373.2
30.080	227.74	154.17	881.59	316.06	1410.2
37.794	281.49	163.82	919.14	329.82	1445.5
47.776	347.96	173.10	954.81	342.42	1477.8
57.429	408.39	183.46	991.04	354.02	1506.6
66.769	464.50	197.48	1041.4	364.73	1535.4
Wt.% EG = 100					
0	0.5241	39.420	190.90	173.79	627.46
0.4310	3.9413	49.954	233.14	181.84	647.68
1.2906	9.5232	59.969	273.05	189.44	666.29
2.5739	17.580	72.580	319.80	196.64	683.90
4.2738	27.533	87.261	371.87	203.46	700.30
6.3808	38.844	100.86	416.89	211.19	718.74
8.8835	51.929	113.50	455.37	219.62	737.35
11.769	66.191	125.27	492.77	228.59	758.23
15.020	81.905	136.26	524.49	237.89	777.73
18.623	98.938	146.54	554.62	247.38	798.00
22.557	116.51	156.19	581.43	264.09	832.18
30.217	150.81	165.26	604.75	284.70	867.80

Table 4.4d Specific Conductance (κ) Values of AOT in Ethylene glycol - Water Mixture at 35° C

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 0					
0	1.8520	1.4215	130.40	3.1856	282.66
0.0512	6.5625	1.4869	135.77	3.2729	289.57
0.1021	11.402	1.5517	141.27	3.3592	296.88
0.1528	15.907	1.6165	145.31	3.4954	310.97
0.2031	20.851	1.6800	151.73	3.6291	322.15
0.2532	25.635	1.7433	157.82	3.7604	333.05
0.3030	30.270	1.8062	164.03	3.8894	343.05
0.3525	35.039	1.8687	168.30	4.0162	353.27
0.4018	39.700	1.9306	174.87	4.1716	365.97
0.4508	43.961	1.9921	179.81	4.3236	378.63
0.4995	48.397	2.0532	184.81	4.4725	390.72
0.5480	53.119	2.1138	189.97	4.6183	401.49
0.5962	57.463	2.1739	194.93	4.7610	412.61
0.6441	61.910	2.2336	200.20	4.9009	423.75
0.6918	66.274	2.2929	205.43	5.1721	442.29
0.7393	70.532	2.3713	211.75	5.4327	463.20
0.7864	74.708	2.4489	218.15	5.6833	481.37
0.8334	79.238	2.5257	225.55	5.9244	490.37
0.8801	83.268	2.6018	231.14	6.1566	507.17
0.9265	87.503	2.6772	238.71	6.3803	524.63
0.9727	91.790	2.7519	245.57	6.5960	540.01

Table 4.4d Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 0			
1.0871	102.07	2.8259	252.22	6.8041	555.60
1.1550	107.88	2.8992	258.33	7.1029	563.91
1.2224	113.56	2.9718	264.38	7.5683	605.23
1.2893	118.94	3.0437	271.08		
1.3557	124.68	3.1150	277.53		
		Wt.% EG = 10			
0	2.9488	0.7912	58.412	2.4010	175.03
0.1719	15.072	0.8416	62.219	2.6077	189.96
0.1989	17.230	0.8917	65.694	2.8092	203.78
0.2258	19.073	0.9415	69.631	3.0058	217.37
0.2526	20.647	0.9911	73.585	3.1976	231.50
0.2794	22.648	1.0403	77.643	3.5675	257.44
0.3061	24.000	1.0893	81.072	3.9202	282.79
0.3327	26.303	1.1380	84.497	4.2568	307.66
0.3592	27.577	1.2106	89.357	4.7341	339.13
0.3857	29.242	1.2826	95.528	5.1810	369.14
0.4120	30.854	1.3777	102.36	5.7343	402.46
0.4383	32.502	1.4717	109.06	6.3655	442.84
0.4646	34.956	1.5648	116.39	6.9384	481.90
0.5090	37.518	1.6568	123.27	7.9386	541.45
0.5350	39.286	1.7478	130.14	8.7825	593.87
0.5868	43.197	1.8603	137.76	9.5043	635.20

Table 4.4d Continued

[AOT] x10^3/ mol kg^{-1}	**κ x 10^4 / S m^{-1}**	**[AOT] x10^3/ mol kg^{-1}**	**κ x 10^4 / S m^{-1}**	**[AOT] x10^3/ mol kg^{-1}**	**κ x 10^4 / S m^{-1}**
Wt.% EG = 10					
0.6384	46.745	1.9713	145.61	10.129	670.27
0.6896	50.904	2.0808	153.94	10.674	702.90
0.7406	54.891	2.1889	160.90		
Wt.% EG = 20					
0	2.6449	1.2061	88.191	5.6175	296.89
0.0402	5.6700	1.3267	94.947	6.0177	312.06
0.0805	8.4376	1.4472	100.99	6.4177	325.25
0.1207	11.405	1.5677	107.35	6.8176	338.82
0.1609	14.533	1.6882	113.58	7.2174	351.98
0.2011	17.491	1.8087	120.11	7.6170	364.62
0.2413	20.402	1.9292	126.61	8.0164	377.49
0.2815	23.397	2.0496	132.81	8.8149	399.78
0.3218	26.390	2.1701	139.29	9.6129	423.49
0.3620	29.335	2.2905	145.43	10.410	444.01
0.4022	32.677	2.4110	151.60	11.207	464.75
0.4424	35.572	2.5314	157.94	12.003	483.49
0.4826	39.092	2.6518	163.56	12.799	502.95
0.5228	41.944	2.7721	169.33	13.594	520.34
0.5630	44.515	2.8925	175.72	14.389	537.18
0.6032	47.834	3.0129	181.23	15.183	552.50
0.6434	50.553	3.1332	187.42	15.976	567.41
0.6836	53.505	3.2536	193.09	17.165	591.35

Table 4.4d Continued

[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}
		Wt.% EG = 20			
0.7238	56.041	3.3739	198.67	18.353	611.03
0.7640	58.912	3.4942	203.89	19.935	636.50
0.8042	61.743	3.6145	210.65	23.879	686.61
0.8444	64.005	3.7749	218.69	31.727	775.59
0.8846	67.018	3.9352	225.66	39.519	844.27
0.9248	69.859	4.0955	232.39	51.105	925.33
0.9650	72.182	4.2558	239.80	62.570	984.27
1.0052	75.317	4.4161	248.94	77.673	1020.3
1.0454	78.086	4.6164	257.60	96.260	1049.3
1.0856	80.856	4.8167	265.04		
1.1258	83.605	5.2172	280.86		
		Wt.% EG = 30			
0	2.3265	2.5845	142.83	5.8709	300.12
0.0980	7.9902	2.7095	148.92	6.0367	306.22
0.1955	13.293	2.8334	155.14	6.2004	314.89
0.2924	18.805	2.9564	161.38	6.3622	322.54
0.3887	24.254	3.0783	167.03	6.5221	329.55
0.4844	29.646	3.1993	172.81	6.6800	335.91
0.5796	34.820	3.3193	178.67	6.8362	341.91
0.6743	40.446	3.4384	185.47	6.9905	348.38
0.7684	45.698	3.5565	190.94	7.1430	355.08
0.8620	50.857	3.6737	197.42	7.2937	360.53

Table 4.4d Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 30					
0.9550	56.528	3.7899	203.14	7.4427	368.72
1.0475	61.296	3.9053	209.15	7.5901	374.91
1.1394	66.267	4.0197	214.21	7.7357	382.12
1.2764	73.643	4.1333	220.62	8.0221	390.75
1.4122	81.262	4.2834	227.34	8.3022	398.35
1.5469	88.627	4.4688	235.41	8.8441	422.78
1.6804	95.282	4.6518	245.03	9.3630	440.29
1.8128	102.42	4.8326	254.42	9.8603	458.14
1.9441	109.18	5.0111	262.56	10.337	479.30
2.0743	116.32	5.1873	270.65	10.795	495.99
2.2035	123.41	5.3614	277.73	11.659	519.22
2.3315	129.55	5.5333	286.06	12.458	552.09
2.4585	136.39	5.7032	293.65	14.220	613.37
Wt.% EG = 40					
0	2.9087	3.1722	137.64	6.1325	258.86
0.1172	7.9905	3.2814	142.78	6.2346	263.00
0.2341	13.430	3.3904	147.05	6.3364	267.57
0.3507	18.520	3.4991	150.94	6.4380	271.00
0.4670	23.646	3.6075	155.11	6.5394	274.66
0.5830	28.496	3.7157	157.54	6.6405	278.42
0.6987	33.537	3.8236	161.49	6.7413	282.39
0.8141	38.437	3.9313	166.05	6.9424	288.39

Table 4.4d Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 40			
0.9293	43.640	4.0387	170.79	7.1424	294.42
1.0441	48.364	4.1458	175.00	7.3416	300.38
1.1587	53.489	4.2526	179.48	7.5398	307.82
1.2729	58.349	4.3592	184.05	7.7370	314.82
1.3869	63.036	4.4656	189.05	7.9334	321.46
1.5006	68.091	4.5717	193.37	8.1288	327.85
1.6140	72.439	4.6775	197.88	8.3234	335.25
1.7271	77.536	4.7830	202.27	8.6135	344.08
1.8399	82.438	4.8884	207.07	8.9016	352.39
1.9525	87.483	4.9934	212.18	9.1877	360.83
2.0647	92.180	5.0982	215.76	9.4718	369.96
2.1767	96.681	5.2028	219.81	9.8476	383.74
2.2884	101.04	5.3071	224.78	10.220	392.94
2.3999	106.02	5.4111	229.80	10.681	402.15
2.5110	110.68	5.5149	233.53	11.136	419.76
2.6219	115.64	5.6185	238.23	11.587	432.42
2.7325	119.96	5.7218	242.60	12.209	442.51
2.8428	124.51	5.8248	245.92	12.648	458.61
2.9529	129.04	5.9276	250.25	13.082	471.12
3.0627	133.42	6.0302	255.15		
		Wt.% EG = 50			
0	2.4758	10.696	363.77	20.178	620.37

Table 4.4d Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 50					
0.5158	20.289	11.152	377.80	20.584	630.09
1.0286	39.061	11.605	391.11	20.987	640.41
1.5385	57.151	12.056	404.65	21.389	650.42
2.0455	74.623	12.504	415.81	21.788	660.24
2.5495	93.168	12.950	428.60	22.185	671.47
3.0506	109.61	13.394	441.52	22.580	679.46
3.5489	126.91	13.835	451.90	22.974	688.77
4.0444	143.65	14.273	466.18	23.365	698.78
4.5370	160.47	14.71	478.34	23.754	709.10
5.0269	177.92	15.144	487.83	24.142	717.40
5.5140	194.92	15.576	500.42	24.527	727.01
5.9983	210.19	16.005	512.83	25.101	740.87
6.4800	227.01	16.432	523.96	25.672	754.53
6.9589	242.69	16.857	535.49	26.238	767.27
7.4352	259.23	17.280	547.23	26.799	780.12
7.9088	275.35	17.701	557.35	27.542	796.71
8.3798	290.97	18.119	568.17	28.277	812.50
8.8482	306.48	18.535	578.19	29.186	831.31
9.3140	320.28	18.949	588.71	30.084	852.56
9.7773	334.99	19.361	598.02	30.971	871.28
10.238	348.77	19.771	608.03		

Table 4.4d Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt. % EG = 60					
0	1.9656	31.043	643.30	64.488	1165.63
0.5456	14.685	33.109	679.86	67.411	1206.84
1.6294	42.069	35.135	710.88	70.241	1246.50
3.2374	79.019	37.123	743.67	72.982	1289.3
5.3486	128.39	39.074	776.68	75.639	1326.9
7.9363	187.00	40.988	807.92	79.474	1381.0
10.469	241.83	42.867	835.72	83.140	1430.4
12.948	296.17	44.712	867.74	87.783	1494.9
15.375	349.23	46.524	895.55	93.225	1567.5
17.752	398.75	48.303	922.91	98.304	1636.0
20.081	446.39	50.051	948.28	103.97	1701.1
22.362	489.20	51.768	976.08	110.05	1777.1
24.598	530.75	54.287	1014.3	116.39	1856.5
26.789	571.40	57.546	1057.3	122.84	1941.5
28.937	607.96	61.467	1120.4	129.30	2022.0
Wt.% EG = 70					
0	1.9515	12.850	242.73	51.938	833.01
0.2978	8.7821	15.559	292.33	55.976	886.68
0.8917	21.559	19.531	362.36	59.887	933.43
1.7782	39.413	24.660	447.09	63.678	976.91
2.9522	63.826	29.607	527.37	67.353	1017.4
4.4070	91.748	34.384	599.93	70.917	1063.9

Table 4.4d Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 70					
6.1343	123.32	38.997	665.84	74.376	1101.7
8.1246	161.13	43.455	725.72		
10.367	200.22	47.766	781.55		
Wt.% EG = 80					
0	1.5603	44.031	555.12	111.88	1156.3
0.3385	7.4333	49.028	607.30	119.03	1213.5
1.0133	18.283	53.853	660.03	125.719	1266.0
2.0205	33.788	58.515	708.11	131.998	1308.1
3.3537	53.152	63.022	750.65	137.902	1349.7
5.0051	76.804	67.381	791.63	143.463	1388.1
6.9648	101.86	71.600	829.19	148.710	1428.8
9.2214	131.23	75.686	866.96	153.670	1463.2
11.762	168.98	79.644	902.08	158.364	1492.2
14.573	204.97	83.480	933.54	162.814	1517.9
17.638	234.03	87.200	965.56	167.039	1548.3
22.125	298.61	90.810	1000.1	171.055	1575.1
27.911	367.73	96.027	1041.9	176.354	1609.9
33.483	431.27	101.02	1079.4	181.993	1644.9
38.852	495.85	105.81	1112.9		
Wt.% EG = 90					
0	0.7979	65.516	521.89	145.08	983.51
1.0401	13.207	69.511	549.58	150.60	1014.5

Table 4.4d Continued

[AOT] x10^3/ mol kg^{-1}	**κ x 10^4 / S m^{-1}**	**[AOT] x10^3/ mol kg^{-1}**	**κ x 10^4 / S m^{-1}**	**[AOT] x10^3/ mol kg^{-1}**	**κ x 10^4 / S m^{-1}**
		Wt.% EG = 90			
2.5927	30.282	73.440	572.18	155.97	1042.3
4.6492	51.153	77.304	599.65	162.47	1074.3
7.1978	75.796	81.104	624.58	169.99	1108.9
10.224	102.28	84.844	645.52	177.23	1143.7
13.217	127.71	88.523	669.00	184.18	1173.8
17.155	162.38	92.144	690.60	190.88	1203.5
21.517	196.52	95.707	713.20	199.43	1237.6
26.278	234.65	99.214	732.26	209.55	1278.6
30.954	276.06	102.67	752.64	219.09	1318.5
35.545	309.24	106.07	773.80	228.10	1355.3
40.055	345.14	109.41	792.85	238.27	1395.8
44.486	377.32	114.99	821.32	249.33	1441.5
48.839	408.72	121.37	857.66	261.04	1484.0
53.116	438.63	127.56	891.34	273.13	1528.3
57.321	468.16	133.57	919.59	285.41	1569.5
61.453	494.80	139.41	954.37		
		Wt.% EG = 100			
0	0.6083	29.318	167.28	172.46	754.14
0.5632	4.5400	36.769	206.00	185.04	794.51
1.6859	12.073	46.370	254.62	196.79	826.92
3.3614	23.046	60.101	323.15	209.89	864.20
5.5791	36.624	77.262	400.47	223.96	911.89

Table 4.4d Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 100			
8.3255	51.969	93.234	468.40	238.64	941.35
11.584	63.139	111.71	542.38	253.59	976.19
15.336	93.133	128.71	604.31	268.55	1014.7
19.558	112.58	144.41	658.98		
24.228	140.95	158.96	711.15		

Table 4.4e Specific Conductance (κ) Values of AOT in Ethylene glycol - Water Mixture at 40 °C

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 0			
0	1.8437	1.3406	136.05	3.3897	337.13
0.0524	6.9876	1.4081	142.12	3.4940	345.96
0.1045	12.244	1.4751	148.12	3.5969	356.52
0.1564	17.346	1.5416	154.30	3.7319	368.50
0.2079	22.848	1.6076	160.80	3.8645	380.94
0.2592	28.190	1.6730	167.37	3.9947	392.57
0.3101	33.610	1.7379	172.95	4.1226	404.24
0.3608	38.479	1.8024	179.40	4.2483	414.96
0.4112	43.982	1.8875	187.03	4.4023	428.49
0.4613	48.956	1.9718	195.79	4.5530	441.31
0.5111	53.776	2.0553	204.22	4.7005	454.41
0.5607	58.680	2.1379	211.67	4.8449	467.45
0.6100	63.438	2.2196	219.05	4.9863	477.53
0.6590	68.447	2.3006	227.05	5.1248	491.16
0.7077	73.225	2.3807	235.99	5.2604	503.91
0.7562	78.122	2.4601	244.38	5.5200	524.84
0.8044	83.155	2.5386	252.56	5.7766	544.73
0.8524	88.026	2.6164	260.96	6.0198	564.42
0.9001	92.797	2.6935	268.27	6.2538	582.98
0.9475	97.632	2.7887	277.54	6.4792	585.44
0.9947	102.17	2.8829	286.52	6.6963	601.75

Table 4.4e Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 0					
1.0650	109.31	2.9758	295.82	7.0077	625.43
1.1347	115.93	3.0677	305.84	7.3031	647.89
1.2039	122.66	3.1766	316.26	7.6739	679.78
1.2725	129.16	3.2839	326.95		
Wt.% EG = 10					
0	3.8879	0.4750	63.044	1.7445	237.70
0.0256	6.5809	0.4993	65.638	1.8494	251.44
0.0512	9.4587	0.5478	72.494	2.0552	278.65
0.0766	12.393	0.5960	79.114	2.2561	307.73
0.1020	15.715	0.6439	86.498	2.6437	357.86
0.1274	18.496	0.6916	92.829	3.0135	406.22
0.1526	21.517	0.7391	100.04	3.3667	447.85
0.1778	24.232	0.7863	107.26	3.7043	493.87
0.2030	27.515	0.8332	113.49	4.0275	530.32
0.2280	31.118	0.8800	120.14	4.4871	582.67
0.2530	34.656	0.9264	127.67	4.9188	631.98
0.2779	38.316	0.9727	133.62	5.4554	686.19
0.3028	41.964	1.0416	142.61	6.0702	754.65
0.3276	45.854	1.1099	152.23	6.6307	810.14
0.3523	48.708	1.2003	165.17	7.1438	856.91
0.3770	51.574	1.3119	179.77	7.6151	910.04
0.4016	54.196	1.4221	194.16	8.4516	995.68

Table 4.4e Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 10					
0.4261	57.935	1.5309	208.83	9.1712	1065.0
0.4506	60.416	1.6384	223.77	9.7968	1148.5
Wt.% EG = 20					
0	3.4242	1.4974	112.54	4.7132	283.49
0.0326	6.0454	1.5950	119.01	4.8754	290.90
0.0651	8.9580	1.6925	125.22	5.0375	297.92
0.0977	11.824	1.7901	131.31	5.1997	304.85
0.1303	14.763	1.8877	137.21	5.3618	311.67
0.1629	17.757	1.9852	143.64	5.5238	318.32
0.1954	20.878	2.0828	149.75	5.8479	330.22
0.2280	23.674	2.1803	155.60	6.1719	342.39
0.2606	26.258	2.2778	161.38	6.4958	355.09
0.2931	28.912	2.3753	167.06	6.8196	369.50
0.3257	31.924	2.4728	172.02	7.1433	382.45
0.3583	35.383	2.5703	177.83	7.4670	392.34
0.3908	37.326	2.6678	183.59	7.7905	404.91
0.4559	42.059	2.7653	188.55	8.4372	424.66
0.5211	46.673	2.8628	193.47	9.0836	445.28
0.5862	51.405	2.9603	198.62	9.7297	461.10
0.6513	56.356	3.0577	204.45	11.343	488.86
0.7164	61.124	3.1552	209.59	11.988	505.93
0.7815	64.999	3.2526	215.04	12.954	519.22

Table 4.4e Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 20					
0.8466	69.554	3.3500	219.89	14.563	541.24
0.9117	73.957	3.4475	225.36	16.170	575.93
0.9768	78.117	3.5774	230.65	17.774	602.11
1.0419	82.580	3.7397	238.11	20.975	629.40
1.1069	87.582	3.9020	245.73	24.167	671.70
1.1720	91.822	4.0643	253.17	27.351	716.74
1.2371	95.749	4.2266	261.33	30.525	756.21
1.3022	100.21	4.3888	269.09	33.690	786.54
1.3998	106.37	4.5510	276.52	36.846	813.12
Wt.% EG = 30					
0	2.3038	1.8701	117.62	4.2775	254.00
0.1191	9.9350	1.9749	123.92	4.4235	261.62
0.2374	17.291	2.0790	129.88	4.5678	269.48
0.3546	25.066	2.1823	135.72	4.7106	277.66
0.4710	32.441	2.2849	141.74	4.8798	286.13
0.5865	39.228	2.3867	147.64	5.0468	294.67
0.7010	46.517	2.4878	153.01	5.2661	305.57
0.7769	51.466	2.5881	158.68	5.5349	319.07
0.8524	55.970	2.6877	163.91	5.7979	332.21
0.9275	60.657	2.7866	169.70	6.3074	357.98
1.0022	65.141	2.8848	174.70	6.7961	380.20
1.0766	69.828	2.9823	180.33	7.2651	402.33

Table 4.4e Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 30			
1.1506	74.434	3.0791	185.54	7.7157	424.33
1.2242	78.553	3.2071	193.18	8.1490	441.38
1.2974	82.753	3.3339	200.17	8.5658	459.96
1.3702	87.592	3.4595	207.24	8.9671	478.64
1.4427	91.944	3.5839	214.33	9.3538	496.96
1.5148	96.114	3.7072	221.83	9.7267	515.27
1.5866	100.63	3.8293	228.02	10.086	533.32
1.6580	104.90	3.9804	237.07		
1.7644	111.04	4.1298	244.96		
		Wt.% EG = 40			
0	3.2184	4.1165	215.02	7.8799	394.19
0.1537	10.686	4.2567	221.71	8.0083	400.28
0.3068	18.986	4.3965	229.49	8.1363	406.70
0.4595	27.856	4.5358	236.35	8.3913	414.25
0.6116	35.778	4.6747	243.17	8.6446	423.70
0.7632	44.223	4.8131	249.63	8.8965	434.77
0.9143	51.766	4.9511	257.13	9.1468	442.33
1.0649	59.970	5.0886	263.73	9.3956	452.10
1.2151	68.060	5.2258	270.53	9.6430	461.07
1.3647	76.798	5.3624	277.40	9.8888	469.45
1.5138	84.560	5.4987	282.61	10.133	478.91
1.6625	92.118	5.6345	290.95	10.376	486.34

Table 4.4e Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 40			
1.8106	100.13	5.7699	298.21	10.618	494.71
1.9583	108.33	5.9049	304.90	10.858	501.17
2.1055	114.86	6.0394	311.52	11.215	515.30
2.2522	122.18	6.1736	316.43	11.569	527.30
2.3984	129.47	6.3073	323.55	11.921	537.86
2.5441	136.98	6.4406	330.29	12.269	548.63
2.6894	144.44	6.5735	336.38	12.728	563.50
2.8342	151.42	6.7059	342.88	13.182	577.55
2.9785	159.09	6.8380	348.50	13.743	594.98
3.1224	165.90	6.9696	354.33	14.295	610.16
3.2658	171.30	7.1009	360.23	14.840	628.31
3.4087	178.86	7.2317	366.54	15.377	640.61
3.5512	186.55	7.3621	372.50	16.430	666.76
3.6932	193.95	7.4922	378.25	17.453	690.35
3.8348	200.57	7.6218	383.53		
3.9759	207.70	7.7510	389.07		
		Wt.% EG = 50			
0	2.3881	9.4139	370.84	17.881	645.16
0.3967	19.084	9.7698	383.17	18.202	654.17
0.7917	36.322	10.124	395.66	18.522	663.27
1.1849	52.517	10.477	408.49	18.840	672.28
1.5764	67.643	10.828	420.25	19.157	680.98

Table 4.4e Continued

[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[AOT] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}
		Wt.% EG = 50			
1.9661	82.079	11.178	431.88	19.473	691.60
2.3541	99.622	11.527	443.76	19.788	699.39
2.7404	115.34	11.874	456.17	20.101	709.61
3.1250	129.70	12.219	465.67	20.414	716.69
3.5079	145.62	12.564	478.96	20.724	725.69
3.8891	161.26	12.906	490.53	21.034	733.18
4.2687	176.66	13.247	500.59	21.496	744.92
4.6466	191.67	13.587	511.52	21.956	756.65
5.0229	206.84	13.926	523.76	22.413	770.11
5.3976	220.50	14.263	536.00	22.867	781.44
5.7706	234.49	14.599	545.71	23.468	799.14
6.1420	248.60	14.933	556.03	24.065	812.09
6.5118	262.70	15.266	564.73	24.805	831.01
6.8801	277.73	15.597	576.26	25.537	849.53
7.2467	289.44	15.928	585.17	26.263	867.63
7.6118	301.88	16.256	595.39	26.981	886.65
7.9753	317.44	16.584	603.28	27.693	905.57
8.3373	331.30	16.910	615.52	28.398	918.83
8.6977	344.73	17.235	623.71	29.097	940.17
9.0566	356.56	17.559	635.65	29.789	955.85
		Wt.% EG = 60			
0	2.2929	6.0015	207.30	13.175	413.61

Table 4.4e Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 60					
0.2948	12.715	6.2777	215.42	13.684	426.20
0.5887	24.900	6.5531	223.58	14.441	447.10
0.8816	34.289	6.8276	232.94	15.192	465.45
1.1736	43.505	7.1013	241.55	15.937	484.65
1.4647	52.932	7.3742	250.13	16.675	502.67
1.7549	63.393	7.6462	258.61	17.650	526.89
2.0442	71.598	7.9174	268.12	18.613	547.94
2.3326	82.403	8.1878	275.79	19.565	573.63
2.6201	93.360	8.4574	281.66	20.974	603.07
2.9067	104.75	8.7262	289.85	22.130	629.08
3.1924	113.86	8.9942	296.32	23.270	655.25
3.4772	122.25	9.2613	304.47	24.394	679.13
3.7612	133.40	9.5277	313.34	25.503	701.31
4.0442	142.38	9.7930	320.06	27.677	745.42
4.3264	152.23	10.058	330.15	29.792	786.09
4.6078	161.29	10.585	342.75	31.853	825.35
4.8882	169.95	11.109	356.29	33.860	864.09
5.1678	179.52	11.630	371.86	35.816	900.31
5.4466	189.41	12.148	386.84	37.722	935.92
5.7245	198.28	12.663	399.80	39.581	967.79
Wt.% EG = 70					
0	1.9101	25.110	522.83	78.882	1326.6

Table 4.4e Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 70					
0.3037	9.6833	30.139	616.33	83.785	1392.8
0.9094	24.970	34.989	701.02	88.480	1450.3
1.8134	47.166	39.672	777.62	92.979	1501.9
3.0104	73.336	44.195	847.74	97.295	1550.6
4.4935	107.21	48.566	914.38	101.44	1603.9
6.2540	146.06	52.793	978.91	106.71	1664.9
8.2820	182.59	56.883	1036.57	112.94	1734.4
10.566	236.37	60.842	1092.7	119.903	1811.5
13.094	286.06	64.677	1148.5	127.418	1897.1
15.853	341.14	68.393	1195.0	135.293	1981.2
19.894	422.98	73.756	1258.8		
Wt.% EG = 80					
0	1.6199	21.273	339.49	75.213	997.46
0.2497	7.1852	22.796	360.20	79.600	1040.8
0.7480	16.861	24.518	384.35	83.839	1080.8
1.4926	30.786	26.221	408.06	87.937	1125.3
2.4802	48.085	27.906	430.71	93.192	1172.7
3.7064	68.927	29.778	455.25	98.223	1217.3
4.9233	89.610	31.628	480.61	103.05	1262.9
6.1313	109.58	33.656	507.21	108.80	1311.0
7.3302	129.72	35.657	533.52	115.32	1371.7
8.5203	148.62	38.608	572.95	122.47	1433.1

Table 4.4e Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 80					
9.7017	167.19	42.452	622.36	129.15	1487.1
10.874	185.60	46.195	670.33	136.28	1547.1
12.270	207.60	49.843	714.75	143.71	1609.0
13.654	227.94	53.397	761.28	151.33	1664.4
15.026	248.87	56.862	801.49	160.35	1735.9
16.611	272.30	61.073	846.69	169.68	1804.9
18.181	294.84	65.958	900.42	180.63	1882.2
19.734	316.28	70.668	950.71	190.18	1957.5
Wt.% EG = 90					
0	0.9165	74.774	714.09	190.67	1438.2
0.9618	10.807	81.830	768.04	200.52	1491.3
2.8753	36.292	88.677	821.32	209.84	1537.6
5.2483	64.873	95.323	868.29	218.67	1580.8
8.0684	96.622	101.78	917.70	228.66	1624.7
11.783	136.68	108.05	958.91	241.76	1680.8
15.901	179.07	114.14	1000.7	255.68	1741.0
20.401	224.84	122.97	1057.1	268.60	1801.1
27.445	295.62	131.44	1110.7	280.63	1847.8
35.987	375.10	139.58	1158.5	291.84	1895.7
44.250	453.59	147.40	1204.4	302.34	1938.2
52.248	523.77	157.37	1263.3	313.35	1974.5

Table 4.4e Continued

[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 90					
59.994	591.23	169.15	1323.4	324.72	2013.8
67.499	653.38	180.23	1386.5	335.26	2063.8
Wt.% EG = 100					
0	0.7296	33.136	225.77	189.58	953.65
0.5039	4.6616	41.867	279.10	207.66	1014.6
1.5089	13.681	52.366	331.21	225.67	1063.9
3.0094	25.016	64.394	398.52	241.82	1127.0
4.9971	39.916	77.695	475.78	269.59	1212.0
7.4611	58.243	92.011	554.40	302.70	1305.8
10.388	76.931	107.09	621.31	328.55	1371.9
13.762	102.195	122.69	690.44	355.34	1436.0
17.566	127.630	138.60	756.41	380.53	1493.2
21.780	154.150	154.63	827.31	402.92	1545.8
26.383	182.444	171.77	888.84		

Table 4.5 Values of cmc of CPC in EG + water media at 298 K determined from surface tension and conductance data

Weight % EG	cmc / mmol kg^{-1} (from surface tension)		cmc / mmol kg^{-1} (from conductance)		
	Present work	Reported[a] at 300.5 K (ref. 26)	Present work	Reported[a] at 303 K (ref. 27)[b]	Reported[a] at 303 K (ref. 28)
0	0.91	--	0.90	1	1.07
10	1.01	--	1.10	1.05	--
20	1.36	--	1.33	1.18	1.7
30	1.89	--	1.80	1.32	--
40	3.03	--	3.00	2.04	4.0
50	3.70	--	3.90	2.89	--
60	6.10	--	6.20	--	11.0
70	9.10	--	9.50	--	--
80	19.8	--	20.0	--	--
90	40.8	--	40.0	--	--
100	90.7 (247)[c]	230	92.0	--	--

[a] cmc reported in mol dm^{-3}, [b] percentage of EG is given in volume %,

[c] value of second cmc

Table 4.6 Specific Conductance (κ) Values of CPC in Ethylene glycol - Water Mixture at 25° C

[CPC] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[CPC] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[CPC] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}
			Wt.% EG = 0		
0	1.1596	0.3644	45.529	0.9606	99.542
0.0306	5.1136	0.3946	49.191	1.0782	103.79
0.0611	8.8795	0.4247	52.484	1.1952	110.81
0.0916	12.430	0.4548	55.950	1.3117	114.67
0.1221	16.168	0.4848	59.590	1.4277	117.15
0.1525	19.933	0.5448	65.651	1.6006	121.08
0.1829	23.851	0.6046	71.004	1.7724	124.85
0.2132	27.568	0.6643	76.644	2.0561	137.72
0.2435	31.159	0.7238	82.663	2.3366	146.23
0.2738	34.578	0.7832	87.052	2.6140	155.89
0.3041	38.463	0.8425	93.010	2.8883	174.30
0.3343	41.923	0.9016	95.492	3.1595	183.50
			Wt.% EG = 10		
0	2.0015	1.1337	79.071	2.0877	109.79
0.0177	5.3745	1.2072	80.848	2.1501	111.82
0.0705	8.8553	1.2799	83.678	2.2241	114.39
0.1576	15.251	1.3517	85.569	2.3091	116.94
0.2775	23.295	1.4226	88.617	2.4047	120.19
0.4286	33.655	1.4927	90.982	2.5102	123.39
0.5110	38.790	1.5619	93.196	2.6251	126.64

Table 4.6 Continued

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 10					
0.5923	44.748	1.6304	95.346	2.7929	131.19
0.6726	49.901	1.6980	97.506	3.0084	138.17
0.7519	55.397	1.7648	99.353	3.2655	145.34
0.8302	60.705	1.8309	101.63	3.5575	153.64
0.9075	65.944	1.8962	103.86	3.9210	163.65
0.9838	70.770	1.9608	106.00	4.3384	174.65
1.0592	74.832	2.0246	108.17	4.7923	185.78
Wt.% EG = 20					
0	1.9720	1.1021	77.608	3.0915	141.63
0.0570	6.6461	1.2081	83.155	3.3222	146.19
0.1138	10.377	1.3134	87.268	3.5491	152.31
0.1704	13.510	1.4180	92.436	3.7725	156.31
0.2267	18.217	1.5218	96.630	3.9923	164.39
0.2829	22.321	1.6250	99.901	4.2087	173.61
0.3389	26.572	1.7783	106.27	4.4218	177.62
0.3947	31.699	1.9302	110.587	4.6315	184.44
0.4502	33.937	2.0805	116.104	4.8381	189.22
0.5056	37.469	2.2293	120.657	5.2420	197.49
0.5608	41.691	2.3766	123.836	5.6339	206.16
0.6706	49.442	2.5224	126.533	6.0143	214.87
0.7796	56.606	2.6668	130.891	6.3839	220.52
0.8879	63.354	2.8098	134.019	6.7429	230.41

Table 4.6 Continued

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 20					
0.9954	70.388	2.9513	138.787		
Wt.% EG = 30					
0	2.1916	0.6584	42.623	2.8242	129.40
0.0274	3.9507	0.7009	45.294	3.0636	134.35
0.0547	5.7375	0.7539	48.392	3.3003	140.01
0.0820	7.7156	0.8068	51.023	3.5344	143.81
0.1093	9.6179	0.8596	54.258	3.7658	149.27
0.1365	11.085	0.9122	56.944	3.9947	154.08
0.1637	12.784	9.6474	59.877	4.2661	160.34
0.1909	14.709	1.0171	62.933	4.5340	165.98
0.2180	16.387	1.0694	65.917	4.8857	171.90
0.2505	18.401	1.1736	70.132	5.3170	180.83
0.2830	20.574	1.2773	76.285	5.7391	189.08
0.3154	22.334	1.3805	82.027	6.1524	195.66
0.3478	24.086	1.4832	86.386	6.5572	203.70
0.3801	25.972	1.5854	91.072	7.3421	217.08
0.4124	28.239	1.7379	95.379	8.0959	228.96
0.4500	30.784	1.8893	102.42	8.8203	241.44
0.4876	32.899	2.0396	107.56	9.8555	255.57
0.5304	35.298	2.1889	112.56	10.834	277.10
0.5731	37.907	2.3864	117.77		
0.6158	40.032	2.5821	122.76		

Table 4.6 Continued

[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[AOT] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 40					
0	2.1876	1.3768	58.759	3.3100	125.43
0.0320	3.7083	1.5221	64.871	3.5616	131.47
0.0959	6.5507	1.6659	70.501	3.9059	139.56
0.1912	10.652	1.8082	76.018	4.3825	148.78
0.2858	14.565	1.9491	81.710	4.8421	156.95
0.3799	18.666	2.0886	87.134	5.2856	165.36
0.5044	23.683	2.2268	92.692	5.7137	172.94
0.6279	28.561	2.3635	97.420	6.1272	178.76
0.7808	34.838	2.5259	103.45	6.7219	189.36
0.9321	40.955	2.6864	108.53	7.2877	197.196
1.0819	46.909	2.8713	113.99	8.0008	207.79
1.2301	53.109	3.0795	119.58	8.9905	221.94
Wt.% EG = 50					
0	2.9227	2.4588	75.077	5.8600	146.85
0.0300	3.9049	2.6791	80.823	6.1264	152.31
0.0895	5.8259	2.8931	86.984	6.3813	155.76
0.1781	8.6470	3.1013	92.570	6.7437	160.49
0.2949	12.227	3.3038	98.021	7.1931	165.91
0.4388	16.503	3.5008	102.96	7.7066	171.89
0.5803	20.691	3.6927	107.68	8.1734	177.44
0.7196	24.971	3.8795	112.06	8.5996	182.34
0.8567	28.901	4.0615	116.18	8.9903	186.54

Table 4.6 Continued

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 50			
0.9916	32.939	4.2388	119.58	9.3497	190.43
1.1507	37.600	4.4117	122.78	9.6814	194.25
1.3326	42.711	4.5802	126.02	9.9885	197.63
1.5357	48.661	4.7447	129.06	10.274	200.40
1.7583	55.191	4.9839	133.28	10.539	203.45
1.9988	62.106	5.2897	138.10		
2.2322	68.520	5.5814	142.70		
		Wt.% EG = 60			
0	2.4611	3.5382	81.254	8.2519	165.06
0.0863	4.3694	3.8922	88.518	8.7286	171.23
0.2577	8.3674	4.2392	95.879	9.2413	177.33
0.4275	12.145	4.5794	103.39	9.9786	186.84
0.5960	15.678	4.9130	110.36	10.907	197.15
0.7629	19.401	5.2402	116.58	11.987	207.61
0.9284	22.972	5.5613	123.02	13.179	220.28
1.1740	28.185	5.8763	129.09	14.270	230.42
1.4164	33.583	6.1854	135.13	15.589	242.65
1.6558	38.448	6.4889	140.30	17.054	255.67
1.9703	46.631	6.7867	144.63	18.587	268.82
2.4322	57.225	7.0792	149.38	20.126	281.51
2.8084	65.505	7.4233	153.94	21.624	294.56
3.1770	73.333	7.8155	159.55		

Table 4.6 Continued

[CPC] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
Wt.% EG = 70					
0	1.7099	7.7878	128.77	18.268	244.82
0.1020	3.8893	8.3151	136.32	18.976	251.31
0.3055	7.9886	8.8371	144.51	19.674	256.47
0.6093	13.477	9.3538	151.13	20.361	261.05
1.0119	20.737	9.8653	158.61	21.038	266.91
1.5109	29.650	10.540	167.79	21.705	271.66
2.1039	39.366	11.370	178.10	22.362	275.44
2.7876	50.321	12.186	187.45	23.009	281.68
3.5586	62.896	12.990	196.92	23.774	286.95
4.3188	74.683	13.780	204.76	24.526	292.22
5.2540	88.635	14.558	212.42	25.386	297.30
5.8073	97.148	15.323	219.40	26.349	303.60
6.1730	103.01	16.079	226.64	27.407	312.52
6.7169	111.52	16.819	233.40	28.552	319.07
7.2551	119.85	17.549	238.67	29.666	326.45
Wt.% EG = 80					
0	0.6463	24.266	336.04	60.558	631.47
0.2451	5.1077	26.231	357.31	64.583	665.76
0.7339	13.280	28.160	377.52	68.431	695.05
1.4634	25.477	30.055	396.08	72.115	720.80
2.4291	37.509	31.917	414.26	76.787	752.04
3.6253	59.730	33.745	429.37	81.206	781.33

Table 4.6 Continued

[CPC] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[CPC] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}	[CPC] x10^{3}/ mol kg^{-1}	κ x 10^{4} / S m^{-1}
Wt.% EG = 80					
5.0450	81.043	35.542	445.36	86.405	812.14
6.6798	105.26	37.308	461.71	91.274	846.37
8.5206	133.09	39.044	473.89	95.845	875.97
10.557	160.31	40.750	486.82	100.14	903.97
12.778	190.56	44.077	513.96	108.01	953.77
14.957	220.41	47.295	539.83	115.05	998.92
17.094	247.91	50.409	561.83	121.37	1044.2
19.191	274.41	53.424	582.23		
21.249	300.79	56.345	603.04		
Wt.% EG = 90					
0	0.4572	38.451	267.91	90.927	515.98
3.0657	25.485	40.871	281.17	95.841	536.27
6.0771	49.339	43.252	294.51	100.57	556.46
9.0356	72.619	45.596	307.62	105.11	573.39
11.943	94.52	47.903	317.24	109.50	589.78
13.377	104.84	50.175	334.08	113.72	606.17
14.799	114.50	52.412	348.90	119.12	626.81
16.209	124.98	56.785	366.12	124.26	647.55
17.607	134.99	61.029	388.16	129.18	665.84
20.368	152.67	65.148	405.27	135.03	692.55
23.081	171.90	69.149	423.14	140.56	709.75
25.750	188.80	73.037	441.37	145.81	729.67

Table 4.6 Continued

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 90			
28.374	206.09	76.815	457.53	150.79	747.60
30.956	222.82	80.489	472.07	155.52	763.36
33.495	238.43	84.063	488.09	160.03	780.38
35.993	255.05	87.541	502.58	164.33	796.14
		Wt.% EG = 100			
0	0.4043	11.575	52.689	118.65	523.30
0.4884	2.2173	12.526	56.709	125.93	550.78
0.9762	4.8120	13.475	60.554	133.08	578.16
1.4635	6.5548	15.367	68.809	140.09	603.28
1.9502	8.5842	17.251	77.567	146.98	628.00
2.4365	10.697	20.062	89.452	160.38	673.12
2.9222	12.975	22.854	102.53	173.30	720.80
3.4073	15.913	25.629	115.40	185.78	757.41
3.8920	17.942	28.386	127.70	197.84	797.20
4.3761	19.812	32.943	150.30	209.49	836.37
4.8597	21.876	37.452	171.50	220.76	872.47
5.3428	23.378	42.801	194.99	231.66	906.52
5.8253	26.528	48.083	223.88	242.21	942.20
6.3073	29.598	55.025	256.14	252.44	974.81
6.7888	31.844	63.544	296.34	262.35	1005.7
7.2698	33.034	71.891	329.86	271.95	1032.8
7.7502	34.373	80.072	366.72	285.82	1073.1

Table 4.6 Continued

[CPC] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3 / mol kg^{-1}	κ x 10^4 / S m^{-1}
		Wt.% EG = 100			
8.2301	36.471	88.092	401.35	299.09	1116.9
8.7096	39.007	95.956	433.58	311.79	1158.4
9.6668	43.337	103.67	462.72		
10.622	48.337	111.23	492.73		

Table 4.7 Ratio of the intensities of Fluorescence Emission of Pyrene at 374 nm (I_1) and at 384 nm (I_3) in AOT + water + EG system at 298 K

% EG	[AOT] x10^3/ mol kg^{-1}	I_1 / I_3	% EG	[AOT] x10^3/ mol kg^{-1}	I_1 / I_3
0	0	1.6809	10	1.1597	1.7902
	0.3417	1.6028		1.3254	1.7870
	0.5126	1.5888		1.4911	1.7734
	0.6834	1.5850		1.6568	1.7422
	1.8794	1.5511		1.8224	1.7346
	2.0503	1.5286		1.9881	1.7835
	2.2111	1.4699		2.3195	1.7458
	2.3920	1.4548		2.6508	1.7120
	2.5628	1.3581		2.9822	1.4205
	2.7337	1.3362		3.3135	1.3515
	3.0754	1.2514		3.6449	1.2684
	3.4171	1.1631		3.9762	1.2218
	4.2714	1.1025		4.3076	1.1939
	5.1267	1.0670		4.6389	1.1726
	5.9800	1.0433		4.9703	1.1665
	6.8342	1.0222		5.3016	1.1541
	8.5428	0.9945		5.6330	1.1463
10	0	1.8339	20	0	1.6765
	0.3314	1.8420		5.8727	1.6015
	0.4970	1.8123		1.1745	1.5974
	0.6627	1.7931		1.7618	1.5871
	0.8284	1.7851		2.0554	1.5635
	0.9941	1.8077		2.6427	1.5256

Table 4.7 continued

% EG	[AOT] x10^3/ mol kg^{-1}	I_1/I_3	% EG	[AOT] x10^3/ mol kg^{-1}	I_1/I_3
20	2.9363	1.6809	30	5.9708	1.4223
	3.3474	1.6028		6.3689	1.3883
	3.5236	1.5888		7.1650	1.3508
	3.7585	1.5850		7.9611	1.3391
	3.9347	1.5511	40	0	1.6606
	4.1109	1.5286		1.4444	1.6565
	4.4045	1.4699		2.4554	1.6431
	4.6982	1.4548		2.8887	1.6439
	5.2854	1.3581		3.3220	1.6472
	5.8727	1.3362		3.7553	1.6268
	6.4600	1.2514		4.1887	1.6236
	7.0472	1.1631		4.4775	1.6179
30	0	1.1025		4.9108	1.6000
	0.7961	1.0670		5.3441	1.5820
	1.9903	1.0433		5.7775	1.5625
	2.7068	1.0222		6.0663	1.5397
	3.1844	0.9945		6.6441	1.5195
	3.8213	1.8339		6.9329	1.5099
	4.1398	1.8420		7.2218	1.4852
	4.4582	1.8123		7.5107	1.4428
	4.6970	1.7931		7.7996	1.4351
	4.9359	1.7851		8.0884	1.4132
	5.2543	1.8077		8.6662	1.3906

Table 4.7 continued

% EG	[AOT] x10^3/ mol kg^{-1}	I_1 / I_3	% EG	[AOT] x10^3/ mol kg^{-1}	I_1 / I_3
40	9.3884	1.3565	50	31.560	1.2511
	10.111	1.3280		47.340	1.1861
	11.555	1.3023	60	0	1.7021
50	0	1.6807		3.8540	1.6866
	1.0520	1.6815		5.7810	1.6821
	1.5780	1.6795		7.7080	1.6642
	2.1040	1.6722		9.6350	1.6584
	2.6300	1.6692		11.562	1.6420
	3.1560	1.6639		13.489	1.6221
	3.6820	1.6617		15.416	1.5982
	4.2080	1.6570		17.342	1.5672
	4.7340	1.6537		19.269	1.5368
	5.2600	1.6472		21.196	1.5085
	5.7860	1.6429		23.123	1.4835
	6.3120	1.6399		25.050	1.4605
	6.8380	1.6311		26.977	1.4391
	7.3640	1.6221		28.904	1.4205
	7.8900	1.6147		30.831	1.4049
	8.4160	1.6033		32.758	1.3862
	8.9420	1.5898		34.685	1.3736
	9.4680	1.5738		36.612	1.3589
	10.520	1.5439		38.539	1.3506
	21.040	1.3273		57.808	1.2799

Table 4.7 continued

% EG	[AOT] x10^3/ mol kg^{-1}	I_1 / I_3	% EG	[AOT] x10^3/ mol kg^{-1}	I_1 / I_3
60	77.078	1.2435	70	59.967	1.3941
	96.347	1.2215		66.630	1.3845
	115.62	1.2057		73.304	1.3565
	134.89	1.1946		79.957	1.3368
70	0	1.7058		86.620	1.3247
	3.3320	1.6868		93.283	1.3177
	4.9970	1.6830		99.946	1.3060
	8.3290	1.6775		109.94	1.2927
	9.9950	1.6712		119.94	1.2789
	11.660	1.6651		133.26	1.2674
	13.326	1.6637		166.58	1.2469
	16.658	1.6539	80	0	1.6545
	19.989	1.6466		2.8630	1.6410
	23.321	1.6241		5.7260	1.6337
	26.652	1.6014		11.453	1.6210
	29.984	1.5796		17.179	1.6192
	31.649	1.5607		22.906	1.6095
	33.315	1.5564		28.632	1.5985
	36.647	1.5285		34.358	1.5898
	39.978	1.5061		40.241	1.5753
	43.310	1.4861		45.811	1.5699
	46.641	1.4657		51.537	1.5494
	53.304	1.4239		57.264	1.5145

Table 4.7 continued

% EG	[AOT] x10^3/ mol kg^{-1}	I_1 / I_3	% EG	[AOT] x10^3/ mol kg^{-1}	I_1 / I_3
80	63.232	1.5008	90	32.600	1.5929
	68.717	1.4839		38.030	1.5818
	74.443	1.4684		43.460	1.5805
	80.169	1.4573		48.890	1.5721
	86.222	1.4438		54.330	1.5689
	91.622	1.4288		59.760	1.5632
	97.349	1.4227		65.190	1.5535
	103.46	1.4104		70.620	1.5451
	109.21	1.4031		76.060	1.5314
	114.96	1.3953		81.490	1.5281
	126.45	1.3755		86.920	1.5223
	137.95	1.3576		92.350	1.5099
	149.44	1.3508		97.790	1.4993
	160.94	1.3410		103.22	1.4934
	172.44	1.3296		108.65	1.4885
	189.68	1.3198		124.95	1.4706
	206.92	1.3069		141.25	1.4457
	229.91	1.3007		162.98	1.4286
90	0	1.6202		190.14	1.4091
	10.870	1.6111		217.30	1.3849
	16.310	1.6067		244.46	1.3767
	21.730	1.6077		271.63	1.3600
	27.160	1.5934	100	0	1.5781

Table 4.7 continued

% EG	[AOT] x10^3/ mol kg^{-1}	I_1/I_3	% EG	[AOT] x10^3/ mol kg^{-1}	I_1/I_3
100	0.1283	1.5725	100	15.395	1.5485
	0.2566	1.5806		20.527	1.5414
	0.5132	1.5617		30.790	1.5379
	1.0263	1.5603		41.053	1.5275
	1.5395	1.5590		51.317	1.5183
	2.0527	1.5541		76.975	1.5020
	2.5658	1.5455		102.63	1.5012
	3.0790	1.5716		128.29	1.4836
	3.5922	1.5637		179.61	1.4556
	4.1053	1.5598		205.27	1.4374
	4.6185	1.5498		230.92	1.4157
	5.1317	1.5581		256.58	1.4025
	7.6975	1.5719		282.24	1.4028
	10.263	1.5482		307.90	1.3881
	12.829	1.5512		333.56	1.3743
	15.395	1.5485		359.22	1.3664

Table 4.8 Fitted values of the parameters of Eq. (4.1) for pyrene in AOT + water + EG system at 25 °C

% EG	A_1	A_2	c_0 (mol kg^{-1})	b x 10^3 (mol kg^{-1})	c_0/b	$(c_0+b)/2$ (mol kg^{-1})
0	1.68	1.02	0.0027	0.72	3.75	0.0017
10	1.84	1.14	0.0030	0.41	7.32	0.0017
20	1.60	1.20	0.0037	0.67	5.52	0.0022
30	1.72	1.34	0.0046	0.98	4.69	0.0028
40	1.66	1.30	0.0072	1.30	5.54	0.0043
50	1.80	1.20	0.0120	6.80	1.76	0.0094
60	1.81	1.22	0.0216	12.7	1.70	0.0172
70	1.78	1.27	0.0380	21.5	1.77	0.0298
80	1.72	1.30	0.0610	39.7	1.54	0.0504
90	1.61	1.36	0.1100	37.1	2.95	0.0736
100	1.57	1.38	0.1400	66.9	2.09	0.1035

Table 4.9 Counter ion binding constant values of AOT and CPC from slope ration method. A few values given in the parentheses are those obtained from the Corrin – Harkins method

Weight % EG	Temperature in °C					β of CPC at 25 °C
	20	25	30	35	40	
	β of AOT					
0	-	(0.39)	-	-	-	0.62
10	0.19	0.20 (0.28)	0.19	0.15	0.22	0.54
20	0.21	0.15 (0.18)	0.19	0.21	0.19	0.54
30	0.15	0.16	0.21	0.18	0.18	0.54
40	0.22	0.19	0.16	0.17	0.17	0.54
50	0.23	0.23	0.20	0.19	0.20	0.43
60	0.29	0.28	0.16	0.25	0.20	0.41
70	0.23	0.24	0.21	0.27	0.28	0.33
80	0.21	0.24	0.17	0.27	0.26	0.34
90	0.26	0.23	0.21	0.22	0.29	0.33
100	0.26	0.28	0.24	0.23	0.29	0.25

Table 4.10a Surface Tension (γ) Values of AOT in 10% Ethylene glycol - Water Mixture at 25 °C in Presence of NaCl

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
[NaCl] = 0.0023					
0.0039	61.2	0.3531	41.8	3.3097	29.4
0.0157	56.4	0.5195	40.0	4.0548	29.0
0.0353	53.3	0.7526	37.6	4.8718	29.0
0.0666	50.7	1.0960	35.2	5.7717	28.7
0.1094	48.0	1.5476	33.0	6.8297	28.1
0.1634	45.7	2.0837	31.0	8.0914	28.9
0.2400	43.8	2.6790	30.4	9.2092	28.1
[NaCl] = 0.0053					
0.0031	60.4	0.3854	38.4	2.4600	28.7
0.0122	54.5	0.5545	36.4	2.9900	28.3
0.0306	50.5	0.7717	34.5	3.7300	28.3
0.0611	47.2	1.0300	33.2	4.8700	28.0
0.1065	44.6	1.3500	31.4	6.0500	27.6
0.1664	42.6	1.6900	30.0	7.0600	27.5
0.2551	40.7	2.0700	29.0		
[NaCl] = 0.0076					
0.0030	60.9	0.6770	34.3	3.3100	27.8
0.0118	54.5	1.0000	31.6	3.8100	27.5

Table 4.10 Continued

[AOT] x10^3 / mol kg^{-1}	**γ / mN m^{-1}**	**[AOT] x10^3 / mol kg^{-1}**	**γ / mN m^{-1}**	**[AOT] x10^3 / mol kg^{-1}**	**γ / mN m^{-1}**
		[NaCl] = 0.0076			
0.0300	50.3	1.3500	30.2	4.4500	27.7
0.0588	46.7	1.7100	28.8	5.2700	27.5
0.1314	43.0	2.0900	28.0	6.3800	27.1
0.2595	39.5	2.4600	28.1		
0.4389	36.9	2.8700	27.9		

Table 4.10b Surface Tension (γ) Values of AOT in 20% Ethylene glycol - Water Mixture at 25 °C in Presence of NaCl

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
[NaCl] = 0.002					
0.0063	56.0	0.5443	40.1	3.6957	30.2
0.0188	53.2	0.8155	38.0	4.7315	29.7
0.0500	50.2	1.1594	35.7	6.0044	28.9
0.1122	47.5	1.6014	33.9	7.6745	28.9
0.2049	44.9	2.1288	32.2	9.5794	28.5
0.3455	42.2	2.8242	30.7	11.370	28.4
[NaCl] = 0.0037					
0.0067	54.9	0.4330	39.0	4.0130	29.3
0.0200	51.4	0.6435	37.0	5.2964	29.3
0.0467	48.0	0.9306	35.3	7.0937	28.9
0.0932	46.8	1.2944	33.5	9.3262	28.7
0.1725	43.7	1.7614	31.5	11.882	28.2
0.2839	41.2	2.3181	30.4	30.508	28.1

Table 4.11 Values of standard free energy of micellization for AOT and CPC in water + EG media

Weight % EG	Temperature / K					ΔG_m^0 / kJmol^{-1} for CPC at 298 K
	293	298	303	308	313	
	ΔG_m^0 / kJ mol^{-1} for AOT					
0	-33.6	-34.3	-34.9	-35.7	-36.6	-44.2
10	-30.4	-31.1	-31.4	-32.0	-32.5	-41.4
20	-27.6	-28.2	-28.3	-28.8	-29.2	-39.9
30	-27.6	-27.9	-28.2	-28.4	-28.6	-38.3
40	-25.8	-26.1	-26.4	-26.5	-25.5	-36.2
50	-24.6	-25.0	-24.8	-24.6	-24.4	-32.5
60	-23.4	-22.9	-22.6	-22.7	-22.7	-29.9
70	-21.2	-21.0	-21.0	-20.9	-20.5	-26.5
80	-18.6	-18.6	-18.7	-18.4	-18.0	-23.6
90	-16.4	-16.5	-16.3	-16.3	-16.2	-20.4
100	-14.8	-14.8	-14.7	-14.6	-14.6	-16.1

Table 4.12 Values of standard entropy of micellization for AOT in water + EG media

Weight % EG	Temperature / K				
	293	298	303	308	313
	ΔS_m^0 / J mol^{-1} K^{-1}				
0	148	148	148	148	148
10	110	110	110	110	110
20	76	76	76	76	76
30	50	50	50	50	50
40	156	76	-4	-84	-164
50	68	34	0	-34.4	-68.4
60	-112	-72	-32	8	48
70	14	-3	-20	-37	-54
80	46	-3	-52	-101	-150
90	-56	-42	-28	-14	0
100	-60	-49	-38	-27	-16

Table 4.13 Values of standard enthalpy of micellization for AOT in water + EG media

Weight % EG	Temperature / K				
	293	298	303	308	313
	ΔH^0_m / kJ mol^{-1}				
0	9.8	9.8	9.9	9.9	9.7
10	1.8	1.7	1.9	1.9	1.9
20	-5.3	-5.6	-5.3	-5.4	-5.4
30	-13.0	-13.0	-13.1	-13.0	-13.0
40	19.9	-3.4	-27.6	-52.4	-76.8
50	-4.8	-15.0	-24.9	-35.2	-45.8
60	-56.2	-44.4	-32.3	-20.2	-7.7
70	-17.2	-21.9	-27.1	-32.5	-37.5
80	-5.2	-19.6	-34.6	-49.9	-65.0
90	-32.6	-28.4	-24.4	-20.3	-15.9
100	-32.5	-29.5	-26.1	-23.0	-19.7

Table 4.14 Surface excess values of AOT and CPC in water + EG media

Weight % of EG	Temperature / K					Γ_{cmc} / mol m^{-2} for CPC at 298 K
	293	298	303	308	313	
	Γ_{cmc} / mol m^{-2} for AOT					
0	1.94	1.80	1.74	1.74	1.67	2.29
10	1.74	1.72	1.55	1.56	1.60	2.05
20	1.62	1.60	1.39	1.31	1.36	1.81
30	1.47	1.43	1.35	1.24	1.22	1.53
40	1.34	1.27	1.24	1.16	1.05	1.47
50	1.27	1.27	1.17	1.12	1.02	1.36
60	1.20	1.12	1.10	1.06	0.95	1.23
70	1.14	1.05	1.06	1.04	0.94	1.01
80	1.05	0.91	0.95	0.90	0.93	0.97
90	0.89	0.82	0.88	0.82	0.71	0.84
100	0.79	0.65	0.7	0.67	0.61	0.77

Table 4.15 Values of standard free energy of adsorption for AOT and CPC in water + EG media

Weight % EG	Temperature / K					ΔG^0_{ad} / kJmol^{-1} for CPC at 298 K
	293	298	303	308	313	
	ΔG^0_{ad} / kJ mol^{-1}					
0	-55.1	-57.1	-58.2	-58.6	-60.2	-57.3
10	-52.4	-52.3	-54.9	-55.3	-54.3	-53.9
20	-49.4	-50.0	-52.9	-53.7	-53.6	-53.4
30	-49.1	-49.7	-51.0	-52.6	-53.1	-53.1
40	-46.9	-47.9	-48.6	-49.6	-51.2	-48.6
50	-46.0	-45.8	-47.8	-48.1	-49.3	-44.0
60	-44.0	-44.7	-45.2	-45.6	-46.7	-40.9
70	-41.1	-43.2	-42.0	-42.4	-43.5	-38.7
80	-37.8	-41.5	-39.5	-40.3	-38.3	-33.9
90	-36.8	-38.3	-36.9	-38.3	-39.9	-28.8
100	-34.7	-38.5	-36.9	-38.9	-40.5	-26.6

Table 4.16 Values of the surface tension of water + EG media at different temperatures

Weight % EG	Temperature / K				
	293	298	303	308	313
	γ_0 / mN m^{-1}				
0	72.8	72.0	71.5	70.4	70.0
10	68.5	67.2	66.5	66.1	65.1
20	65.4	64.5	63.9	63.0	62.3
30	63.1	62.7	61.8	61.0	60.4
40	59.6	59.2	58.5	57.8	57.0
50	57.7	57.4	56.9	56.3	55.4
60	55.7	55.4	54.9	54.3	53.3
70	53.8	53.3	52.8	52.3	51.6
80	51.5	51.4	50.8	50.0	49.5
90	49.8	49.3	48.9	48.7	47.5
100	48.2	47.9	47.5	47.3	46.8

Table 4.17 Values of the surface tension of AOT and CPC at the cmc in water + EG media

% EG	Temperature / K					γ_{lim} / mN m^{-1} for CPC at 298 K
	293	298	303	308	313	
	γ_{lim} / mN m^{-1}					
0	31.0	31.0	31.0	30.5	30.5	42.0
10	30.5	31.0	30.5	30.0	30.5	41.5
20	31.6	31.0	31.0	31.5	30.5	40.0
30	31.5	31.5	31.0	31.0	30.5	40.0
40	31.3	31.5	31.0	31.0	30.0	41.0
50	30.5	31.0	30.0	30.0	30.0	41.7
60	31.0	31.0	30.0	30.0	30.5	41.8
70	31.1	30.0	30.5	30.0	30.0	41.0
80	31.3	30.5	31.0	30.5	30.5	41.4
90	31.5	31.0	30.5	30.5	30.5	42.2
100	32.5	32.3	31.8	31.0	31.0	39.8

Table 4.18 Values of density, molar volume (V) and Gordon Parameter (GP) of water + EG mixed solvent and values of γ_0/γ_{lim} for AOT and CPC in water + EG media at 25 °C

% EG	Density x 10^{-3} kg m^{-3}	V x 10^6 m^3 mol^{-1}	$\gamma/V^{1/3}$ (GP) J m^{-3}	γ_0 / γ_{lim} for AOT	γ_0 / γ_{lim} for CPC
0	0.99704	18.00	2.75	2.32	1.73
10	1.01234	19.14	2.51	2.16	1.61
20	1.02055	20.56	2.37	2.04	1.54
30	1.04109	21.97	2.24	1.99	1.51
40	1.05482	23.83	2.06	1.9	1.44
50	1.06774	26.14	1.95	1.84	1.36
60	1.07951	29.05	1.81	1.79	1.33
70	1.09002	32.83	1.66	1.71	1.30
80	1.09893	37.92	1.53	1.63	1.25
90	1.10657	45.06	1.39	1.58	1.20
100	1.11283	55.78	1.25	1.48	1.20

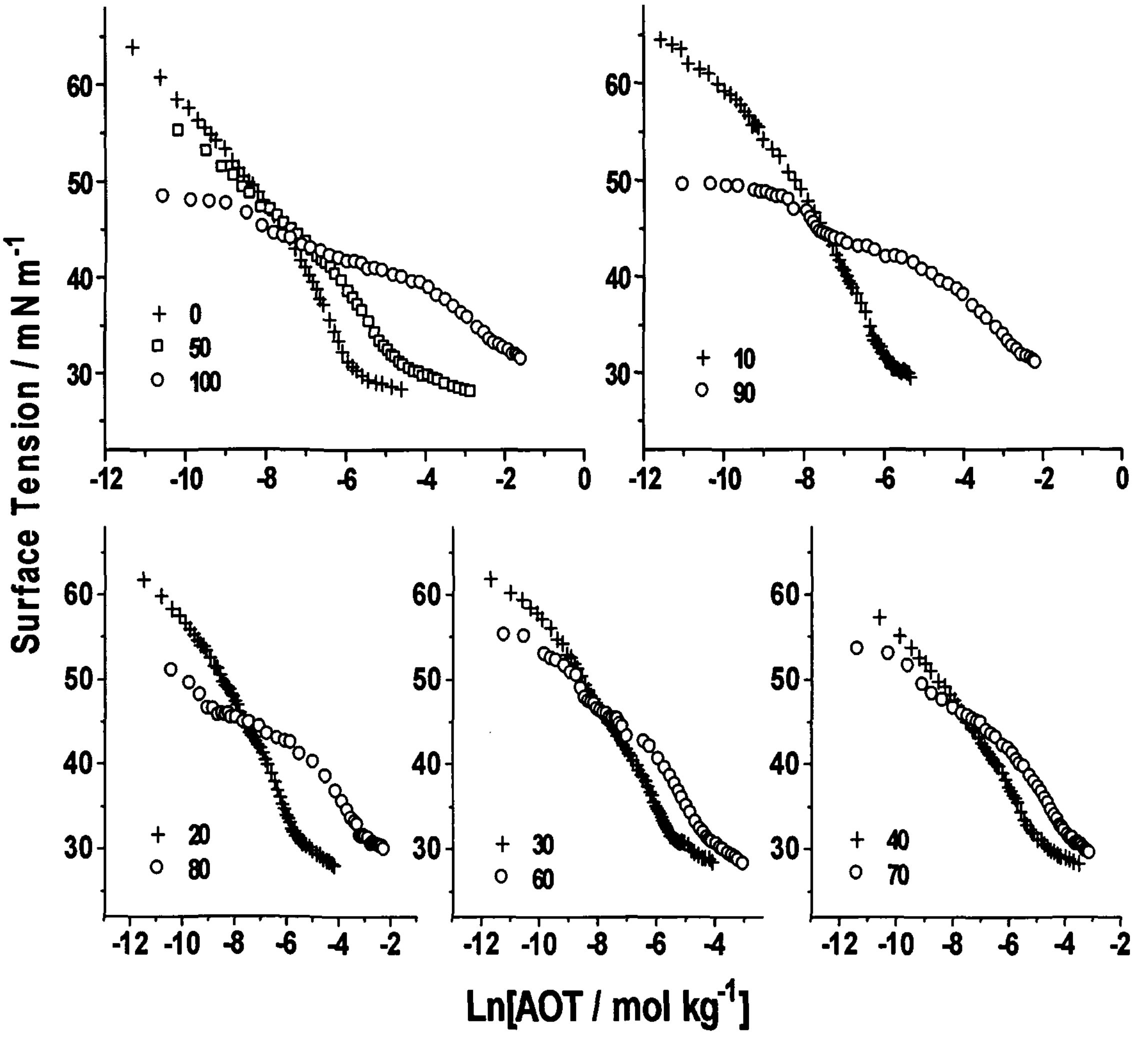

Fig. 4.1. Surface tension of AOT + water + EG system at 293 K as a function of AOT concentration. The weight percentages of EG are indicated in the insets.

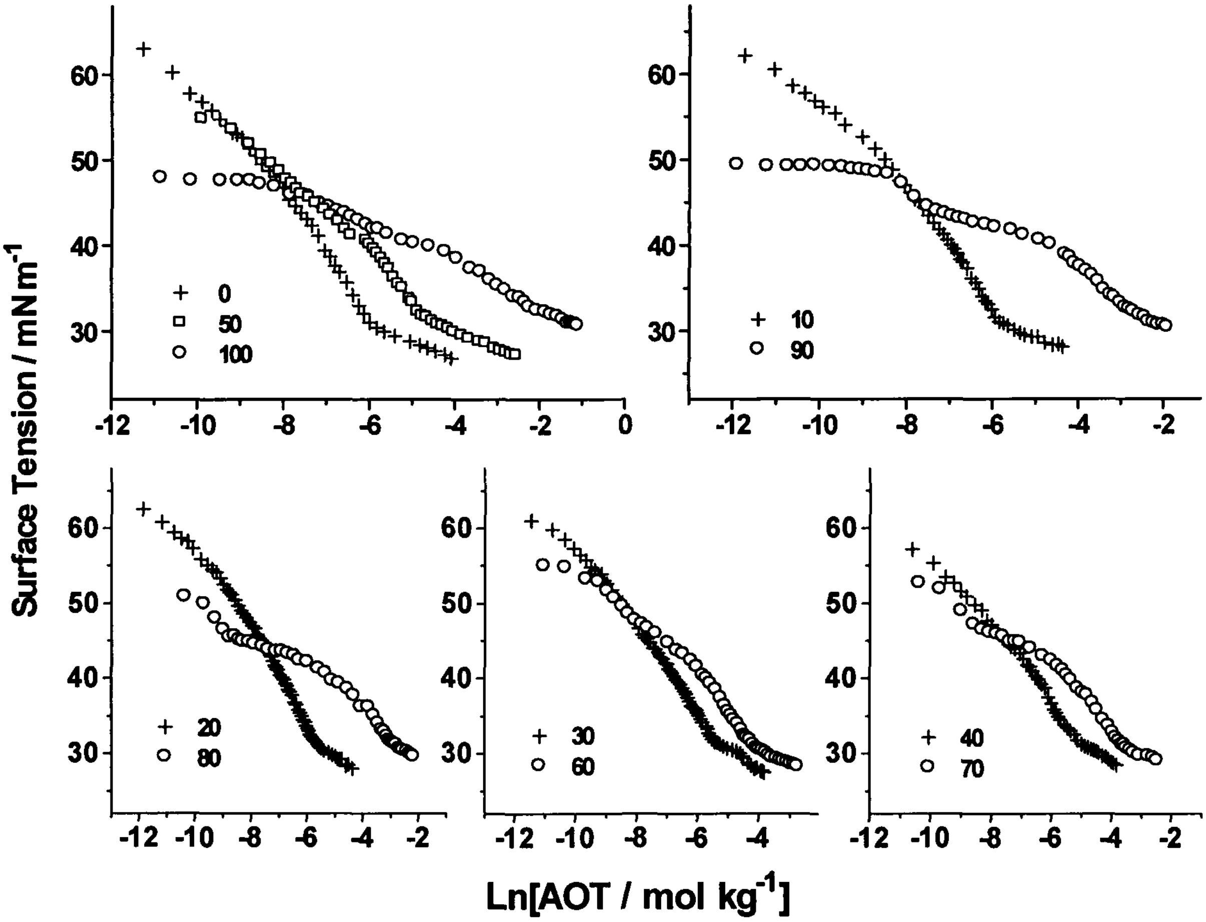

Fig. 4.2. Surface tension of AOT + water + EG system at 298 K as a function of AOT concentration. The weight percentages of EG are indicated in the insets.

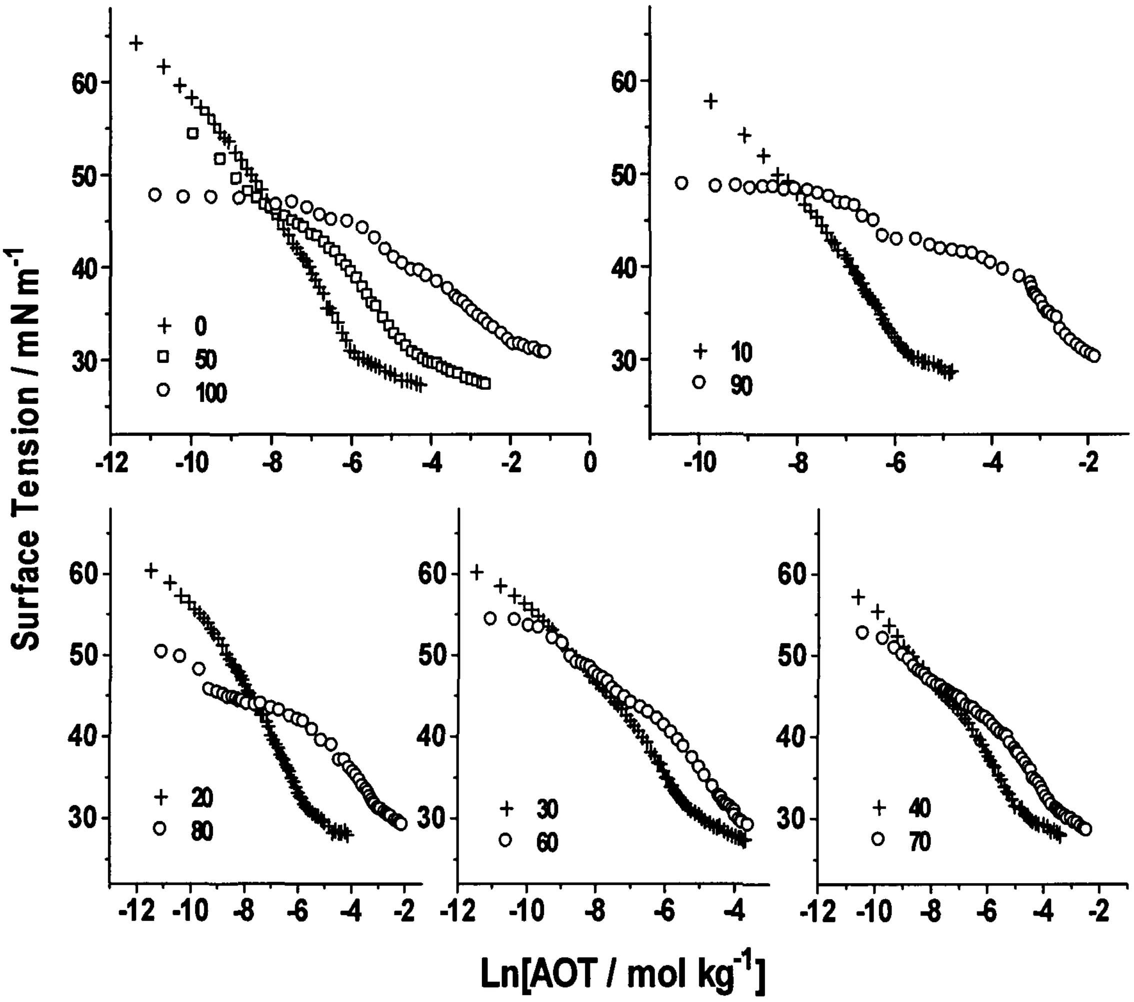

Fig. 4.3. Surface tension of AOT + water + EG system at 303 K as a function of AOT concentration. The weight percentages of EG are indicated in the insets.

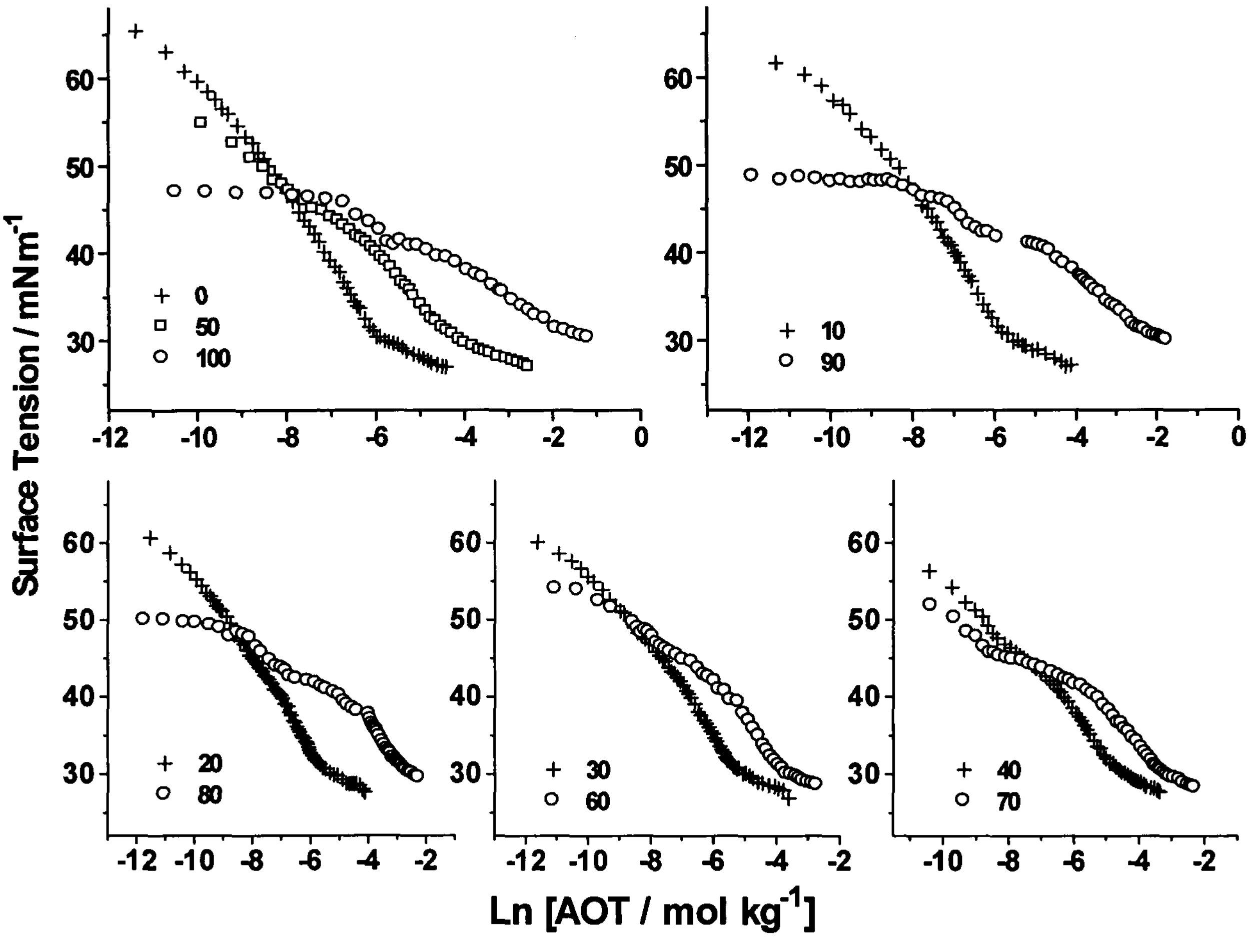

Fig. 4.4. Surface tension of AOT + water + EG system at 308 K as a function of AOT concentration. The weight percentages of EG are indicated in the insets.

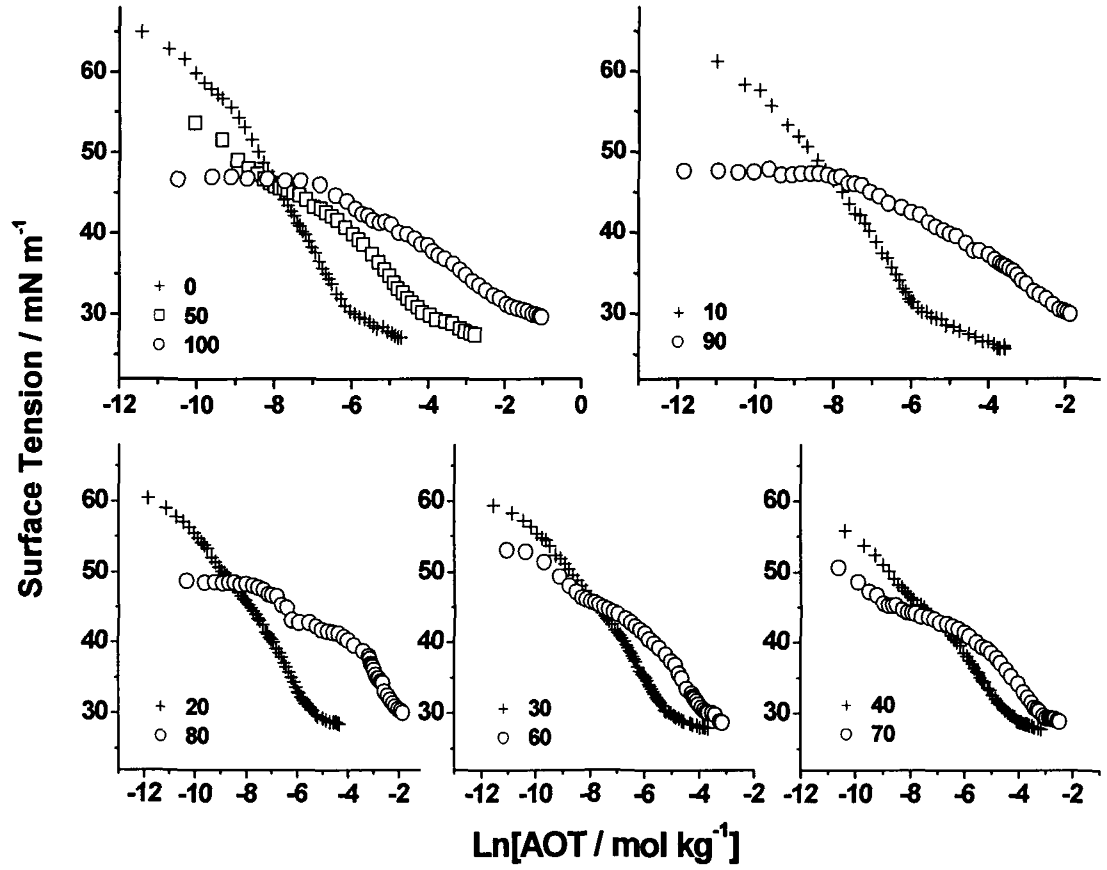

Fig. 4.5. Surface tension of AOT + water + EG system at 313 K as a function of AOT concentration. The weight percentages of EG are indicated in the insets.

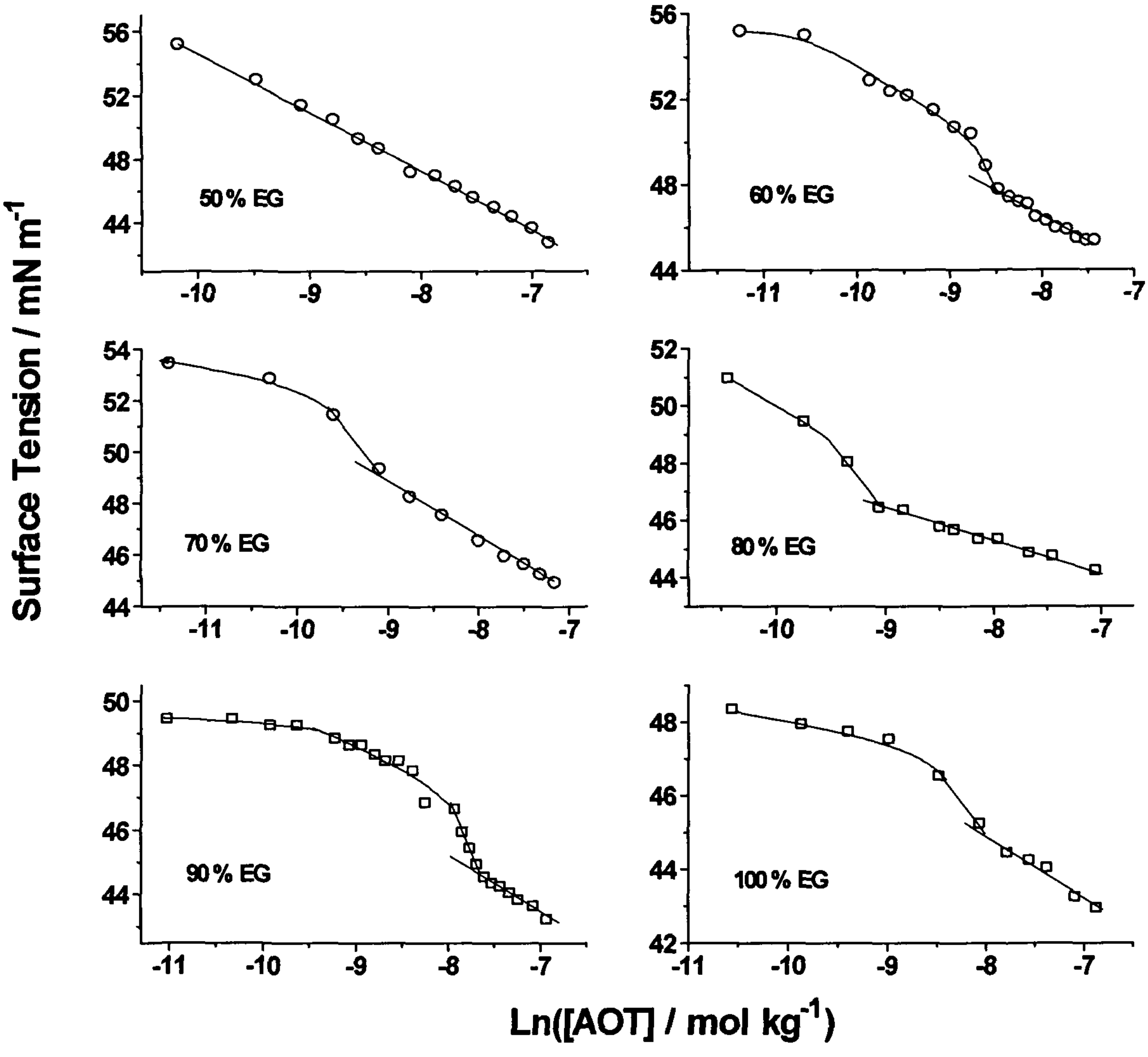

Fig. 4.6 Surface tension of AOT + water + EG system at 293 K as a function of AOT concentration in the region of low concentration below cmc.

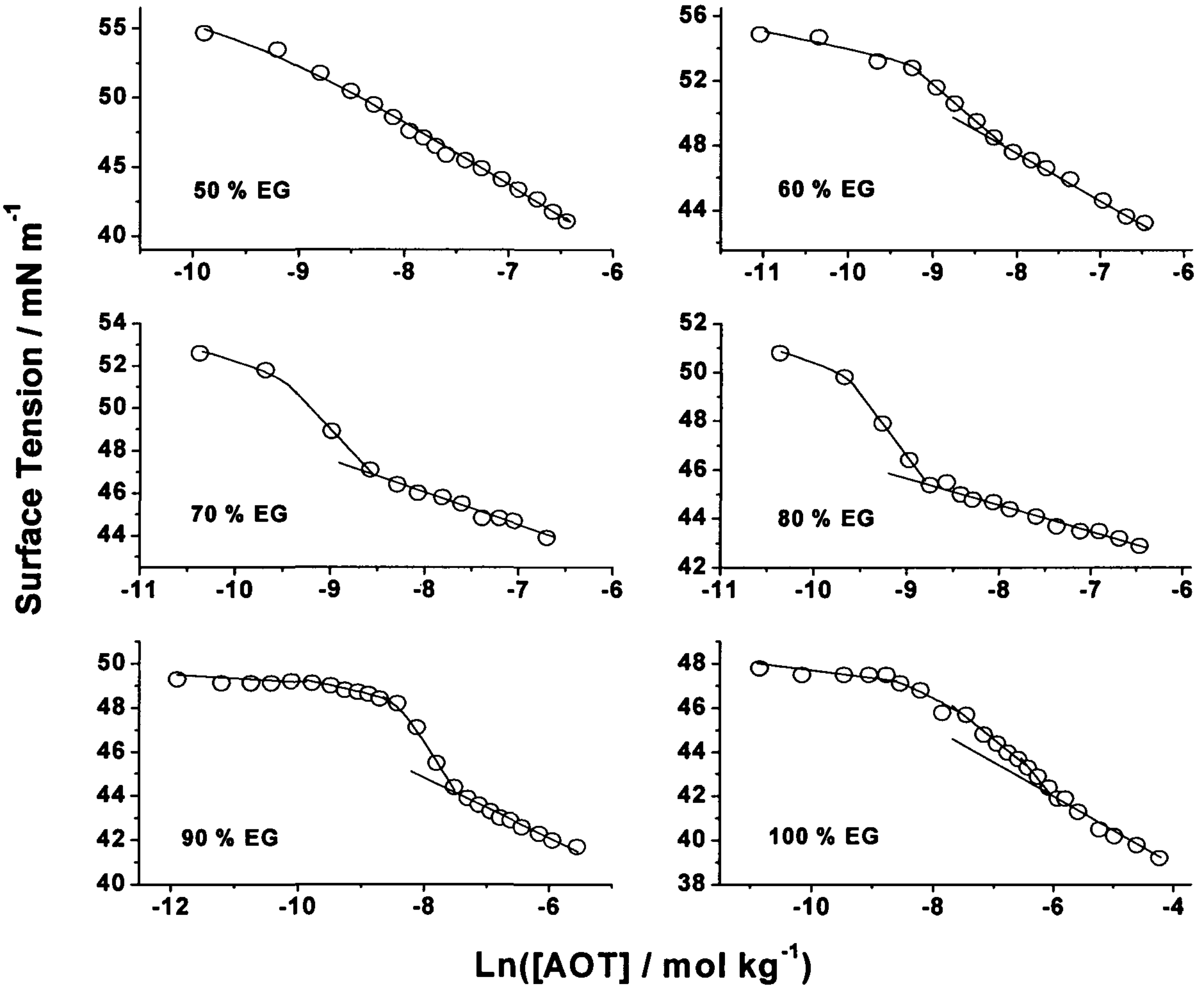

Fig. 4.7 Surface tension of AOT + water + EG system at 298 K as a function of AOT concentration in the region of low concentration below cmc.

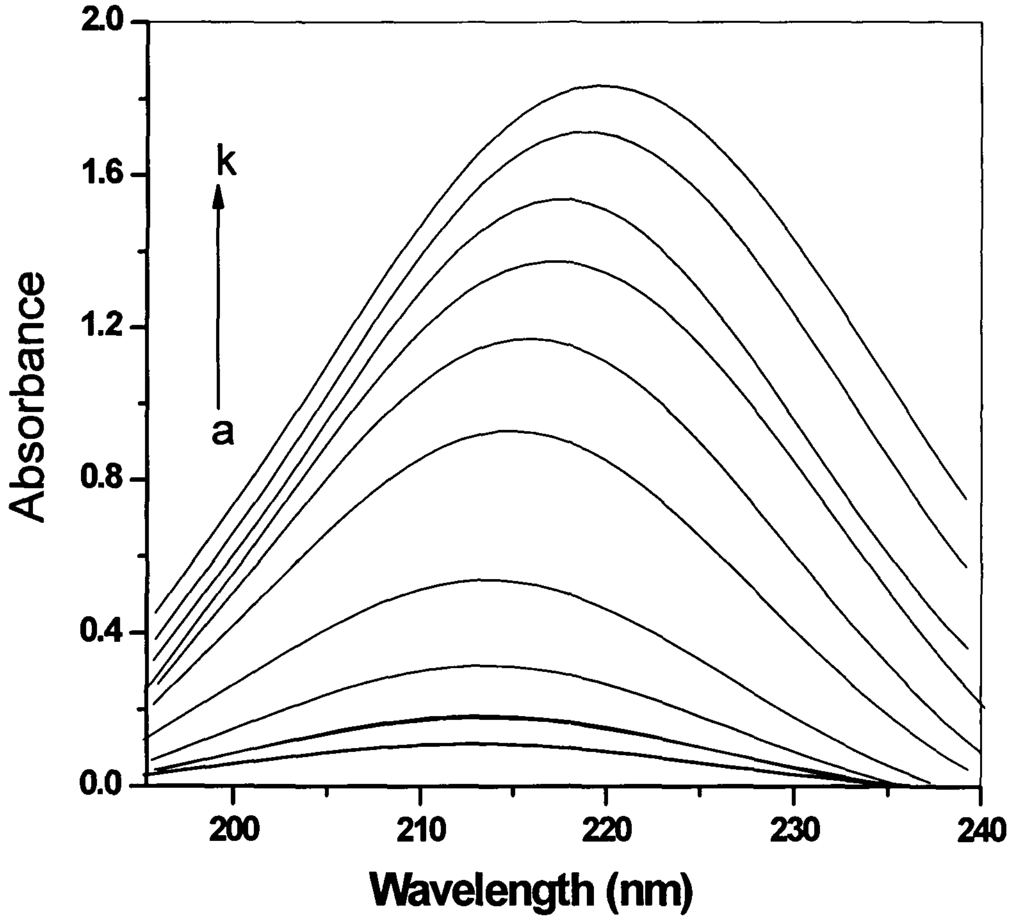

Fig. 4.8 Absorbance spectra of AOT in EG + water medium containing 60 weight % EG at 25 °C. The AOT concentrations in mol kg^{-1} are; (a) 3.1×10^{-4}, (b) 6.2×10^{-4}, (c) 1.23×10^{-3}, (d) 1.85×10^{-3}, (e) 3.08×10^{-3}, (f) 6.15×10^{-3}, (g) 9.23×10^{-3}, (h) 1.23×10^{-2}, (i) 1.54×10^{-2}, (j) 2.31×10^{-2}, (k) 3.08×10^{-2}

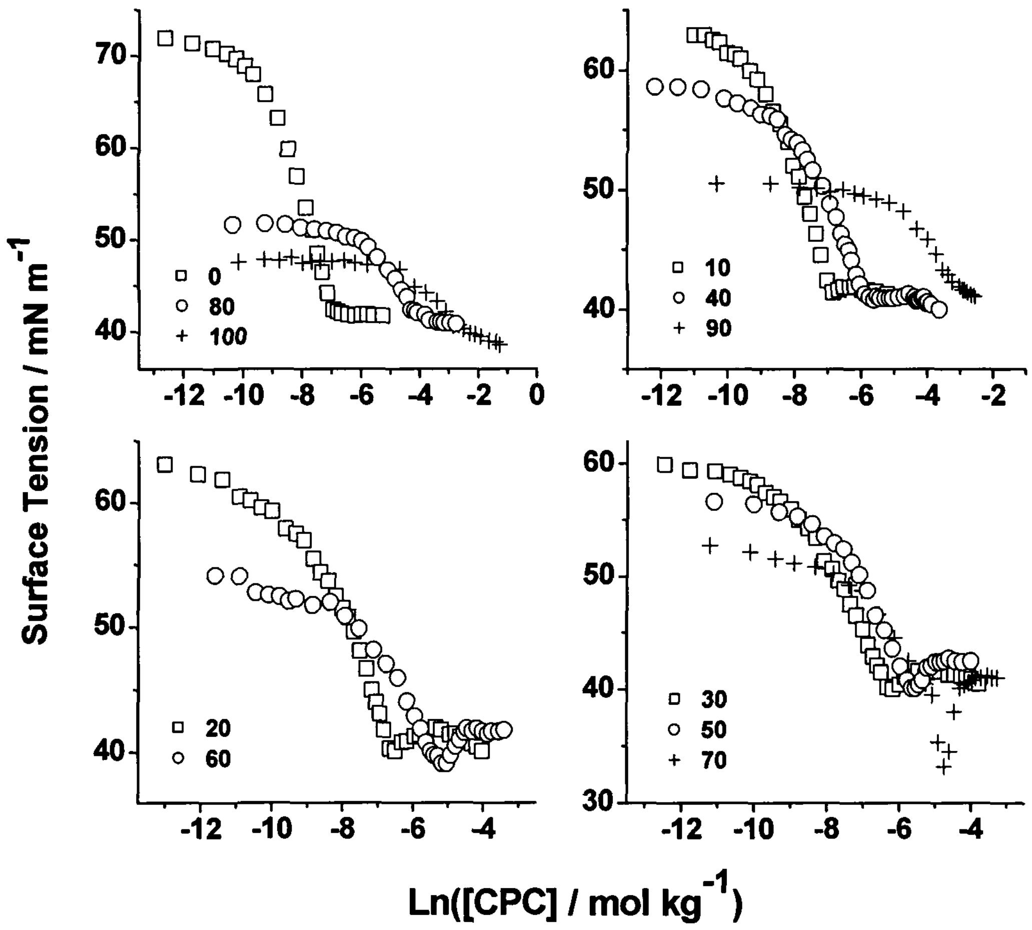

Fig. 4.9. Surface tension of CPC + water + EG system at 298 K as a function of CPC concentration. The weight percentages of EG are indicated in the insets.

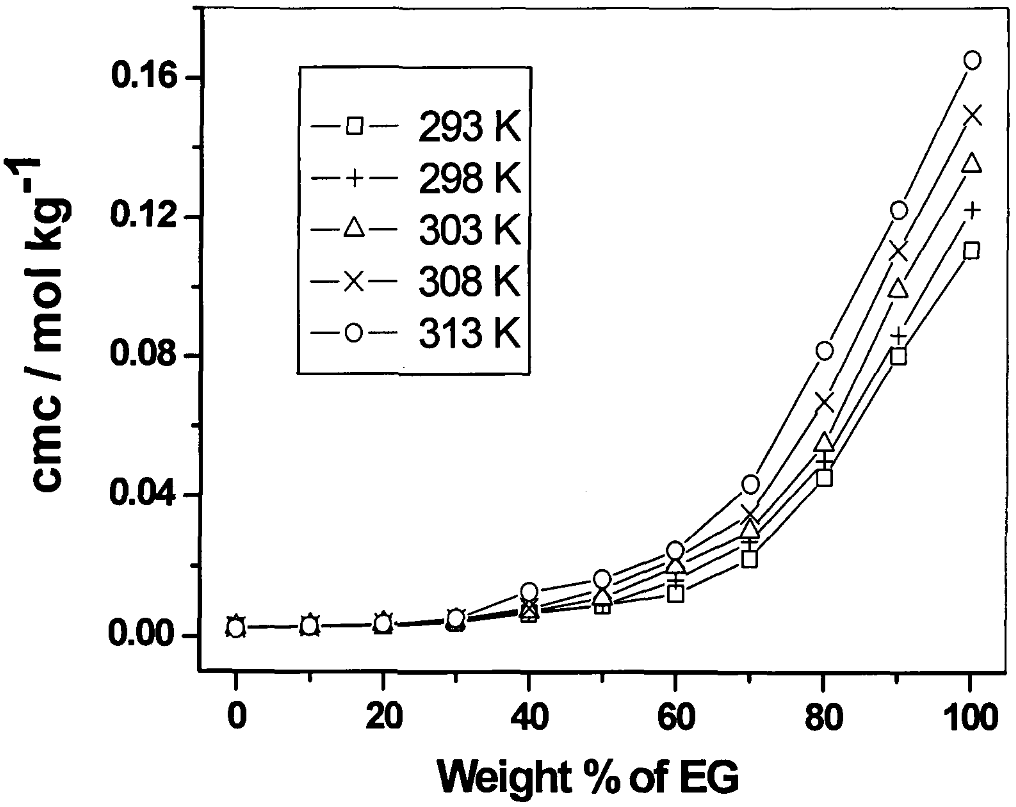

Fig. 4. 10 Variation of cmc of AOT with percentage of EG of the medium

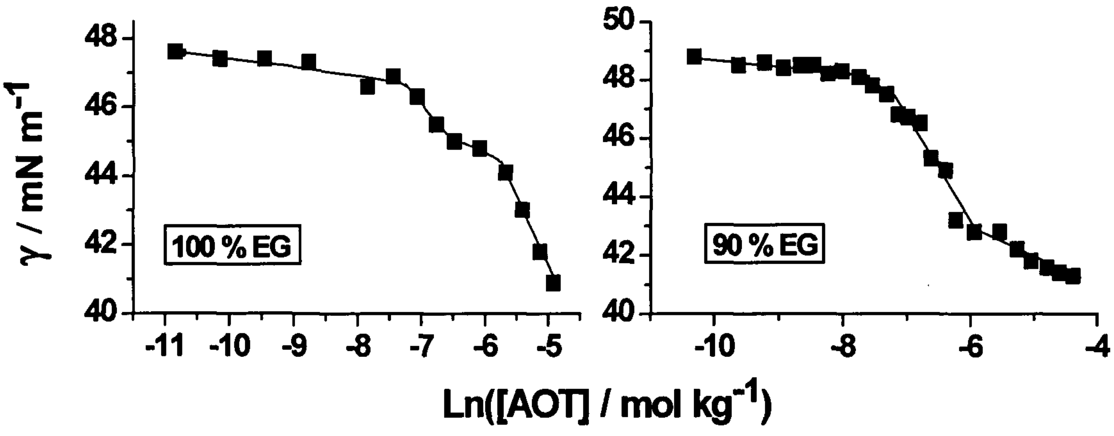

Fig. 4.11 Surface tension of AOT in EG and 90 % EG + water media at 303 K as a function of AOT concentration in the region of low concentration below cmc.

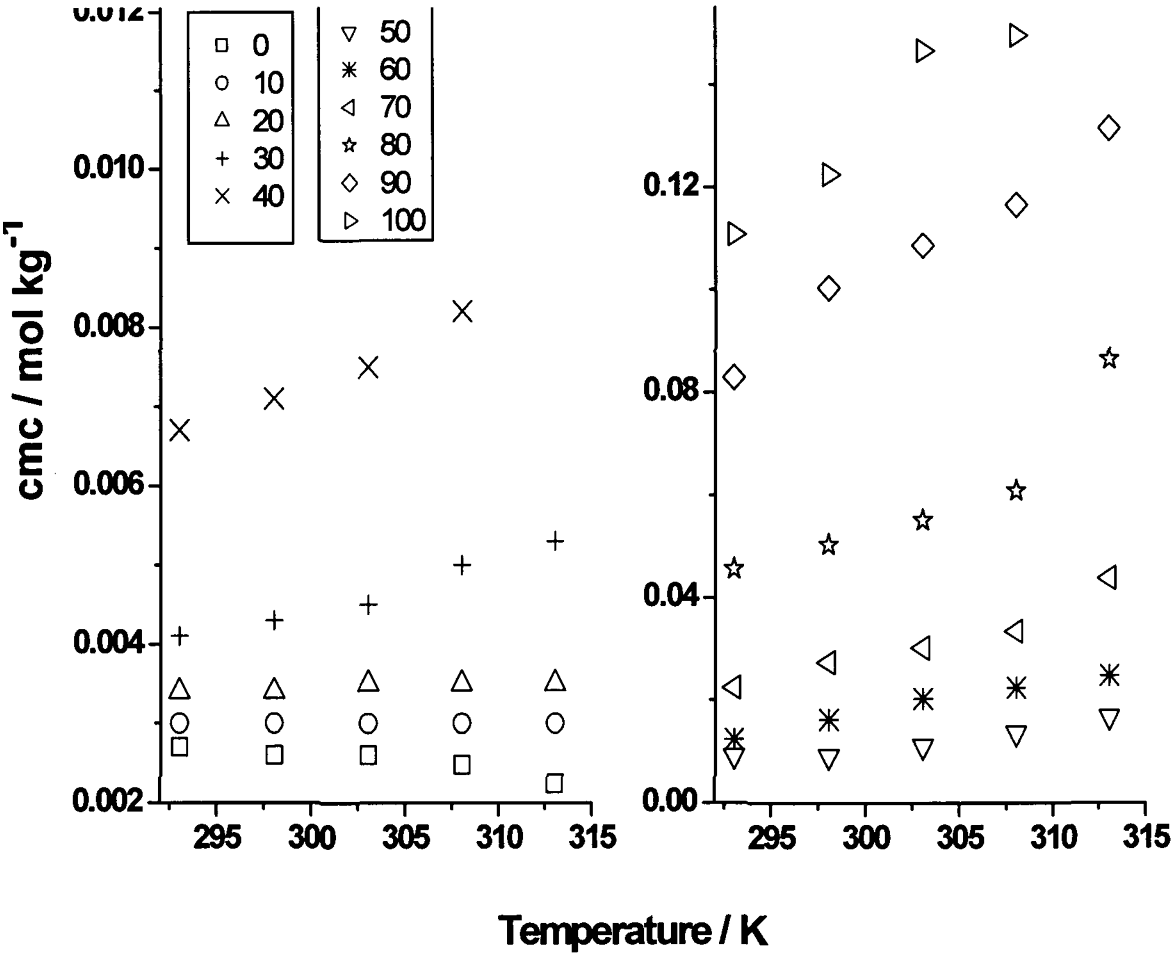

Fig. 4.12 Plots of cmc versus temperature for AOT in EG + water media

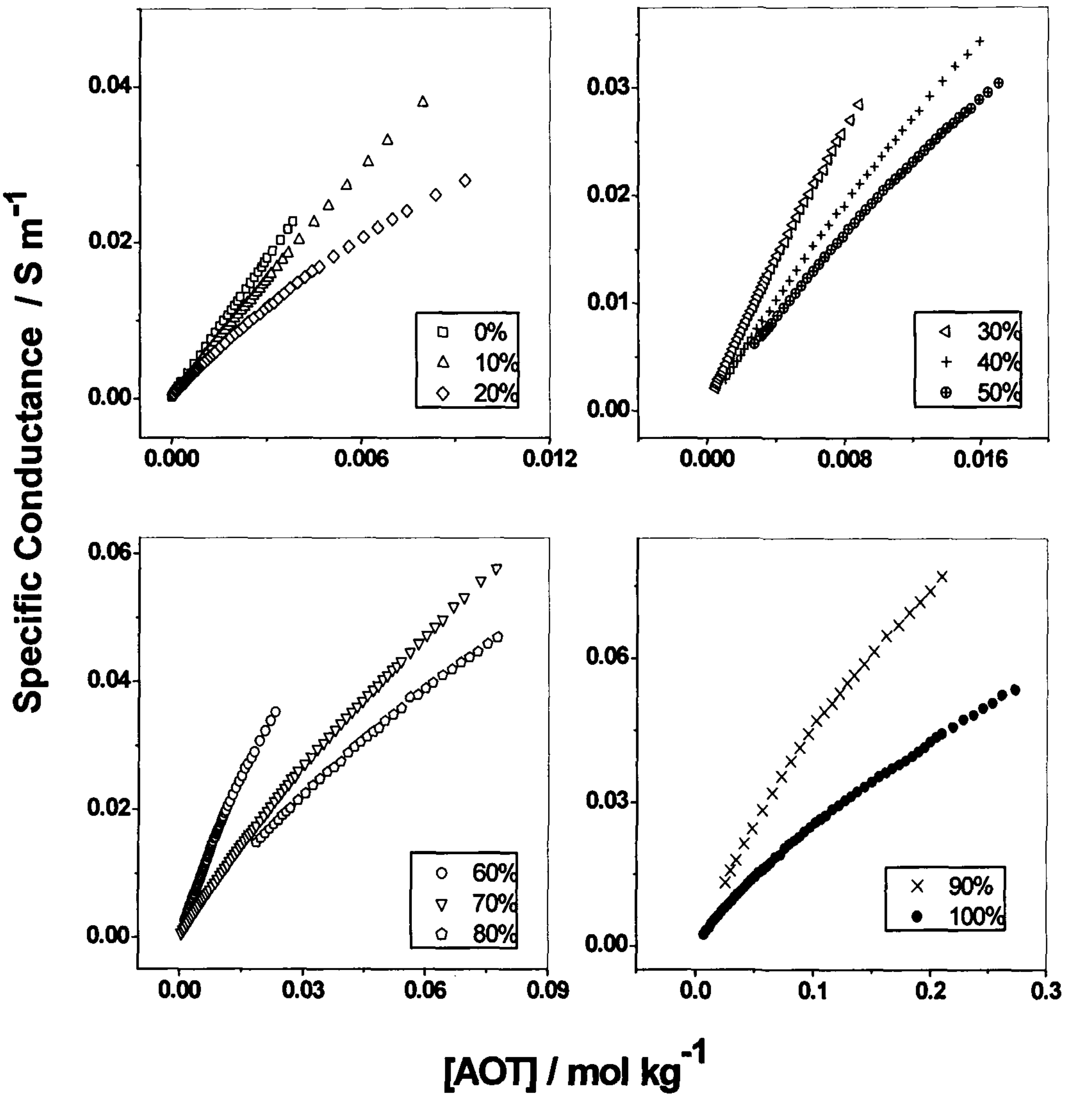

Fig. 4.13. Specific conductance of AOT + water + EG system at 293 K as a function of AOT concentration. The weight percentages of EG are indicated in the insets.

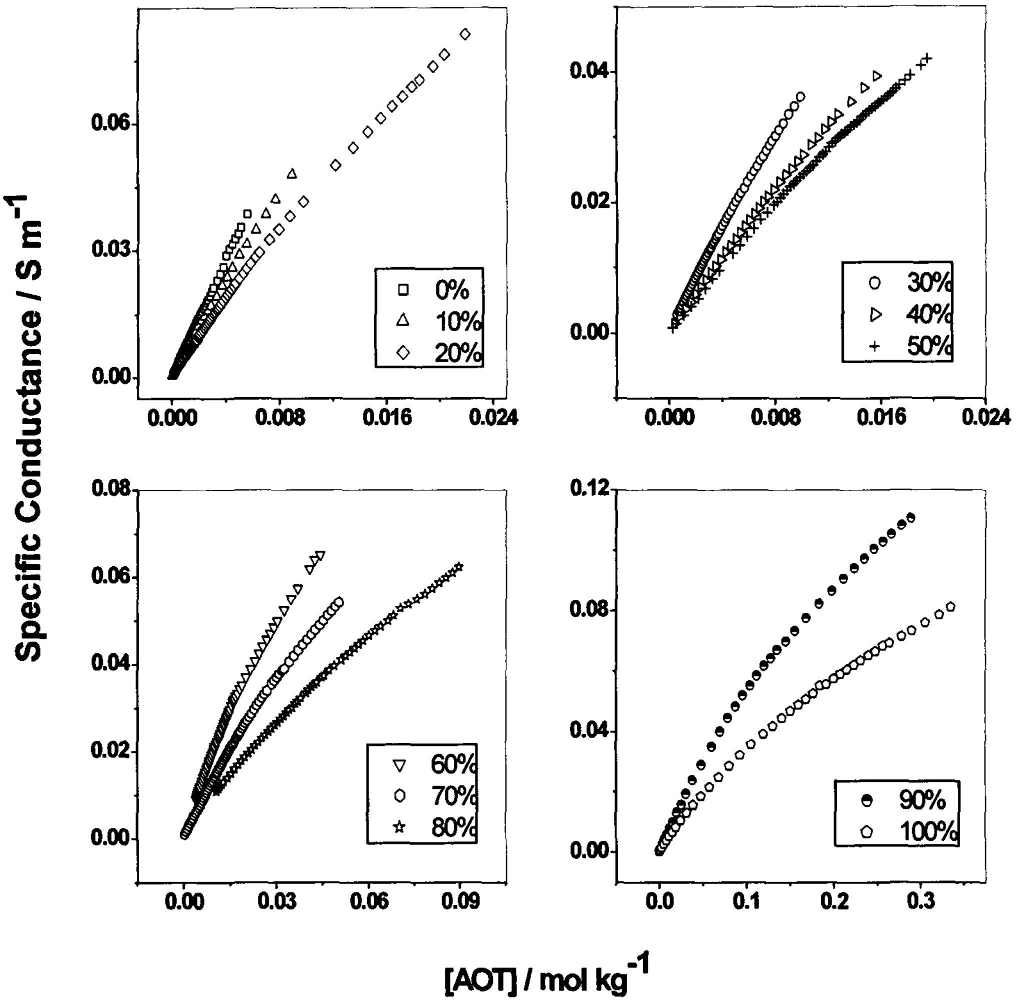

Fig. 4.14. Specific conductance of AOT + water + EG system at 298 K as a function of AOT concentration. The weight percentages of EG are indicated in the insets.

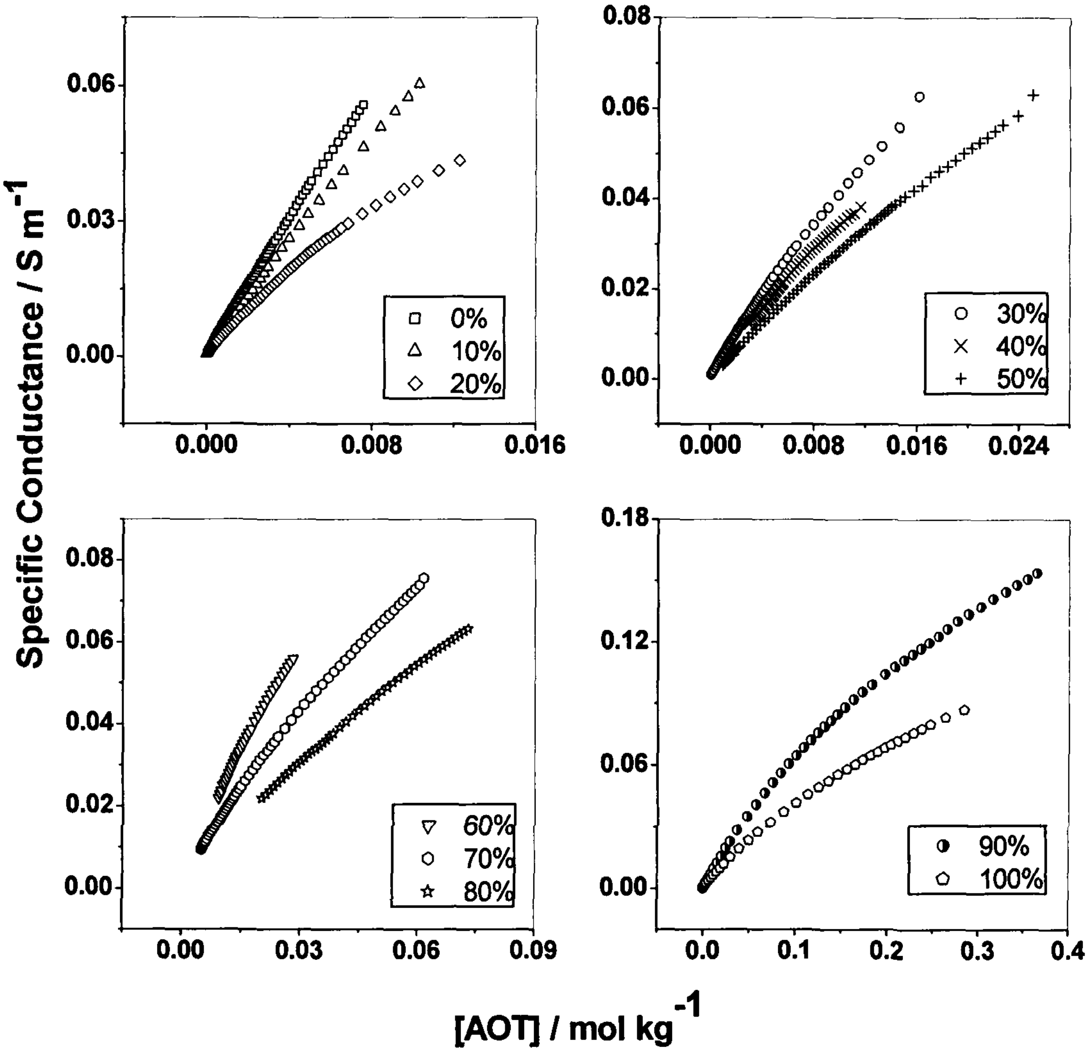

Fig. 4.15. Specific conductance of AOT + water + EG system at 303 K as a function of AOT concentration. The weight percentages of EG are indicated in the insets.

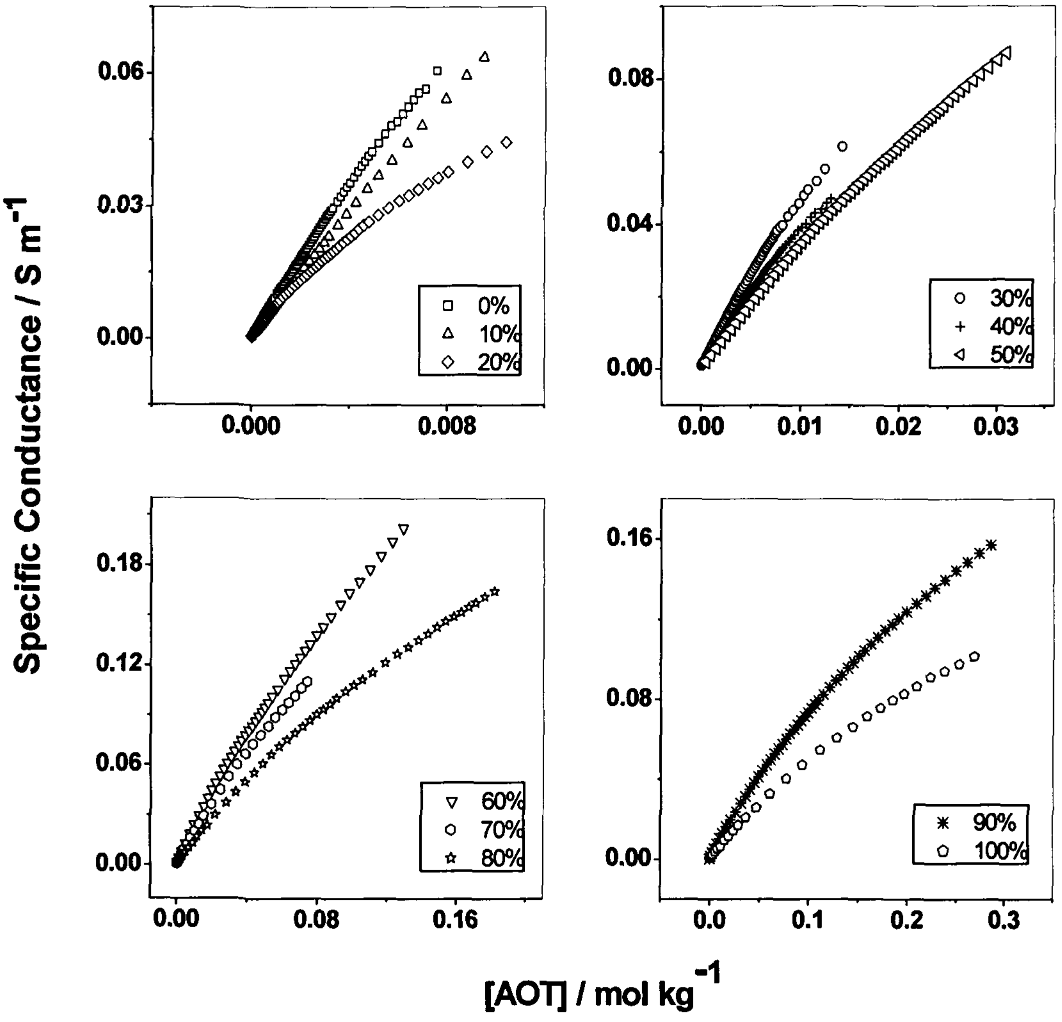

Fig. 4.16. Specific conductance of AOT + water + EG system at 308 K as a function of AOT concentration. The weight percentages of EG are indicated in the insets.

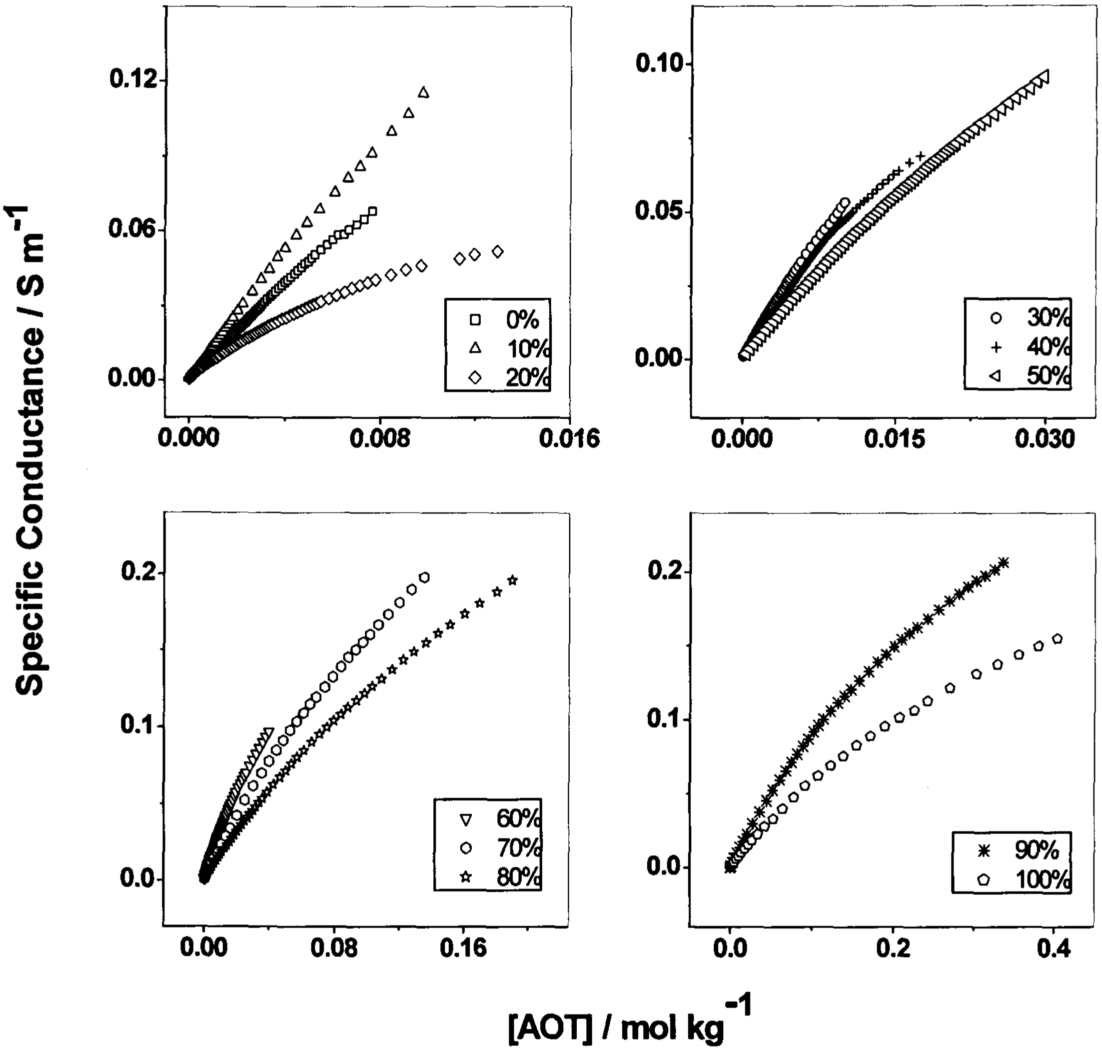

Fig. 4.17. Specific conductance of AOT + water + EG system at 313 K as a function of AOT concentration. The weight percentages of EG are indicated in the insets.

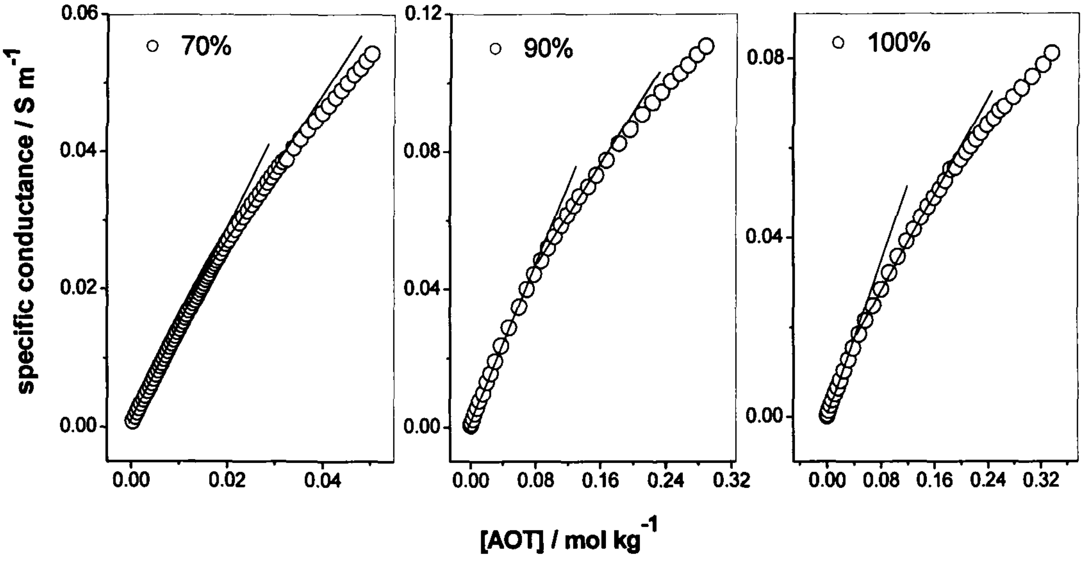

Fig. 4.18. Representative plots of specific conductance of AOT in EG + water mixtures at 298 K showing more than one break points.

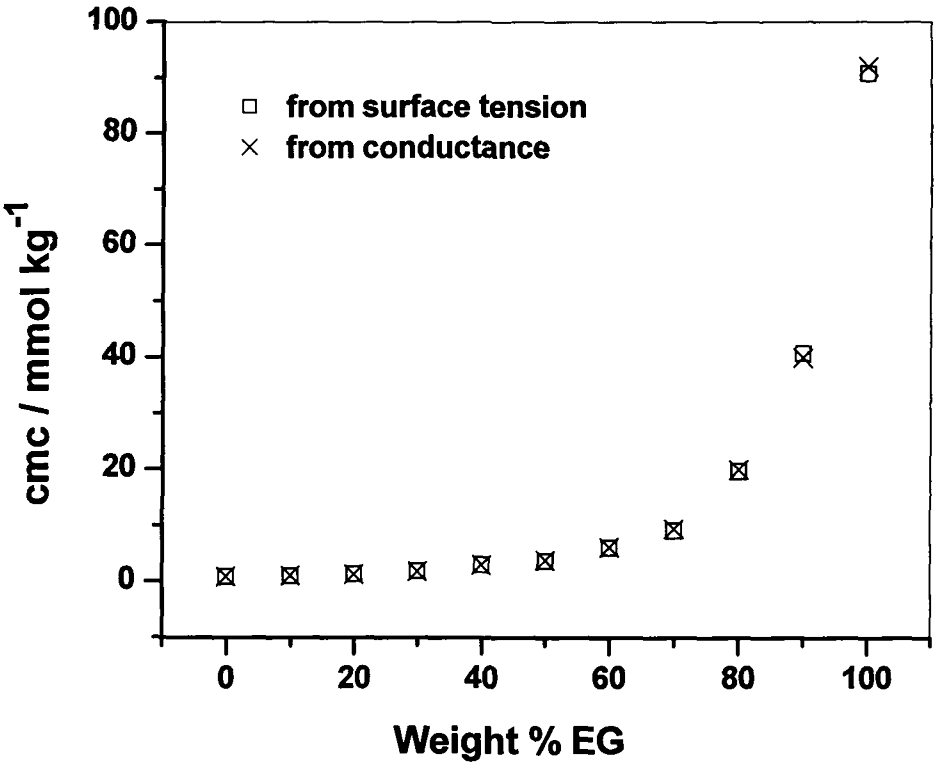

Fig. 4.19 Variation of cmc values of CPC at 298 K with percentage of EG in the medium

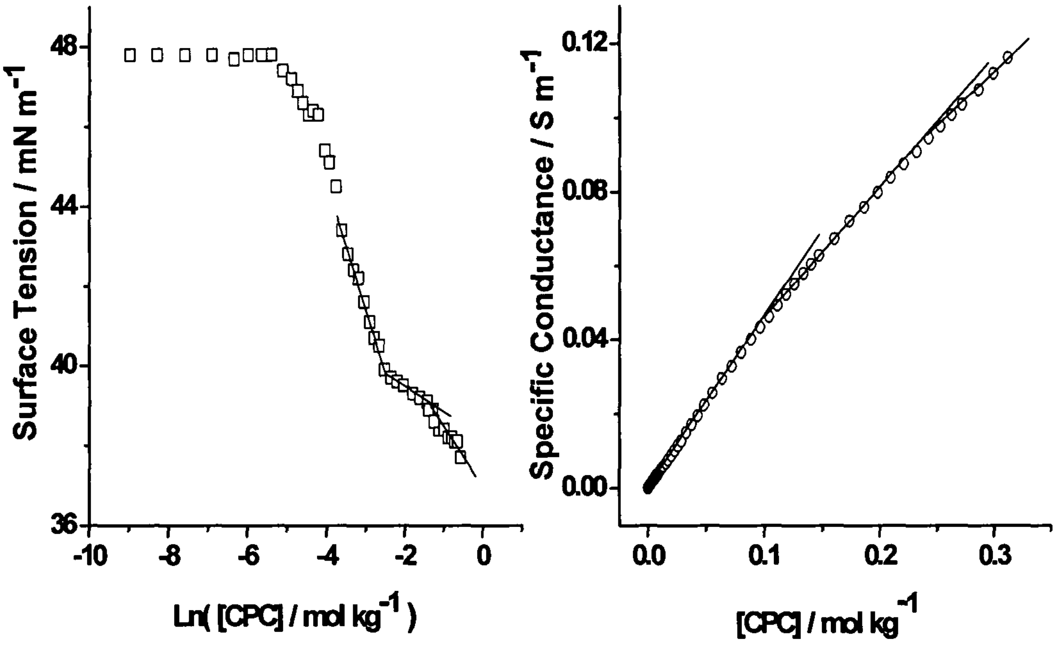

Fig. 4.20 Surface tension and specific conductance isotherms at 298 K of CPC in EG

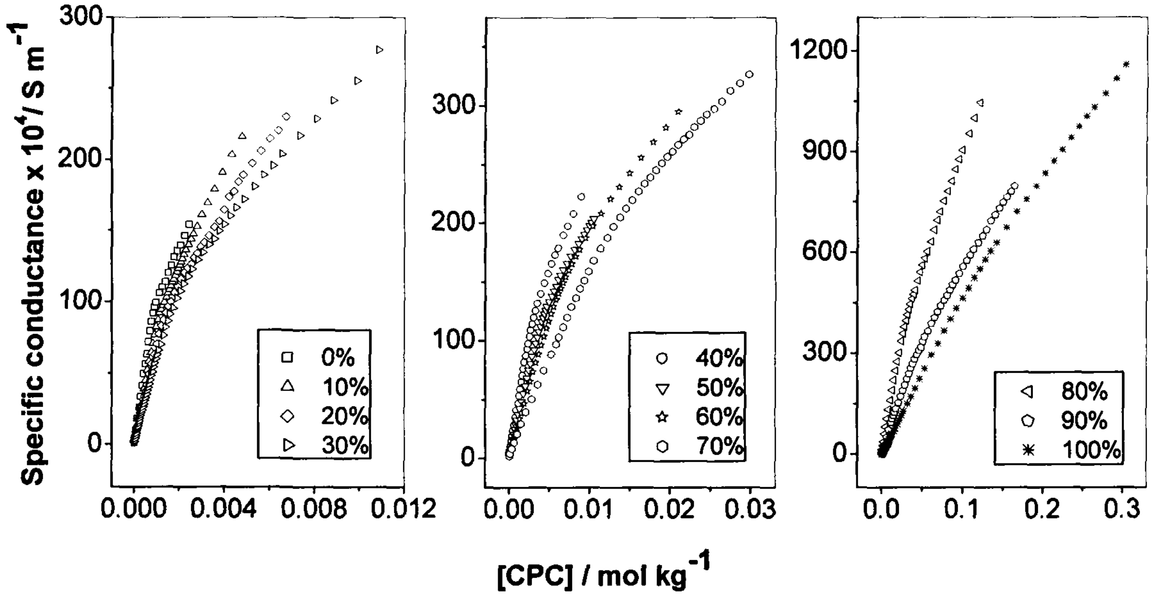

Fig. 4.21. Specific conductance of CPC + water + EG system at 298 K as a function of CPC concentration. The weight percentages of EG are indicated in the insets.

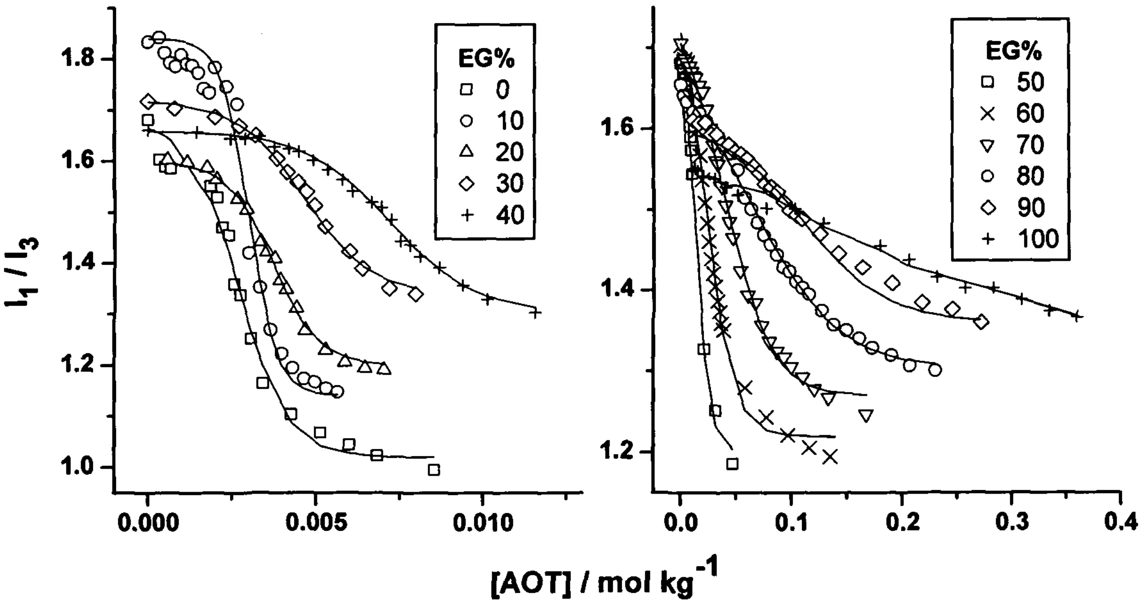

Fig. 4.22 Variation of I_1/I_3 of pyrene with AOT concentration at 25 °C in AOT + water + EG system. The values of weight % EG are shown in the insets. The solid lines indicate the values of I_1/I_3 calculated from Eq. (4.1).

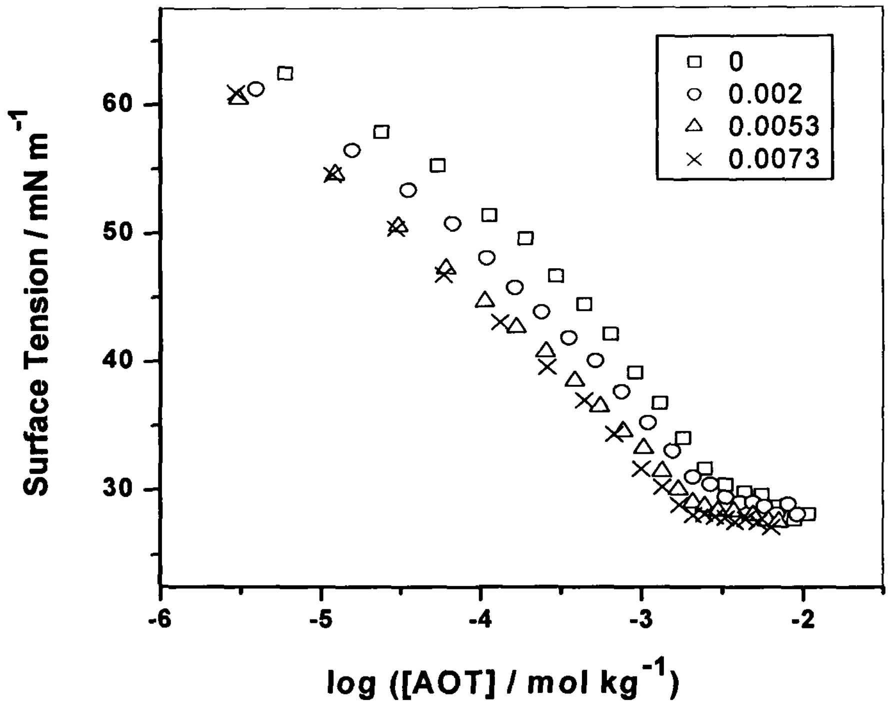

Fig. 4.23 Surface tension isotherms of AOT in water + 10 % EG + NaCl at 298 K. Concentrations of NaCl in mol kg^{-1} are given in the inset.

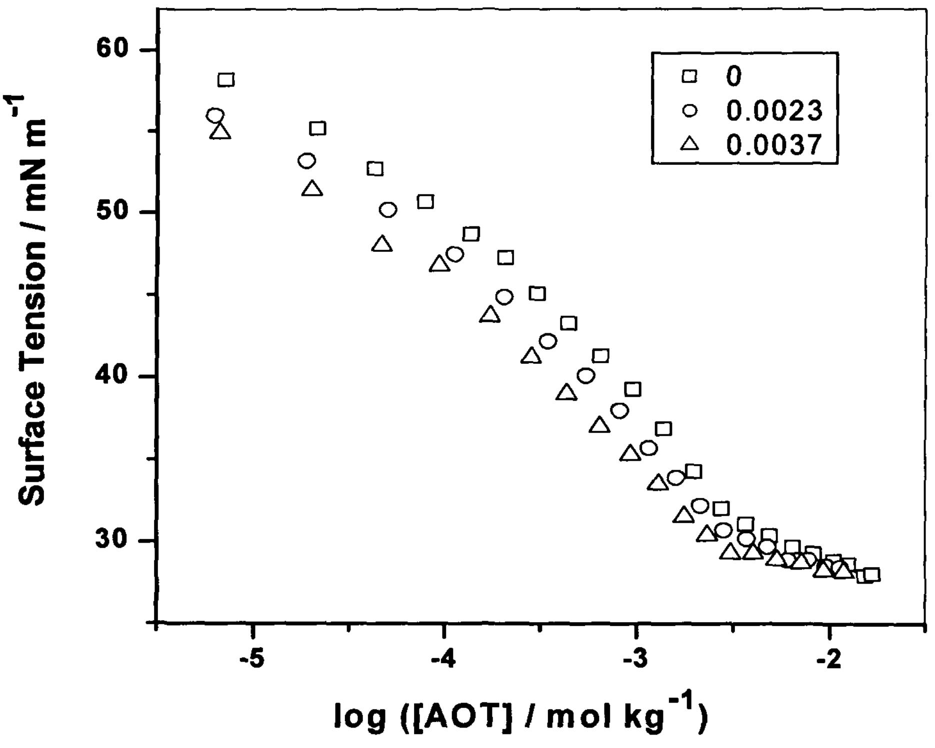

Fig. 4.24 Surface tension isotherms of AOT in water + 20 % EG + NaCl at 298 K. Concentrations of NaCl in mol kg^{-1} are given in the inset.

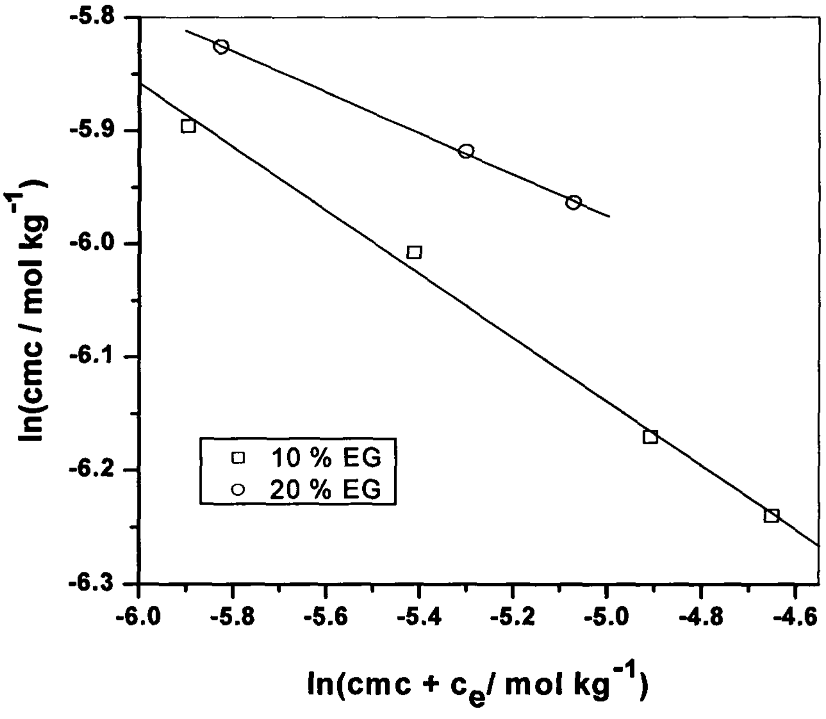

Fig. 4. 25 Corrin-Harkins plots for AOT in water + 10 % EG and water + 20 % EG media at 298 K

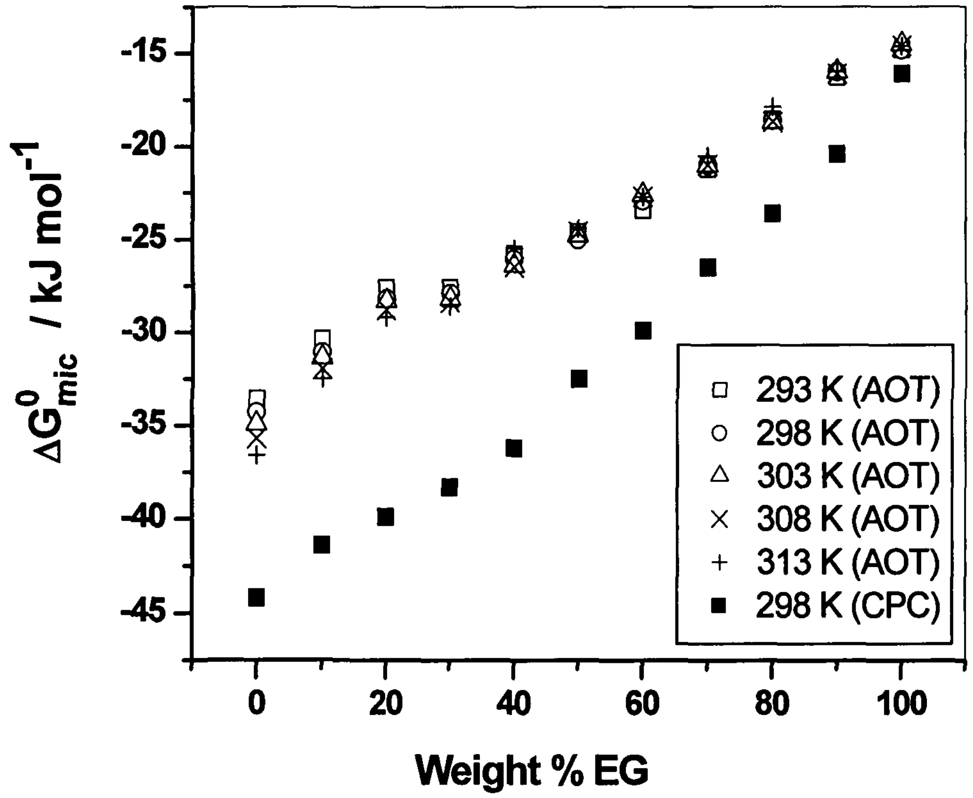

Fig. 4.26 Variation of standard free energy of micellization of AOT and CPC as a function of percentage of EG in the medium

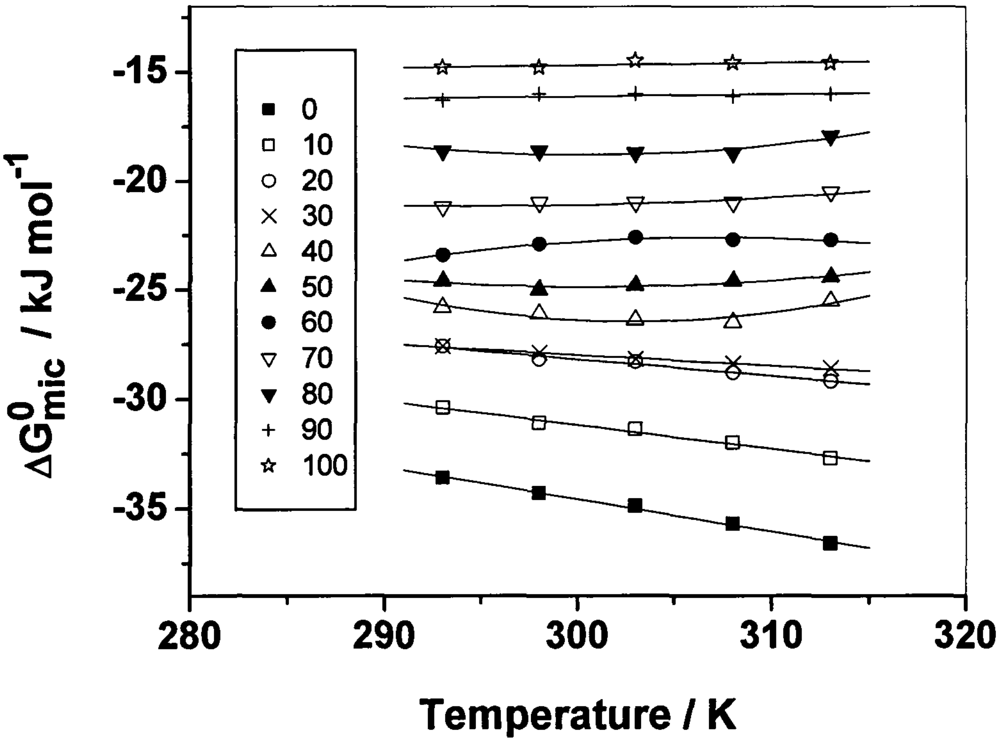

Fig. 4.27 Variation of standard free energy of micellization of AOT as a function of temperature

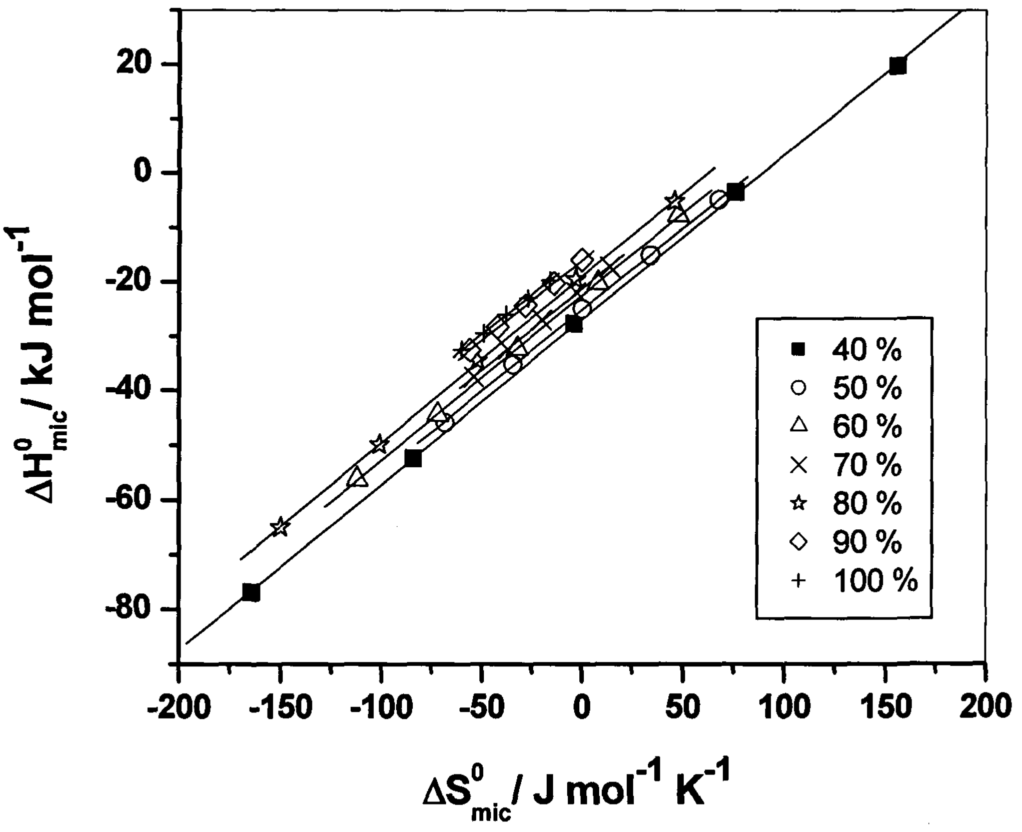

Fig. 4.28 Plots of ΔH^0_{mic} and ΔS^0_{mic} for AOT in water + EG media

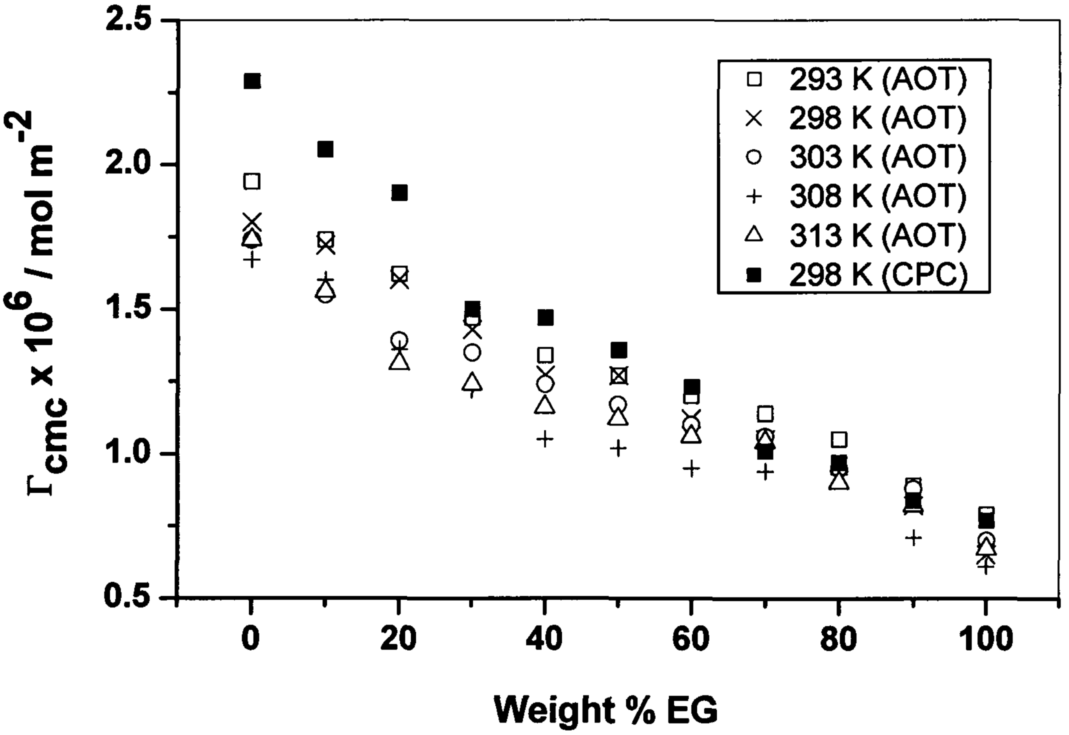

Fig. 4.29 Plots of surface excess of AOT and CPC as a function of weight % of EG

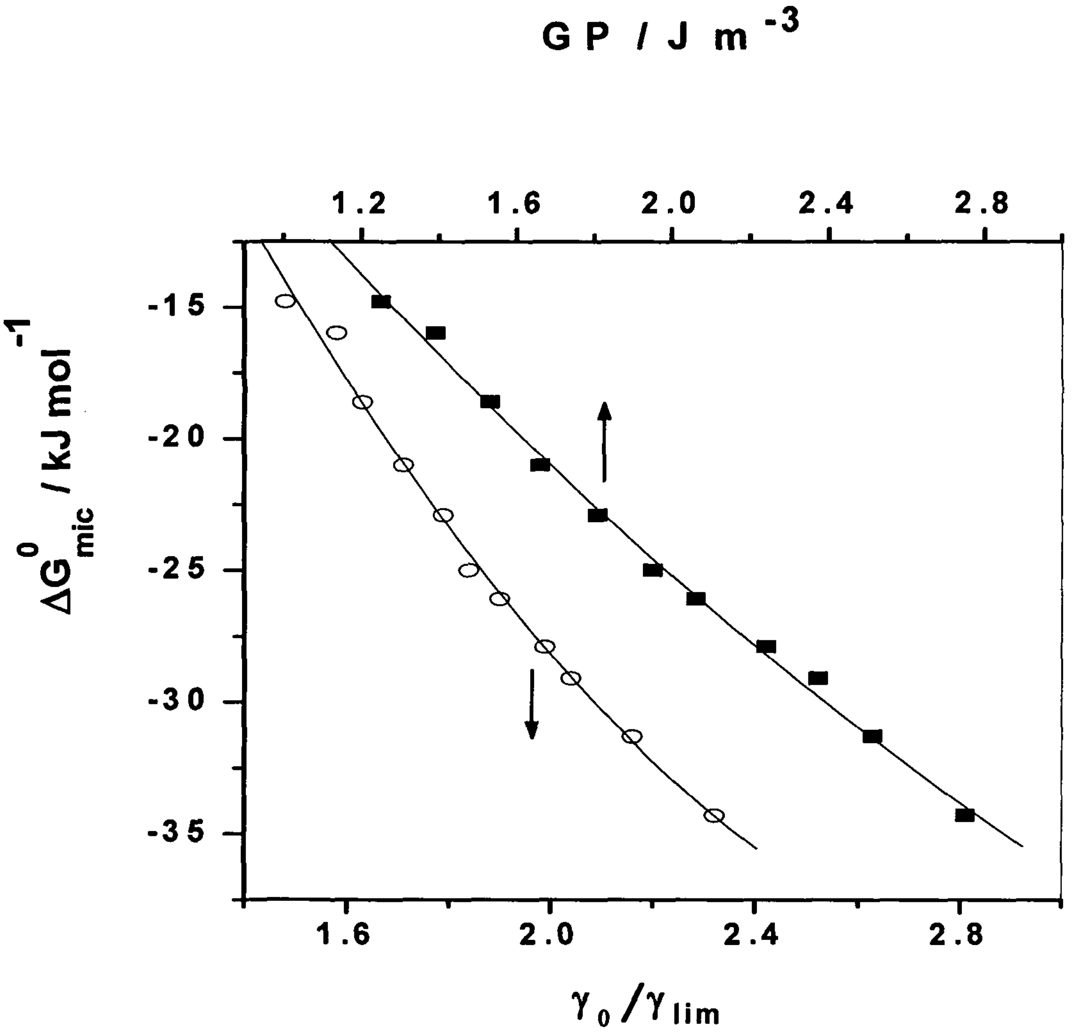

Fig. 4.30 Plots of standard free energy of micellization of AOT in water + EG media at 25 °C as functions of Gordon Parameter and the ratio $\gamma_0/\gamma_{\text{lim}}$

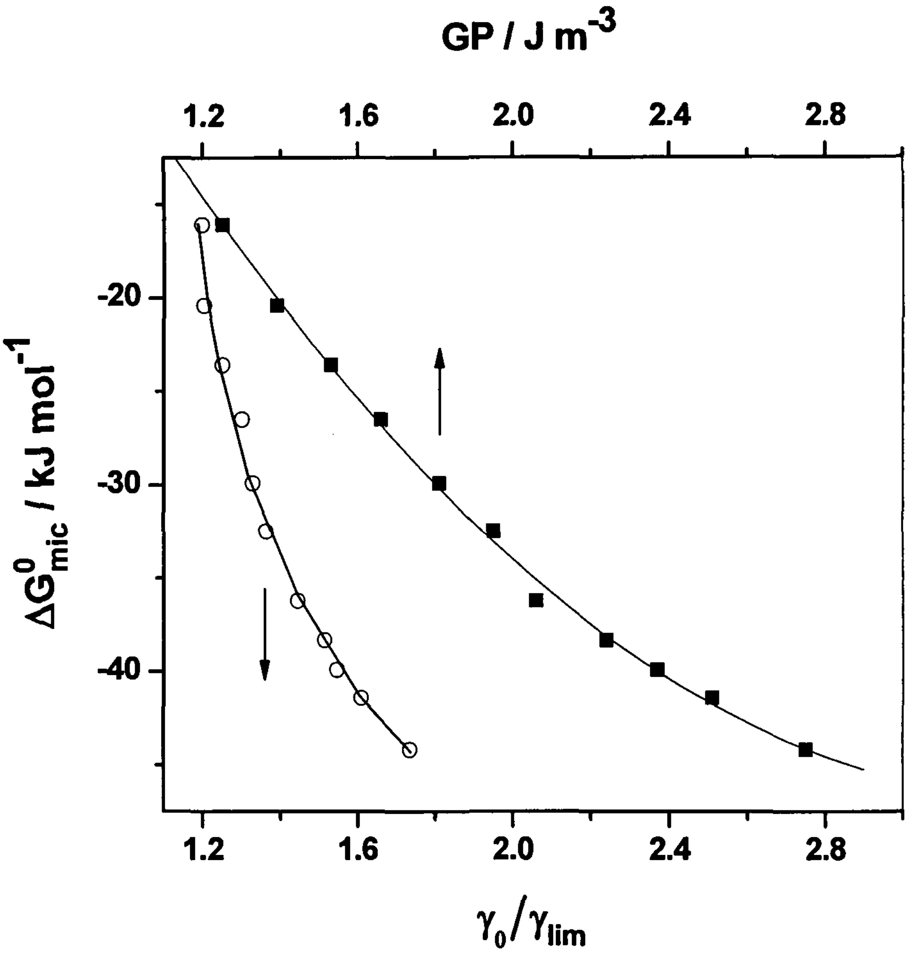

Fig. 4.31 Plots of standard free energy of micellization of CPC in water + EG media at 25 °C as functions of Gordon Parameter and the ratio γ_0/γ_{lim}

CHAPTER V

Aggregation and adsorption properties of sodium dioctylsulfosuccinate, cetylpyridinium chloride and sodium dodecylsulfate in water – formamide mixtures

5.1 Introduction

Importance of solvents on the aggregation phenomenon of amphiphiles has been highlighted in the preceding chapters. In chapter 4, we investigated the adsorption and aggregation behaviour of sodium dioctylsulfosuccinate (AOT) and cetylpyridinium chloride (CPC) in water + ethylene glycol (EG) media. Two unexpected behaviours were observed in water + EG media. They are, (i) occurrence of breaks in the surface tension isotherms of AOT in the submicellar concentration regions when the media contain more than 50 weight % of EG, and (ii) occurrence of minima in the surface tension isotherms of CPC at the critical micelle concentrations (cmc) in water + EG media containing 10 to 70 % EG. It is worthwhile to investigate whether AOT and CPC exhibit such behaviours in other aqueous organic solvents also.

Therefore, in this chapter we have studied the aggregation and adsorption behaviours of AOT and CPC in water + formamide (FA) media. Like water + EG system, water + FA system is also commonly used for studying the effect of solvophobicity on the aggregation and adsorption behaviours of ionic and nonionic surfactants.[1-17]

Moreover, as in water + EG media, the cmc values of AOT at 30 °C in water + FA media reported by Mukherjee et al.[10,11] had unusual trends, viz., (i) cmc increased with increase in FA amount initially and then passed through a maximum at about 22 weight % of FA and (ii) cmc of AOT in FA was less than that in water. In the light of the observations made by us in chapter 4 about the cmc values of AOT in water + EG system, we thought re-examining the surface tension property of AOT in water + FA media may provide information, which would help in understanding the reasons for the reported[10,11] unusual trends in cmc of AOT in water + FA media. This was another reason for carrying out the surface tension measurements of AOT in water + FA mixed solvent.

Furthermore, in this chapter we also report the measured conductance data of sodium dodecylsulfate (SDS) in water + FA media. The reasons for carrying out the conductance measurements of SDS in water + FA are the following: (1) Singh et al.[1] reported from conductance measurements cmc (≈ 0.0009 mol dm^{-3}) of SDS in FA at 25 °C that is ten times lower than in water. (2) According to the cmc values reported by Almgren et al.[2] at 20 °C from conductance measurements, cmc of SDS in water + FA media decreases with increase in the amount of FA with a minimum (cmc ≈ 0.0004 mol dm^{-3}) at 70 weight % FA. Above 70 weight % FA cmc of SDS increases with increase in FA and in FA the cmc (≈ 0.0008 mol dm^{-3}) of SDS has ten times lower value than in water. (3) The cmc of SDS in water + FA media reported from conductance data by Ali and Nain[12] increases with increase in the percentage of FA and attains a maximum at 50 volume % of FA. Again the cmc (≈ 0.0067) of SDS at 25 °C in FA reported by Ali and Nain[12] is slightly lower than in water. (4) Moya et al.[17] recently reported cmc values of SDS at 25 °C from conductance measurements in water + FA media up to 30 weight % FA and their data indicated increase of cmc with increase in weight % of FA. Thus, the reported cmc values of SDS in FA and water + FA media based on conductance measurements[1,2,12] are not in agreement and the trends in the variation of cmc with increasing amount of FA are also contradictory. Therefore, it is worthwhile to carefully re-examine the conductance behaviour of SDS in water + FA media to ascertain the correctness of cmc values derived from the conductance data of SDS in this mixed solvent. In fact, surface tension measurements of SDS in water + FA media made in our laboratory has shown monotonic increase of cmc of SDS with increase in weight % of FA and the cmc of SDS in pure FA is found to be about 28 times higher than in water.[18]

5. 2 Experimental Section

AOT (Sigma, > 99 %), CPC (Sigma, > 99 %), SDS (Fluka, > 99 %), FA (Fluka,> 99.5 %) and pyrene (Fluka,> 97 %) were used without further purification. Millipore grade water was used for making samples. Surface tension, conductance and density measurements were made as described in the preceding chapters.

5.3 Results and Discussion

5.3.1 Nature of surface tension isotherms

The experimental values of surface tension of AOT + water + FA systems as a function of AOT concentration at 25 °C and at varying amounts of FA (0 to 100 weight %) are given in Table 5.1. The surface tension isotherms are shown in

Fig. 5.1. From Fig. 5.1 it is apparent that when the media contain 40 weight % or more of FA, a new break in the surfactant isotherm of AOT occurs much below the cmc as in the case of AOT + water + EG system. In order to get a more clear view of these breaks, we have re-plotted in Fig. 5.2 the surface tension isotherms using enlarged scales. Such breaks in the surface tension isotherms indicate interaction between AOT and FA similar to that between AOT and EG. The interaction between AOT and FA responsible for the first break in the surface tension isotherm occurs at a lower concentration of FA (40 weight %) than EG (more than 50 weight %). On the other hand, in water + FA and water + EG mixed solvent media the concentrations of AOT at which the first break in surface tension isotherms occur are almost same up to 70 % of FA or EG (Table 5.2). The concentration of AOT corresponding to the first break in surface tension isotherm is, however, much higher in the case of FA than EG when the organic solvent amount becomes 80 % or more (Table 5.2). The surface tension at the first break is almost same in the case of FA and EG and its value decreases slightly as the amount of the organic solvent in the medium increases (Table 5.2).

The experimental values of surface tension of CPC + water + FA systems as a function of FA amount at 25 °C are given in Tables 5.3. The surface tension isotherms are shown in Fig. 5.3 and in these isotherms no breaks occur in the submicellar concentration region unlike the case with AOT, which is similar to the observation made in water + EG media (cf. chapter 4). As in the case of water

+ EG media, surface tension isotherms of CPC exhibit surface tension minima at cmc in water + FA media containing 20 to 80 % FA. The depth of the minimum increases with increase in the amount of FA and becomes very sharp in 60 and 70 % FA media. Since surface tension minimum is not found in either pure water or FA medium, the impurity in CPC seems to be negligible and not responsible for the evolution of minimum. Therefore, interaction of FA and EG with CPC micelle seems to be responsible for the occurrence of surface tension minimum in water + FA and water + EG (cf. chapter 4) media. As mentioned in the preceding chapter, we are unable to explain the nature of this interaction at this moment. Surface tension of SDS in water + FA media measured earlier in our laboratory revealed that SDS shows in water as well as FA surface tension minimum due to the presence of impurity. Above 10 % FA, the depth of this minimum keeps on decreasing with the addition of FA, which is illustrated in Fig. 5.4 by taking representative data from reference 18. Thus, it may be inferred that if the surface tension minimum is caused by the impurity in the surfactant, then the depth of the minimum becomes less and less on addition of FA. From this characteristic of the surface tension minimum due to impurity, it may also be concluded that the surface tension minimum occurring in CPC + water + FA system is not due to impurity.

5.3.2 Critical micelle concentration (cmc) from surface tension and conductance

The cmc values of AOT in water + FA media determined from the surface tension isotherms are given in Table 5.2. With increasing FA content of the medium the values of cmc of AOT increases as shown in Fig. 5.5. The present work therefore shows that the cmc of AOT increases with decrease in the solvophobicity of the medium in accordance with the general trend. However, the cmc values of AOT in water + FA media reported by Moulik et al.[10,11] at 303 K increased with FA amount initially, then passed through a maximum at about 22 weight % of FA and eventually cmc of AOT in FA was less than that in water, which is unusual. The present study has revealed that interactions takes place between AOT and FA in the submicellar region as in the case of AOT and EG. The existence of these interactions between AOT and FA might have led to errors in the estimation of cmc values by Moulik et al.[10,11] Compared to the values of cmc of AOT in water + EG media, the values of cmc in water + FA media are found to be higher (Fig. 5.5).

We measured the specific conductance values of AOT in water + FA, but the plots of specific conductance versus concentration of AOT did not show appreciable break and hence cmc values of AOT in water + FA media could not be determined with accuracy from the specific conductance data. This has been illustrated in Fig. 5.6 by the representative plot of measured specific conductance values versus AOT concentration in water + 50 % FA.

The cmc values of CPC in water + FA media at 25 °C determined from the surface tension isotherms are shown in Table 5.4 and Fig. 5.7. The measured specific conductance values of CPC in water + FA are given in Table 5.5 and the plots of specific conductance versus concentration of CPC are shown in Fig. 5.8. In Fig. 5.9, as an example, we have shown plots of surface tension and specific conductance versus concentration of CPC in water + 50 % FA. Similar plots were obtained for CPC at other weight percentages of FA also. Such combined plots of surface tension and specific conductance help in determining the right value of cmc when the surface tension isotherm exhibits minimum.[19] From Fig. 5.9 it is clear that for CPC in water + FA media the cmc is equal to the surfactant concentration corresponding to the surface tension minimum. For comparison sake we could not, however, find in the literature reported values of cmc of CPC in water + FA media.

The measured specific conductance values of SDS in water + FA are given in Table 5.6 and the plots of specific conductance versus concentration of SDS are shown in Fig. 5.10. When combined plots of surface tension and specific conductance were drawn for SDS in water + FA media (representative plot is shown in Fig. 5.11), it was found that in the case of SDS the cmc does not correspond to the concentration corresponding to surface tension minimum as in CPC, but to the concentration where surface tension begins to become almost constant after the minimum. Similar observation has been reported for SDS in water also.[19] Since the plots of specific conductance versus surfactant concentration exhibit more than one break, as pointed out in chapter 4, determining cmc from conductance data alone is difficult. This was the reason for the inconsistency in the reported[1,2,12] values of cmc based on conductance data of SDS in water + FA media. The cmc values chosen from surface tension and conductance data by drawing plots of the type shown in Fig. 5.11 are listed in Table 5.7 and the variation of cmc of SDS with percentage of FA is shown in Fig. 5.12. On the basis of surface tension and the present conductance data it is therefore amply clear that for SDS also cmc monotonically increases with increase in the amount of FA.

5.3.3 Counter ion binding

Counter ion binding constant (β) is determined from the conductance data by the slope ratio method, which is described in chapter 4. Since from conductance data cmc values of AOT in water + FA media could not be determined, β values of AOT also could not be estimated in water + FA media from the slope ratio method. For CPC and SDS, we could estimate the values of β in water + FA media from the slope ratio method and these values are listed in Tables 5.4 and 5.7. The value of β decreases as the amount of FA in the medium increases, which is a common trend observed in an aqueous organic polar solvent medium. However, unlike in water + EG media, β of CPC in water + FA media passes through a minimum as evident from Fig. 5.13. Similarly, β of SDS also passes through a minimum in water + FA medium (Fig. 5.13). As observed in the preceding chapters, in water + FA medium also β is controlled more by the solvophobicity of the medium. In FA the value of β is almost same for both CPC and SDS, which is similar to the observation made in EG for AOT and CPC (cf. chapter 4).

5.3.4 Surface excess and free energy

Surface excess (Γ_{cmc}) values of AOT, CPC and SDS at the air – solvent interface near the cmc were calculated from the surface tension data in the concentration range lying below cmc by using the expression

$$\Gamma_{cmc} = -[1/(2RT)][d\gamma/d\ln c] \qquad (5.1)$$

R and T refer to the gas constant and absolute temperature, respectively. The value of the slope, $d\gamma/d\ln c$, at the cmc was found out by fitting the γ versus lnc data from the concentration region lying just below the cmc to a linear equation. The values of Γ_{cmc} obtained thus for AOT, CPC and SDS are given in Tables 5.2, 5.4 and 5.7, respectively and also shown in Fig. 5.14. From Fig. 5.14 it is clear that in water + FA, Γ_{cmc} of AOT is less than that of CPC and SDS. When the amount of organic solvent is 60 % or more, Γ_{cmc} of AOT in water + FA and water + EG becomes almost same. Γ_{cmc} of AOT and SDS decreases as the FA amount increases in the medium, which is attributable to the decrease in solvophobicity. The change in Γ_{cmc} of CPC in water + FA medium with increasing amount of FA is found to be unusual and is different from that in water + EG medium as apparent from Fig. 5.14. With increase in the amount of FA, Γ_{cmc} of CPC decreases in the range from 0 to 30 weight % FA, increases in the range from 30 to 60 % FA, again decreases in the range from 60 to 90 % FA and remains almost constant between 90 and 100 % FA. At 90 and 100 % FA, Γ_{cmc} has almost same value for CPC and SDS. The interaction of CPC micelles with FA, which is considered to be responsible for the formation of surface tension minimum, may probably be the cause for the unusual trend in the variation of Γ_{cmc} of CPC with percentage of FA.

The values of the standard free energy of micellization per mole of surfactant, ΔG^0_m, were calculated for CPC and SDS in the mixed solvent from the expression,

$$\Delta G^0_{mic} = (1+\beta)RT\ln X_{cmc} \qquad (5.2)$$

where X_{cmc} is cmc in mole fraction unit. The calculated values of ΔG^0_{mic} are presented in Table 5.8. With increasing concentration of FA, ΔG^0_m becomes less favorable to micellization. In the case of AOT, since values of β could not be obtained in the water + FA media from the slope ratio method, we could only calculate the standard hydrophobic free energy, ΔG^0_h, using the relation $\Delta G^0_h = RT\ln X_{cmc}$. The values of ΔG^0_h for AOT are also listed in Table 5. 8.

The standard free energy of adsorption, ΔG^0_{ad}, is generally calculated for both nonionic and ionic surfactants from the equation reported by Rosen and Aronson,[20]

$$\Delta G^0_{ad} = \Delta G^0_{mic} - \Pi_{cmc}/\Gamma_{cmc} \qquad (5.3)$$

Π_{cmc} refers to surface pressure at cmc. The values of ΔG^0_{ad} for CPC and SDS obtained from this equation are listed in Table 5.8.

5.3.5 Solvophobicity index

In chapter 3, we observed that in SDS + water + acetamide system the limiting surface tension at the cmc (γ_{lim}) shows no dependence on the amount of acetamide. In chapter 4, we found that the values of γ_{lim} for AOT and CPC in water, water + EG and EG media are same within ±2 mN m^{-1}. Eastoe and coworkers[21] have also made a similar observation in the case of nonionic surfactants in water + EG media. Based on such observations, we introduced the ratio of the solvent surface tension (γ_0) to the limiting surface tension, γ_0/γ_{lim}, as a new scale to express solvophobicity of a medium towards a particular surfactant. In chapter 4, we have tested this new solvophobicity index in AOT + water + EG and CPC + water + EG systems and it has been found to work as good as the Gordon Parameter (GP)[22,23] scale. As mentioned in chapter 4, this new scale for expressing solvophobicity was successfully applied to Triton X-100 + water + FA system[24] also. The values of γ_0 for water + FA media are listed in Table 5.4. The values of γ_{lim} for AOT, CPC and SDS in water + FA media are given in Tables 5.2, 5.4 and 5.7, respectively. The values of γ_{lim} were taken as the surface tension at the cmc for AOT and SDS, and for CPC as the limiting surface tension value attained after crossing the surface tension minimum. In the cases of all the three surfactants γ_{lim} has a very weak dependence on the amount of FA in spite of strong dependence of γ_0 on FA content. The values of GP and γ_0/γ_{lim} for AOT, CPC and SDS in water + FA media at 298 K are given in Table 5.9. The plots of ΔG^0_{mic} of CPC and SDS and of ΔG^0_h of AOT versus GP and γ_0/γ_{lim} in water + FA media are shown in Figs. 5.15, 5.16 and 5.17, respectively. From Figs. 5.15 – 5.17, we get further support to the observation made in the preceding chapter that the term γ_0/γ_{lim} can be employed as an alternative scale to express solvophobicity of a medium towards a particular surfactant.

Conclusions

In this chapter we have measured surface tension and conductance of AOT and CPC and conductance of SDS in water + FA media at 25 °C. The amount of FA was varied from 0 to 100 weight % in an interval of 10.

Similar to the behaviour of AOT in water + EG media, a new break in the surfactant isotherm of AOT occurs much below the cmc when the media contain 40 weight % or more of FA. Such breaks in the surface tension isotherms indicate interaction between AOT and FA similar to that between AOT and EG. The present work shows that the cmc of AOT increases with increase in FA content of the medium in accordance with the general trend unlike the reported result.[10,11] Acceptable cmc values of AOT could not be determined from its conductance data in water + FA media.

Similar to the trend noticed in water + EG media, surface tension isotherms of CPC exhibit surface tension minima at the cmc in water + FA media containing 20 to 80 % FA. The minimum becomes very sharp in 60 and 70 % FA media. As pointed out in the case of water + EG media, the occurrence of these surface tension minima are not due to impurities in the CPC sample. Further studies are required to explain the mechanism of evolution of surface tension minimum of CPC in water + FA and water + EG (cf. chapter 4) media. Cmc value of CPC increases with increasing amount of FA in the medium and CPC has only one value for cmc in FA.

On the basis of surface tension (cf. chapter 4) and conductance data it has been established that for SDS also cmc monotonically increases with increase in the amount of FA.

Counter ion binding constant of CPC and SDS decreases on adding FA to the medium and passes through a minimum. Surface excess at the cmc of AOT and SDS decreases as the FA amount increases in the medium. The variation of surface excess at the cmc of CPC with percentage of FA has, on the other hand, an unusual trend.

For AOT, CPC and SDS, their values of γ_{lim} in water and FA are found to be same within ±2 mN m^{-1}. It has been demonstrated that the ratio $\gamma_0/\gamma_{\text{lim}}$ can also be used as an index to express the solvophobicity of a medium towards ionic surfactants.

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Table 5.1 Surface tension data of AOT in water + FA media at 298 K

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% FA = 10			
0	70.1	0.1839	50.1	2.1967	35.8
0.0017	68.5	0.2332	48.4	2.5463	34.5
0.0041	66.5	0.2984	48.0	2.9812	33.8
0.0068	64.9	0.3950	45.6	3.5746	32.6
0.0102	63.5	0.5060	44.1	4.1069	32.2
0.0203	61.1	0.6307	43.2	4.5870	31.8
0.0338	58.8	0.7682	42.3	5.1586	31.6
0.0506	56.8	0.9176	41.3	5.7815	31.3
0.0708	55.3	1.0926	40.3	6.3217	31.1
0.0942	53.8	1.3186	38.6	6.8821	30.9
0.1209	52.5	1.5636	38.0	7.2120	30.8
0.1508	51.4	1.8249	37.0		
		Wt.% EG = 20			
0	68.5	0.5184	46.3	5.3918	32.7
0.0044	65.9	0.6880	44.9	5.9575	32.4
0.0105	63.0	0.9395	43.0	6.5033	32.4
0.0175	61.3	1.2694	41.2	7.0878	32.3
0.0263	59.5	1.6734	39.5	8.1922	32.1
0.0525	56.8	2.1464	38.2	9.7043	31.9

Table 5.1 Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% FA = 20					
0.0961	54.0	2.6825	37.0	11.901	31.3
0.1571	51.8	3.2024	35.8	13.057	31.0
0.2264	49.7	3.7776	34.5	14.112	31.3
0.3042	48.6	4.3336	33.6	15.079	31.2
0.3902	47.7	4.8714	33.1	15.967	31.1
Wt.% FA = 30					
0	67.1	0.9388	45.1	13.242	32.2
0.0119	63.3	1.4013	42.9	14.955	32.1
0.0284	60.3	2.3125	40.8	16.598	31.8
0.0474	58.4	3.4267	38.5	19.686	31.5
0.0711	56.8	4.7285	36.6	23.884	31.4
0.1420	52.7	6.2008	35.1	27.633	31.0
0.2601	50.8	7.8252	34.0	32.051	30.7
0.4248	48.4	9.5823	33.2		
0.6358	46.3	11.453	32.6		
Wt.% FA = 40					
0	65.8	0.7664	46.4	14.775	33.3
0.0101	60.9	1.0069	45.7	16.769	33.2

Table 5.1 Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% FA = 40					
0.0223	59.8	1.2867	45.0	19.030	33.1
0.0365	57.8	1.6053	44.1	21.225	32.8
0.0567	55.6	2.0018	43.2	23.654	32.6
0.0810	54.1	2.7892	41.9	26.292	32.4
0.1134	52.1	3.9562	40.2	29.112	32.1
0.1538	50.7	5.4868	38.1	34.425	31.7
0.2024	49.9	7.3600	36.6	41.670	31.4
0.2832	48.8	9.5513	35.1	52.133	30.7
0.4042	48.0	11.332	34.0		
0.5654	46.8	13.073	33.6		
Wt.% FA = 50					
0	64.6	0.6924	46.9	26.035	32.7
0.0248	61.3	1.0368	46.0	29.751	32.6
0.0496	57.4	1.4780	45.1	33.319	32.4
0.0744	54.7	2.4517	43.3	40.040	32.3
0.0992	52.8	4.3717	41.5	46.262	32.0
0.1289	51.1	6.7216	39.3	52.037	31.7
0.1686	50.0	9.9217	37.1	59.964	31.6
0.2181	49.0	13.889	35.3	69.355	31.3

Table 5.1 Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% FA = 50					
0.2973	48.6	18.114	33.9	77.621	30.8
0.4456	47.9	22.159	33.3		
Wt.% FA = 60					
0	63.5	0.5101	46.7	19.922	35.6
0.0319	60.7	0.7009	46.4	28.313	34.1
0.0767	56.1	0.9548	46.0	38.003	33.3
0.1277	52.2	1.3348	45.3	46.905	32.7
0.1596	50.6	1.8396	44.4	55.111	32.7
0.1915	49.2	2.4052	44.1	62.701	32.4
0.2234	48.9	3.6530	43.3	69.740	32.2
0.2681	48.0	6.1125	41.4	79.393	31.8
0.3191	47.7	9.7134	39.7	90.815	31.7
0.3828	47.4	14.357	37.9	100.86	31.6
Wt.% FA = 70					
0	62.1	0.6332	46.5	46.384	33.6
0.0397	58.1	1.0278	45.8	52.132	33.0
0.0793	55.0	1.5786	45.1	57.654	33.0
0.1268	50.9	2.3622	44.7	62.961	32.9

Table 5.1 Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% FA = 70			
0.1665	49.6	4.6910	43.2	68.067	32.7
0.2140	48.5	8.5000	41.5	77.717	32.5
0.2694	47.5	13.686	39.5	90.936	32.2
0.3328	47.3	20.812	37.6	102.85	31.8
0.4040	47.0	27.625	36.2	113.63	31.6
0.4752	46.7	40.394	34.2	123.45	31.5
		Wt.% FA = 80			
0	61.5	0.9962	46.8	24.046	38.8
0.0357	58.5	1.1379	46.2	28.687	38.1
0.0714	57.3	1.2795	45.9	33.700	37.4
0.1071	55.9	1.4209	45.8	39.028	36.6
0.1428	55.2	1.6327	45.6	44.118	36.3
0.1785	53.8	1.9147	45.3	58.658	34.8
0.2141	52.7	2.3364	45.0	65.776	34.3
0.2569	53.2	2.8967	44.7	72.769	33.8
0.3068	51.6	3.5241	44.3	81.000	33.6
0.3638	51.4	4.2178	43.9	90.388	33.1
0.4279	49.9	5.2515	43.6	100.84	33.0
0.4991	49.8	6.6172	43.3	112.27	32.7

Table 5.1 Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% FA = 80			
0.5702	49.5	8.3044	42.6	124.58	32.4
0.6413	47.8	10.300	41.9	148.01	32.1
0.7124	47.8	12.914	41.1	180.49	31.6
0.7834	47.3	16.108	40.6	196.13	31.4
0.8544	47.1	19.835	39.6	217.83	31.2
		Wt.% FA = 90			
0	60.4	1.9600	46.6	27.216	39.7
0.0309	59.2	2.2027	45.3	36.371	38.7
0.0618	58.5	2.4448	45.2	44.731	37.5
0.0926	57.7	2.7467	44.8	50.425	37.3
0.1235	57.5	3.0478	44.7	56.066	36.8
0.1605	57.4	3.3482	44.4	63.508	36.2
0.2037	57.1	3.6477	44.1	81.726	35.1
0.2530	56.2	4.0061	44	99.410	34
0.3085	55.7	4.4227	43.9	116.58	33.7
0.3701	54.7	4.8971	43.8	133.26	33.1
0.4932	54.0	5.4283	43.6	149.48	32.9
0.6776	52.0	6.0155	43.2	165.24	32.5
0.8617	50.7	7.1809	43.1	180.58	32.3

Table 5.1 Continued

[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[AOT] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% FA = 90					
1.0455	49.5	8.9062	42.7	210.02	32.1
1.2290	48.9	11.165	42.2	23.794	32.1
1.4122	48	13.925	41.8	264.45	31.9
1.5951	47.4	17.145	41.2		
1.7777	46.7	21.292	40.5		
Wt.% FA = 100					
0	58.3	2.8772	47.8	69.997	37.1
0.0354	57.9	3.5012	46.2	95.697	35.8
0.0779	58	4.1913	45.5	119.90	34.7
0.1275	57.2	5.2204	44.5	142.73	34.1
0.1842	57	6.2420	43.8	164.30	33.5
0.2479	56.6	7.5930	43	184.72	33.3
0.3186	56.3	9.5956	42.7	213.37	32.9
0.4246	55.1	12.222	42	248.30	32.6
0.5659	54.9	15.437	41.3	224.28	32.2
0.7776	53.7	19.816	41.1	243.45	32.6
1.0593	52.1	25.245	40.3	270.64	32.1
1.4106	51.2	31.028	39.7	296.12	31.9
1.8312	49.6	41.871	38.8	320.06	31.9
2.3203	48.0	56.540	37.8		

Table 5.2 Values of cmc, concentration at the first break point, surface tension at the first break point, limiting surface tension at the cmc, surface excess at the first break and surface excess at cmc of AOT in water + FA media at 298 K (values given in the parentheses correspond to water + EG media taken from chapter 4)

% FA	cmc / mmol kg^{-1}	AOT concentration at the first break / mmol kg^{-1}	Surface tension at the first break / mN m^{-1}	Surface tension at cmc (γ_{lim}) / mN m^{-1}	Γ_{cmc} x 10^6 / mol m^{-2}	Surface excess at the first break
0	2.61	-		31.0	1.80	
10	3.70	-		32.0	1.28	
20	5.52	-		32.5	1.21	
30	9.10	-		33.0	1.06	
40	13.6	0.18	50.0	33.2	1.14	0.96
50	22.4	0.17	49.8	33.2	1.10	1.26
60	31.7	0.22 (0.25)	48.0 (48.0)	33.5	1.09	1.52
70	49.8	0.27 (0.20)	47.5 (47.0)	33.4	0.96	1.21
80	90.7	0.91 (0.17)	46.5 (45.5)	33.0	0.89	0.89
90	149.6	2.20 (0.55)	45.5 (44.0)	32.5	0.88	1.09
100	272.5	8.20 (3.0)	43.0 (42.0)	32.0	0.60	0.93

Table 5.3 Surface tension data of CPC in water + FA media at 298 K

[CPC] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3/ mol kg^{-1}	γ / mN m^{-1}
		Wt.% FA = 10			
0	69.6	0.1996	55.1	1.9319	43.8
0.0067	67.8	0.2657	54.4	2.4242	43.6
0.0147	65.9	0.3450	53.0	3.0267	43.5
0.0240	63.4	0.4371	51.0	3.7316	43.3
0.0347	60.8	0.5420	50.0	4.6421	43.4
0.0467	60.3	0.6595	48.7	5.7352	43.5
0.0600	59.4	0.7895	47.1	7.7840	43.2
0.0800	58.0	0.9834	45.3	11.405	42.7
0.1066	56.4	1.2396	43.5	15.213	41.8
0.1465	56.5	1.5565	43.6		
		Wt.% EG = 20			
0	67.6	0.5775	50.6	2.1130	43.6
0.0116	65.9	0.6921	50.0	2.2903	44.0
0.0256	63.2	0.8065	49.2	2.4891	44.2
0.0418	60.4	0.9206	48.3	2.7088	44.4
0.0604	59.3	1.0344	47.7	3.1453	44.5
0.0813	57.5	1.1479	47.2	3.7922	44.3
0.1045	57.0	1.2611	46.8	4.8503	44.1
0.1392	56.1	1.3741	46.1	6.2908	43.7

Table 5.3 Continued

[CPC] $\times10^3$ / mol kg^{-1}	γ / mN m^{-1}	[CPC] $\times10^3$ / mol kg^{-1}	γ / mN m^{-1}	[CPC] $\times10^3$ / mol kg^{-1}	γ / mN m^{-1}
Wt.% FA = 20					
0.1856	54.9	1.5093	45.5	8.2700	43.8
0.2550	54.3	1.6442	44.8	11.973	43.5
0.3473	52.8	1.8010	43.9	16.968	42.8
0.4625	51.6	1.9572	43.8	24.071	42.4
Wt.% FA = 30					
0	66.4	0.5442	52.8	3.9638	43.6
0.0091	65.6	0.6878	51.7	4.4475	44.0
0.0201	64.9	0.8487	50.4	5.0814	44.4
0.0329	62.8	1.0798	49.1	5.8565	44.6
0.0475	62.1	1.4323	47.3	6.7622	44.3
0.0639	61.3	1.7811	45.7	7.7865	44.4
0.0822	60.0	1.9542	45.4	8.9168	44.2
0.1095	59.2	2.1264	45.1	10.139	43.8
0.1460	58.0	2.4681	44.3	11.441	43.8
0.2187	56.1	2.8064	43.1	13.879	43.6
0.3094	55.1	3.1413	42.4	18.184	42.8
0.4180	54.0	3.4727	42.9		

Table 5.3 Continued

[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}
		Wt.% FA = 40			
0	64.9	0.4027	57.1	4.4791	41.4
0.0062	64.7	0.4994	55.9	4.9830	40.7
0.0135	64.4	0.6077	55.3	5.5731	41.3
0.0221	63.9	0.7274	54.4	6.2422	42.7
0.0320	63.4	0.9652	52.8	6.9826	43.8
0.0430	63.1	1.3176	51.1	7.7860	44.6
0.0553	62.7	1.7796	48.9	8.6441	44.7
0.0737	62.1	2.3449	47.0	10.259	44.6
0.0982	61.5	2.6777	45.6	12.458	44.5
0.1350	60.5	3.0059	44.9	15.035	44.4
0.1839	59.8	3.3296	43.6	17.797	44.4
0.2449	58.9	3.6488	43.3	20.583	43.9
0.3179	57.9	4.0677	41.7		
		Wt.% FA = 50			
0	63.9	1.1306	54.1	10.518	43.1
0.0173	63.5	1.4018	53.2	11.393	43.5
0.0380	63.3	1.7057	52.1	12.542	44.6
0.0622	62.7	2.0417	51.4	13.670	44.5
0.0898	62.1	2.5426	49.8	15.052	44.9

Table 5.3 Continued

[CPC] x10^{3}/ mol kg^{-1}	**γ/ mN m^{-1}**	**[CPC] x10^{3}/ mol kg^{-1}**	**γ/ mN m^{-1}**	**[CPC] x10^{3}/ mol kg^{-1}**	**γ/ mN m^{-1}**
		Wt.% FA = 50			
0.1208	61.7	3.2046	48.6	16.668	44.4
0.1553	61.3	4.0229	46.5	18.758	44.4
0.2070	60.1	4.9916	43.2	21.269	44.3
0.2758	59.6	5.9463	41.7	25.981	43.9
0.3790	58.4	6.8870	38.2	32.363	43.7
0.5163	57.2	7.8142	36.6	38.045	43.7
0.6875	56.1	8.7282	37.3		
0.8923	54.9	9.6292	42.9		
0.3179	57.9	4.0677	41.7		
		Wt.% FA = 60			
0	32.8	1.4716	54.1	11.315	35.7
0.0181	62.3	1.7905	52.9	12.224	34.8
0.0399	61.7	2.1429	52.3	13.120	35.5
0.0653	61.3	2.6682	51.0	14.003	35.6
0.0943	60.8	3.3622	49.8	14.874	39.1
0.1269	60.7	4.2197	48.1	16.016	42.4
0.1631	60.2	5.2342	47.4	17.136	43.1
0.2174	60.1	5.9020	46.8	18.508	43.5
0.2897	59.0	6.5630	44.8	20.113	44.3

Table 5.3 Continued

[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3 / mol kg^{-1}	γ / mN m^{-1}
Wt.% FA = 60					
0.3980	58.4	7.2173	43.3	21.932	44.3
0.5421	57.3	7.8651	41.8	23.941	44.3
0.7219	56.6	8.5064	40.4	26.357	44.2
0.9369	55.8	9.4566	39.1	30.890	44.0
1.1870	54.6	10.393	37.6		
Wt.% FA = 70					
0	61.6	1.4238	54.8	25.706	39.2
0.0311	60.6	2.0378	53.4	28.175	42.9
0.0685	60.2	3.2565	51.8	30.589	43.3
0.1120	59.1	5.0618	49.6	32.950	44.0
0.1618	59.0	6.8405	47.7	35.260	43.8
0.2115	58.9	9.1717	44.5	37.521	43.8
0.2737	58.2	11.910	41.8	39.733	43.9
0.3730	57.8	15.245	39.0	42.753	44.1
0.4971	57.4	17.952	35.6	46.098	43.5
0.6830	56.4	20.597	33.9		
0.9923	55.3	23.181	34.6		

Table 5.3 Continued

[CPC] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[CPC] x10^3/ mol kg^{-1}	γ/ mN m^{-1}	[CPC] x10^3/ mol kg^{-1}	γ/ mN m^{-1}
		Wt.% FA = 80			
0	60.3	3.1712	55.8	41.590	41.5
0.0532	59.9	5.2610	54.1	47.652	42.8
0.1277	59.8	8.3596	51.9	53.538	43.8
0.2128	59.8	12.425	49.4	59.257	43.6
0.3191	59.2	17.404	46.5	65.596	43.5
0.5316	58.7	22.273	44.4	72.489	43.3
0.8500	58.5	27.034	42.4	79.868	43.1
1.3797	57.7	31.692	41.2		
2.1191	56.6	36.249	40.3		
		Wt.% FA = 90			
0	59.5	4.4044	56.5	52.147	43.9
0.0585	59.3	5.4364	55.8	57.727	43.5
0.1403	59.1	6.5781	55.3	64.068	43.2
0.2337	58.8	8.8461	54.4	70.232	42.7
0.3505	58.6	12.210	53.0	77.071	42.6
0.5839	58.3	16.625	51.6	84.513	43.1
0.9336	58.4	22.035	50.0	92.487	43.0
1.3992	58.4	28.371	48.1	100.17	42.8
1.9799	57.5	34.544	46.4	107.57	42.9

Table 5.3 Continued

[CPC] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3/ mol kg^{-1}	γ / mN m^{-1}	[CPC] x10^3/ mol kg^{-1}	γ / mN m^{-1}
		Wt.% FA = 90			
2.6750	57.3	40.561	45.3	114.70	43.2
3.4835	57.0	46.427	44.6	121.59	43.0
		Wt.% FA = 100			
0.1041	58.4	19.386	53.2	92.759	43.6
0.5202	58.2	28.899	51.4	106.67	42.7
1.5577	58.0	39.870	49.7	119.75	42.6
3.4152	57.3	52.096	47.8	132.08	42.4
5.4643	56.9	65.364	46.2	154.71	42.7
11.520	55.5	79.463	44.6	184.37	42.7

Table 5.4 Values of cmc, surface tension of the medium, limiting surface tension, surface excess at the cmc and counter ion binding constant (β)of CPC in water + FA media at 298 K

% FA	cmc / mmol kg^{-1} (from surface tension)	cmc / mmol kg^{-1} (from conductance)	Surface tension of the solvent (γ_0) / mN m^{-1}	Limiting surface tension (γ_{lim}) / mN m^{-1}	Γ_{cmc} x 10^6 / mol m^{-2}	β
0	0.91	0.90	72.2	43.0	2.5	0.65
10	1.23	1.30	69.6	43.5	1.4	0.54
20	2.13	2.10	67.6	44.0	1.2	0.52
30	3.09	3.10	66.4	44.5	1.2	0.39
40	4.99	5.00	64.9	44.5	1.6	0.33
50	7.83	7.80	63.9	44.5	2.8	0.32
60	12.3	11.5	62.8	44.3	3.3	0.23
70	20.2	22.0	61.6	44.0	2.5	0.24
80	36.2	36.0	60.3	43.7	1.6	0.25
90	67.2	68.0	59.5	43.0	1.3	0.22
100	106.0	105.0[a)]	58.5	43.0	1.4	0.33

[a)] Value from ref. 18

Table 5.5 Specific conductance (κ) data of CPC in water + FA media at 298 K

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4/ S m^{-1}
Wt.% FA = 10					
0	94.055	2.8756	283.26	16.651	761.47
0.0399	98.247	3.5128	308.45	17.773	797.40
0.0957	103.50	4.2026	337.59	18.831	830.52
0.1593	109.54	5.0719	369.30	20.151	872.18
0.2386	118.53	6.3523	418.26	21.669	917.46
0.3965	132.77	8.1533	482.00	23.323	969.29
0.6317	153.78	9.8246	538.41	25.054	1016.7
0.9420	181.99	11.380	590.34	26.811	1072.1
1.3250	212.50	12.830	636.74	28.554	1121.3
1.7775	236.46	14.186	682.10	30.250	1169.9
2.2957	259.64	15.457	722.90	32.416	1230.1
Wt.% FA = 20					
0	171.81	6.1005	535.58	18.617	1016.11
0.0724	178.63	7.3506	585.42	20.441	1085.65
0.1736	189.88	8.5659	635.20	22.179	1145.05
0.2890	202.84	9.7477	681.54	24.638	1233.55
0.4328	216.19	10.897	726.41	27.667	1330.89
0.8616	253.67	12.016	769.06	31.103	1447.24
0.1568	312.73	13.106	808.36	34.787	1565.77

Table 5.5 Continued

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4/ S m^{-1}
Wt.% FA = 20					
2.5386	376.43	14.167	848.71	38.578	1688.50
3.6235	430.82	15.200	884.02	42.360	1806.80
4.8139	482.76	16.702	941.95	46.046	1922.02
Wt.% FA = 30					
0	275.83	0.7138	338.56	2.0009	443.48
0.0515	281.16	0.7843	344.37	2.1946	458.27
0.1029	285.24	0.8547	350.08	2.3873	473.63
0.1542	287.95	0.9351	357.21	2.6741	495.23
0.2055	294.44	1.0152	363.96	2.9585	515.64
0.2566	299.90	1.1051	371.37	3.3340	541.83
0.3077	304.34	1.1947	379.72	3.7051	564.28
0.3587	308.96	1.2842	386.69	4.1633	588.44
0.4097	313.50	1.3734	394.61	4.6150	609.66
0.4707	318.49	1.4623	400.86	5.0606	626.11
0.5316	323.74	1.5609	408.54	5.5000	652.20
0.5925	328.89	1.6592	415.85		
0.6532	333.73	1.8061	428.44		
Wt.% FA = 40					
0	359.84	2.9136	572.11	9.8323	964.52

Table 5.5 Continued

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4/ S m^{-1}
		Wt.% FA = 40			
0.0605	364.93	3.4702	609.85	10.563	998.83
0.1209	370.80	4.0186	648.45	11.366	1031.4
0.1933	374.13	4.5589	684.25	12.236	1070.4
0.2775	381.03	5.0913	720.03	13.083	1102.1
0.3736	392.49	5.6159	751.37	13.909	1138.6
0.4814	399.89	6.1330	780.38	14.713	1171.0
0.6008	412.51	6.6427	808.27	15.498	1201.8
0.7199	420.98	7.1452	835.50	16.263	1231.9
0.9568	436.87	7.6406	858.94	17.010	1261.0
1.3096	464.11	8.1291	880.81	17.738	1287.9
1.7749	494.54	8.6108	907.70	18.449	1316.5
2.3486	534.13	9.1800	933.55		
		Wt.% FA = 50			
0	325.31	2.3140	506.91	13.239	1127.8
0.1068	332.07	2.5208	522.80	14.295	1170.8
0.2134	340.16	2.7270	538.71	15.334	1216.1
0.3198	348.71	2.9327	552.71	16.527	1268.9
0.4262	357.10	3.1377	567.92	17.865	1322.7
0.5323	367.62	3.3422	580.85	19.499	1386.0

Table 5.5 Continued

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3 / mol kg^{-1}	κ x 10^4/ S m^{-1}
Wt.% FA = 50					
0.6383	376.44	3.6479	600.88	21.875	1468.3
0.7442	385.31	3.9523	622.11	24.911	1592.7
0.8499	394.84	4.3561	649.07	27.805	1695.7
09765	405.37	4.7577	675.17	31.902	1836.9
1.1029	414.50	5.3560	712.07	35.730	1992.3
1.2291	423.60	6.1460	755.35	40.461	2160.6
1.3551	433.30	7.1213	813.47	44.812	2311.6
1.4809	444.20	8.0834	871.22	50.722	2517.3
1.6274	455.52	9.0325	928.46	57.631	2750.3
1.7736	466.44	9.9689	978.40	71.286	3200.4
1.9403	479.62	11.076	1030.2		
2.1066	492.50	12.166	1078.3		
Wt.% FA = 60					
0	347.34	4.7405	634.93	15.989	1226.7
0.1514	358.35	5.3185	667.45	17.279	1285.0
0.3327	371.62	5.8933	700.14	18.553	1339.4
0.5439	385.35	6.4650	732.77	19.811	1393.2
0.7848	402.21	7.0336	763.30	21.052	1446.0
1.0551	418.60	7.5991	794.25	22.278	1494.7

Table 5.5 Continued

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4/ S m^{-1}
		Wt.% FA = 60			
1.3546	436.23	8.1616	825.04	23.489	1520.6
1.6534	454.29	8.7210	855.81	24.685	1561.0
1.9513	473.07	9.2774	886.34	25.865	1609.5
2.2483	491.50	10.381	937.29	27.032	1652.6
2.5446	510.14	11.474	998.81	28.184	1694.0
2.9874	535.78	12.554	1051.8	29.322	1731.8
3.5750	569.19	13.624	1103.7	30.447	1779.7
4.1594	602.11	14.682	1158.2	31.558	1823.6
		Wt.% FA = 70			
0	337.52	25.172	1551.0	61.022	2805.5
0.2122	347.27	26.870	1621.7	67.960	3025.0
0.6356	374.43	28.543	1691.4	74.396	3254.0
1.2680	414.20	30.191	1756.7	80.383	3434.6
2.1061	461.85	31.813	1819.6	85.966	3602.7
3.3525	522.34	33.412	1875.7	91.186	3751.4
4.9947	604.96	34.987	1937.7	96.076	3898.4
6.6149	687.34	36.538	1990.7	100.67	4035.7
8.6097	783.45	38.370	2053.9	104.98	4162.7
10.572	878.83	40.171	2120.1	108.53	4278.6

Table 5.5 Continued

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4/ S m^{-1}
		Wt.% FA = 70			
12.501	970.93	42.232	2185.8		
14.400	1055.9	44.252	2261.5		
16.267	1147.1	46.513	2332.1		
18.105	1229.8	48.724	2415.9		
19.914	1316.1	51.153	2485.7		
21.694	1396.5	53.782	2571.4		
23.447	1476.2	56.089	2646.9		
		Wt.% FA = 80			
0	319.60	11.781	856.15	37.223	1842.5
0.5528	348.78	12.814	902.18	39.432	1926.4
1.1039	374.63	13.841	948.01	42.043	2010.9
1.6534	403.04	14.861	987.83	45.036	2111.7
2.2011	428.10	15.876	1028.3	48.388	2221.4
2.7472	454.60	16.885	1073.9	52.075	2331.0
3.2916	480.35	17.887	1117.3	56.071	2453.3
3.8343	505.96	19.381	1174.8	63.757	2675.9
4.3754	529.42	20.861	1236.3	71.064	2882.8
4.9148	556.40	22.814	1310.3	78.018	3073.1
5.4526	579.00	24.745	1380.4	84.644	3251.2

Table 5.5 Continued

[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4 / S m^{-1}	[CPC] x10^3/ mol kg^{-1}	κ x 10^4/ S m^{-1}
Wt.% FA = 80					
6.2563	617.31	26.655	1455.7	94.018	3499.8
7.0563	653.46	28.542	1527.7	102.77	3729.2
8.1173	696.48	30.408	1594.9	113.59	4004.0
9.1720	745.87	32.711	1677.1	125.88	4312.4
10.742	809.65	34.983	1764.2		
Wt.% FA = 90					
0	301.70	37.697	1292.1	124.03	3330.8
0.5803	321.73	46.335	1529.3	131.84	3494.1
1.1584	339.57	54.430	1756.2	140.70	3675.3
1.7344	361.16	62.033	1958.2	148.69	3834.8
2.3081	379.78	69.187	2149.1	155.95	3975.2
3.4491	420.41	75.931	2237.0	162.55	4102.6
5.1445	475.16	82.299	2404.9	168.59	4223.7
7.9280	557.74	88.321	2557.3	174.14	4330.2
11.201	660.62	94.026	2695.1	179.26	4415.5
14.929	770.94	99.437	2820.0	183.98	4516.9
19.075	889.83	104.58	2936.1	188.37	4598.5
23.600	1023.1	110.88	3077.9		
28.462	1160.7	117.69	3203.5		

Table 5.6 Specific conductance (κ) data of SDS in water + FA media at 298 K (κ_0 is the specific conductance of the medium taken from Table 5.5)

[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}
		Wt.% FA = 10			
0	-	2.8794	191.74	19.595	940.20
0.0572	2.5036	3.6228	238.59	20.954	977.05
0.1143	6.9947	4.4567	289.30	22.894	1039.1
0.1942	12.201	5.3754	343.19	24.725	1097.8
0.2853	18.299	6.3729	402.42	27.013	1164.2
0.3875	25.452	8.2975	528.26	30.152	1256.0
0.5009	32.977	10.134	628.12	33.431	1354.8
0.6816	44.829	11.888	692.21	36.753	1450.6
0.9064	60.172	13.565	748.44	40.039	1543.8
1.2416	83.990	15.169	799.87	43.232	1640.3
1.6844	118.71	16.707	850.74		
		Wt.% FA = 20			
0	-	2.9545	192.81	19.260	1033.0
0.0590	5.3558	3.7130	237.08	20.591	1076.8
0.1296	10.725	4.5618	285.75	22.174	1135.4
0.2118	28.717	5.4944	339.32	23.966	1202.8
0.3056	35.087	6.5040	395.93	26.190	1271.7
0.4109	41.778	7.9680	491.87	28.732	1356.2
0.5275	49.076	9.8317	603.10	31.484	1445.5

Table 5.6 Continued

[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}
Wt.% FA = 20					
0.7018	60.521	11.601	704.64	34.342	1542.4
0.9330	74.646	13.284	790.67	37.222	1642.8
1.2772	96.386	14.886	860.03	40.349	1732.5
1.7316	123.34	16.412	918.62	43.050	1825.9
2.2922	151.51	17.869	976.02		
Wt.% FA = 30					
0	-	5.6771	320.63	24.604	1245.4
0.0733	5.0524	6.8385	381.06	26.242	1313.4
0.1612	9.7155	7.8472	435.50	27.811	1379.4
0.2635	16.298	8.8344	488.78	29.315	1434.4
0.3801	23.035	10.747	588.65	30.757	1493.0
0.5110	33.674	11.903	644.95	32.815	1568.3
6.5608	42.276	13.029	706.07	34.755	1642.6
8.7288	55.686	14.126	759.63	37.175	1757.1
1.1605	71.649	15.197	812.78	40.489	1866.0
1.5888	96.404	16.241	866.15	43.941	1991.5
2.1541	127.91	17.260	917.63	47.018	2100.1
2.8518	167.12	19.226	1017.1	50.149	2202.0
3.6760	211.98	21.102	1099.5	53.582	2321.9
4.6203	263.53	22.892	1175.4		

Table 5.6 Continued

[SDS] x10^3/ mol kg^{-1}	$(\kappa - \kappa_0)$ x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	$(\kappa - \kappa_0)$ x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	$(\kappa - \kappa_0)$ x 10^4 / S m^{-1}
Wt.% FA = 40					
0	-	19.954	1018.0	61.893	2719.3
0.1760	10.557	21.993	1117.7	63.760	2790.3
3.5173	22.856	23.992	1225.5	67.373	2926.8
5.6227	35.788	26.231	1324.5	70.833	3050.1
8.0740	55.547	28.422	1418.2	74.150	3112.9
1.0869	72.021	30.831	1517.2	77.333	3232.6
1.4006	91.443	33.184	1616.6	81.871	3403.2
1.7480	113.26	35.734	1720.5	86.149	3562.2
2.4399	149.81	38.219	1815.9	90.189	3712.8
3.4698	203.24	40.641	1910.0	94.009	3857.2
5.1659	288.55	43.004	1997.9	98.792	4030.5
6.8370	372.07	45.309	2082.8	104.32	4232.6
8.4834	457.09	47.557	2172.2	109.41	4417.2
10.106	537.69	49.752	2261.5	114.10	4590.1
11.705	615.41	51.895	2342.8	119.27	4778.7
13.281	695.34	53.988	2424.6	124.01	4946.1
14.834	772.27	56.033	2501.5	128.36	5101.3
16.366	845.19	58.031	2576.9		
18.175	934.04	59.984	2650.5		

Table 5.6 Continued

[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}
Wt.% FA = 50					
0	-	8.9805	430.70	31.608	1446.2
0.0992	6.2386	10.574	505.56	33.307	1523.2
0.2180	13.618	12.109	573.80	34.915	1586.9
0.3562	21.668	13.588	637.27	36.440	1679.5
0.5136	31.438	15.015	702.50	38.585	1804.0
0.6901	42.149	16.392	763.09	40.576	1879.1
0.8854	52.390	17.721	816.61	43.017	1971.7
1.1768	68.942	19.006	879.31	45.770	2063.1
1.5625	89.876	20.248	931.55	48.241	2150.5
2.1351	118.38	21.449	984.34	50.889	2242.6
2.8877	152.71	22.612	1032.1	53.247	2332.0
3.8111	192.23	24.288	1112.7	55.359	2408.8
4.8948	246.13	25.886	1184.7	57.262	2469.7
6.1265	305.24	27.907	1283.6	59.257	2535.3
7.4931	366.19	29.811	1365.5	61.523	2619.5
Wt.% FA = 60					
0	-	18.774	844.52	62.267	2493.5
0.4239	27.562	21.117	942.72	66.117	2624.1
0.9317	55.215	24.206	1054.9	69.899	2750.6

Table 5.6 Continued

[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3 / mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}
		Wt.% FA = 60			
1.5228	83.864	27.255	1170.6	74.227	2886.4
2.1965	117.18	31.011	1306.3	79.067	3048.2
2.9523	156.21	34.706	1454.7	84.960	3249.6
3.7893	195.89	38.343	1596.6	96.258	3608.8
5.0395	262.71	41.922	1718.9	106.95	3947.0
6.6965	337.77	45.446	1860.9	117.07	4255.2
9.1609	437.59	48.914	2002.8	131.30	4687.6
11.601	538.24	52.330	2137.6	148.67	5198.0
14.016	640.16	55.693	2261.7	168.17	5747.6
16.406	742.88	59.005	2380.0		
		Wt.% FA = 70			
0	-	14.882	536.99	48.791	1605.6
0.2030	6.9177	15.952	574.07	51.361	1680.8
0.4461	17.267	17.363	622.69	55.091	1802.4
0.7292	28.214	18.757	669.64	58.681	1922.4
1.0518	41.189	20.476	726.64	63.261	2067.0
1.4138	57.288	22.169	781.74	67.620	2209.2
1.8148	72.663	23.836	835.88	71.775	2334.8
2.4137	91.234	25.479	889.53	75.740	2466.0

Table 5.6 Continued

[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}
Wt.% FA = 70					
3.2078	124.16	27.097	941.19	81.357	2630.0
4.3891	166.80	28.692	991.31	86.612	2773.2
5.9464	222.09	30.575	1051.0	91.540	2920.2
7.1011	261.97	32.425	1109.4	96.170	3054.4
8.2448	303.29	34.544	1171.4	100.53	3168.0
9.3774	342.75	36.621	1239.9	105.96	3321.3
10.499	382.21	38.945	1310.4	110.99	3447.9
11.611	421.36	41.218	1379.5	116.79	3606.8
12.711	460.33	43.715	1456.2	122.11	3773.8
13.802	499.34	46.152	1524.2		
Wt.% FA = 80					
0	-	23.370	822.52	88.924	2674.2
0.3708	14.790	26.059	886.12	96.393	2894.0
0.8149	34.950	28.718	968.67	105.95	3157.1
1.3322	75.200	31.349	1049.2	115.08	3400.7
1.9221	99.360	34.597	1145.4	123.81	3623.0
2.5840	124.10	37.801	1239.4	132.16	3837.8
3.3175	151.27	40.963	1332.6	144.04	4125.4
4.4139	192.05	44.702	1442.1	155.19	4383.1
5.8683	244.51	48.382	1553.0	165.69	4618.3

Table 5.6 Continued

[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}	[SDS] x10^3/ mol kg^{-1}	(κ - κ_0) x 10^4 / S m^{-1}
Wt.% FA = 80					
8.0344	325.85	52.603	1674.2	175.60	4835.5
10.894	421.23	56.748	1792.1	184.95	5033.1
13.017	490.09	61.394	1916.9	193.79	5221.7
15.123	561.19	65.947	2043.0	202.17	5397.3
17.211	627.33	70.409	2166.9	210.13	5551.1
19.281	694.27	75.862	2310.3	217.68	5693.9
21.334	758.77	81.182	2447.3		
Wt.% FA = 90					
0	-	54.277	1453.4	211.57	4456.5
0.5743	18.842	68.125	1781.8	223.03	4629.0
1.7193	55.721	81.275	2080.3	233.82	4781.8
3.4287	113.25	93.778	2349.2	243.99	4921.9
5.6924	178.68	105.68	2598.10	255.45	5071.0
9.0554	275.55	117.03	2820.7	266.17	5216.0
13.480	398.87	131.35	3094.7	276.23	5362.2
18.916	540.74	144.83	3343.0	287.21	5497.1
24.251	679.55	157.55	3571.2	297.44	5630.6
29.487	810.49	172.45	3830.9	307.00	5743.4
34.627	946.14	186.36	4044.0	317.19	5837.4
44.629	1199.4	199.37	4264.4		

Table 5.7 Values of cmc, limiting surface tension at the cmc, surface excess at the cmc and counter ion binding constant (β) of SDS in water + FA media at 298 (Values of γ_{lim}, Γ_{cmc} and cmc from surface tension were taken from ref. 18)

% FA	cmc / mmol kg^{-1} (from surface tension)	cmc / mmol kg^{-1} (from conductance)	Surface tension at cmc (γ_{lim}) / mN m^{-1}	Γ_{cmc} x 10^6 / mol m^{-2}	β
0	8.2	8.1	39.0	3.5	0.74
10	11.1	10.5	41.0	3.0	0.52
20	13.6	13.5	42.5	2.6	0.40
30	20.2	20.5	43.5	2.3	0.29
40	30.2	30.0	43.5	2.0	0.23
50	45.0	45.0	43.2	2.0	0.23
60	78.1	78.0	43.4	1.6	0.11
70	108.1	102.0	42.8	1.5	0.11
80	128.7	125.0	42.0	1.6	0.20
90	175.5	170.0	41.5	1.2	0.34
100	229.0	225.0[a]	41.0	1.3	0.34

[a] from ref.18

Table 5.8 Values of standard free energy of micellization (ΔG^0_{mic}) and adsorption for CPC and SDS and of standard hydrophobic free energy (ΔG^0_h) for AOT in water + FA media at 298 K

% FA	CPC		SDS		ΔG^0_h / kJ mol^{-1} for AOT
	ΔG^0_{mic} / kJ mol^{-1}	ΔG^0_{ad} / kJ mol^{-1}	ΔG^0_{mic} / kJ mol^{-1}	ΔG^0_{ad} / kJ mol^{-1}	
0	-45.0	-56.7	-38.0	-47.5	-14.7
10	-40.7	-59.3	-31.8	-41.3	-13.9
20	-37.8	-57.5	-28.4	-38.1	-12.9
30	-33.1	-51.4	-24.7	-34.7	-11.6
40	-29.8	-42.6	-22.1	-32.8	-10.6
50	-27.8	-34.7	-20.6	-31.0	-9.4
60	-24.3	-29.9	-16.8	-28.9	-8.6
70	-22.7	-29.7	-15.7	-28.1	-7.4
80	-20.7	-31.1	-16.1	-27.7	-5.9
90	-18.0	-30.7	-16.6	-31.6	-4.7
100	-17.6	-28.7	-15.2	-29.3	-3.2

Table 5.9 Values of density, molar volume (V) and Gordon Parameter (GP) of water + FA mixed solvent and values of γ_0/γ_{lim} for AOT, CPC and SDS in water + FA media at 25 °C

% FA	Density x 10^{-3} kg m^{-3}	V x 10^6 m^3 mol^{-1}	$\gamma/V^{1/3}$ (GP) J m^{-3}	γ_0/γ_{lim} for AOT	γ_0/γ_{lim} for CPC	γ_0/γ_{lim} for SDS
0	0.99704	18.00	2.75	2.33	1.68	1.85
10	1.01130	18.93	2.61	2.18	1.60	1.70
20	1.02530	19.95	2.49	2.08	1.54	1.59
30	1.03935	21.12	2.40	2.01	1.49	1.53
40	1.05237	22.51	2.30	1.95	1.46	1.49
50	1.06419	24.16	2.21	1.92	1.44	1.48
60	1.07816	26.09	2.12	1.87	1.42	1.45
70	1.09036	28.46	2.02	1.84	1.4	1.44
80	1.10297	31.38	1.91	1.83	1.39	1.44
90	1.11502	35.09	1.82	1.83	1.38	1.43
100	1.12832	39.88	1.70	1.82	1.35	1.42

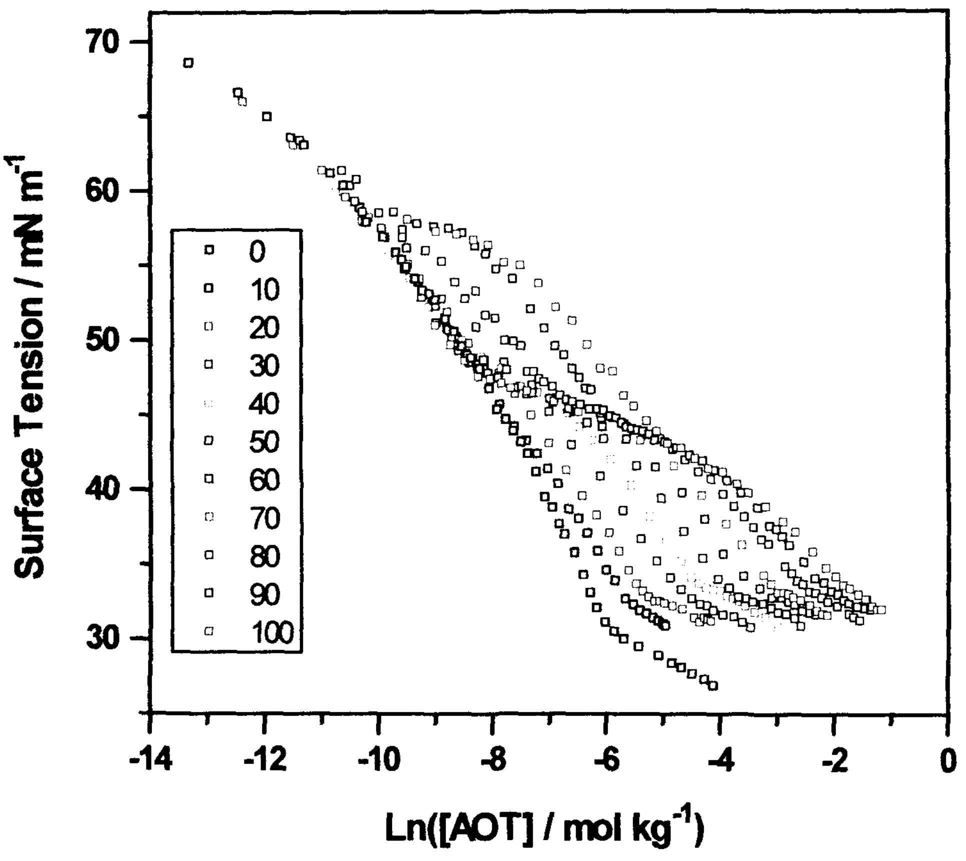

Fig. 5.1 Surface tension of AOT + water + FA system at 298 K as a function of AOT concentration. The weight percentages of FA are indicated in the inset.

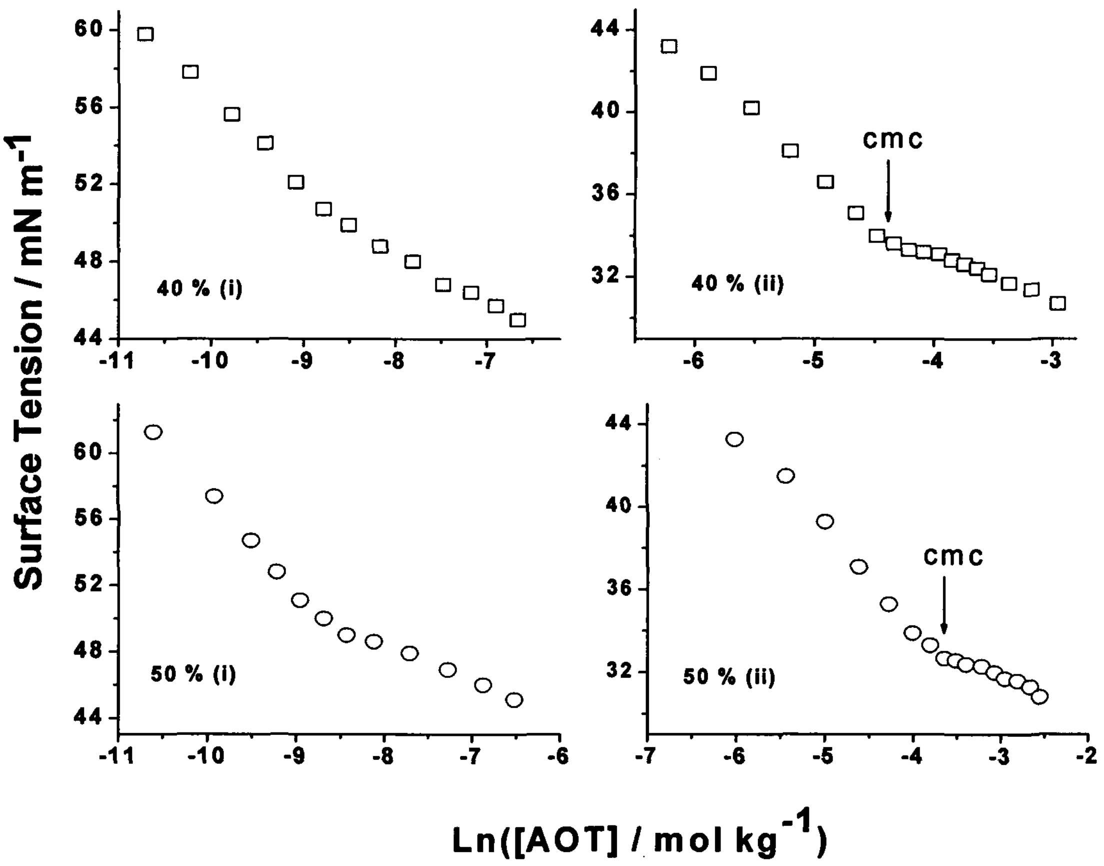

Fig. 5.2a Two regions of surface tension of AOT + water + 40 % FA and AOT + water + 50 % FA systems at 298 K as a function of AOT concentration.

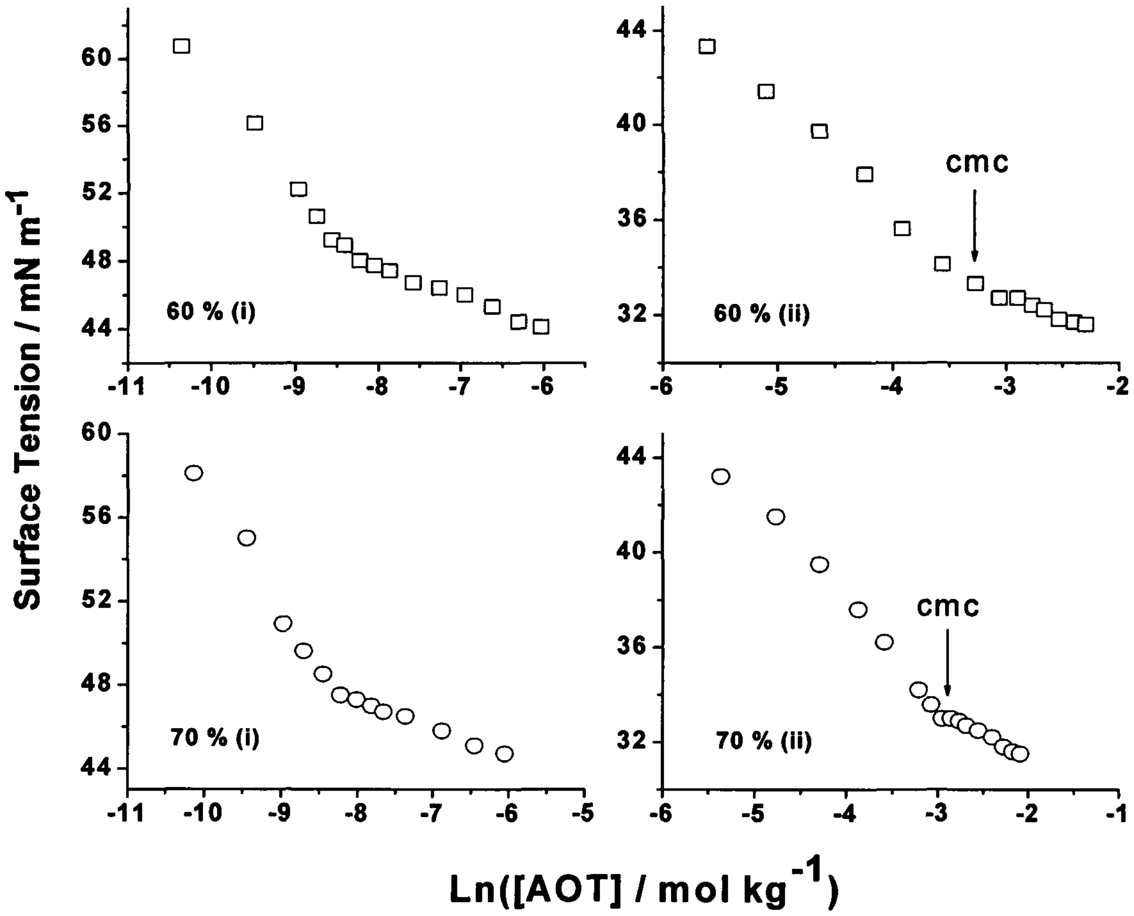

Fig. 5.2b Two regions of surface tension of AOT + water + 60 % FA and AOT + water + 70 % FA systems at 298 K as a function of AOT concentration.

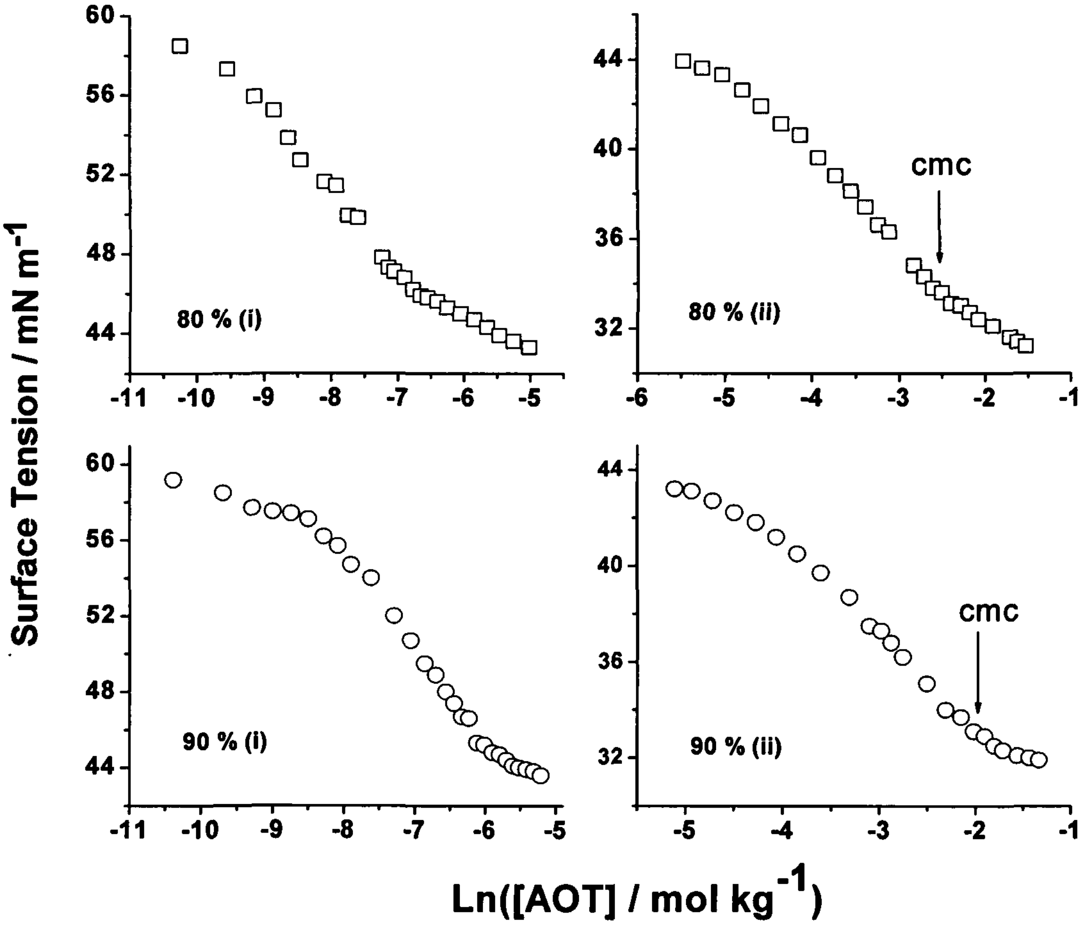

Fig. 5.2c Two regions of surface tension of AOT + water + 80 % FA and AOT + water + 90 % FA systems at 298 K as a function of AOT concentration.

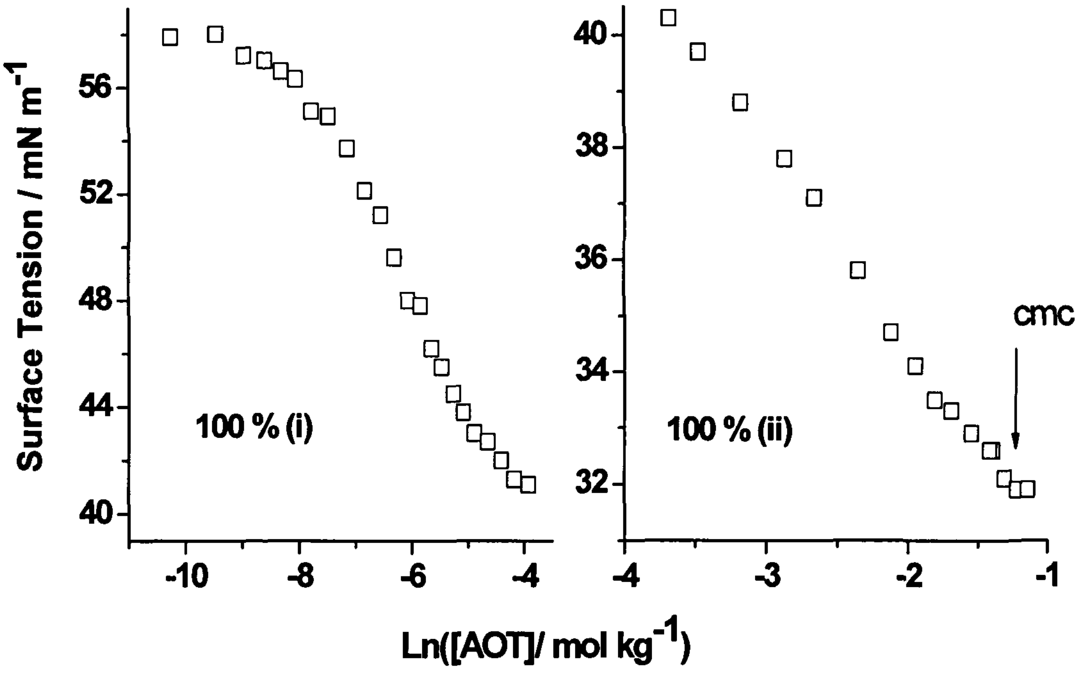

Fig. 5.2d Two regions of surface tension of AOT + FA system at 298 K as a function of AOT concentration.

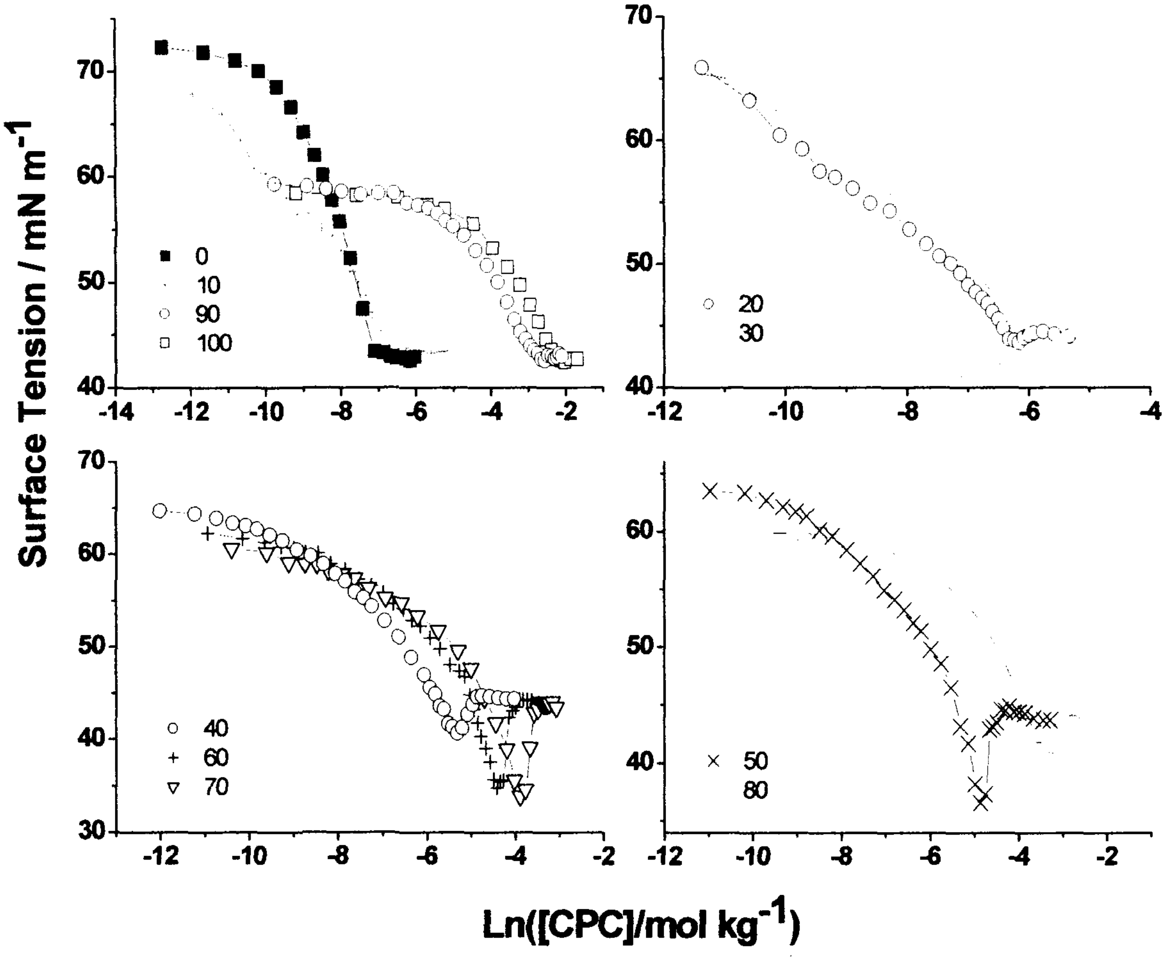

Fig. 5.3 Surface tension of CPC + water + FA system at 298 K as a function of CPC concentration. The weight percentages of FA are indicated in the insets.

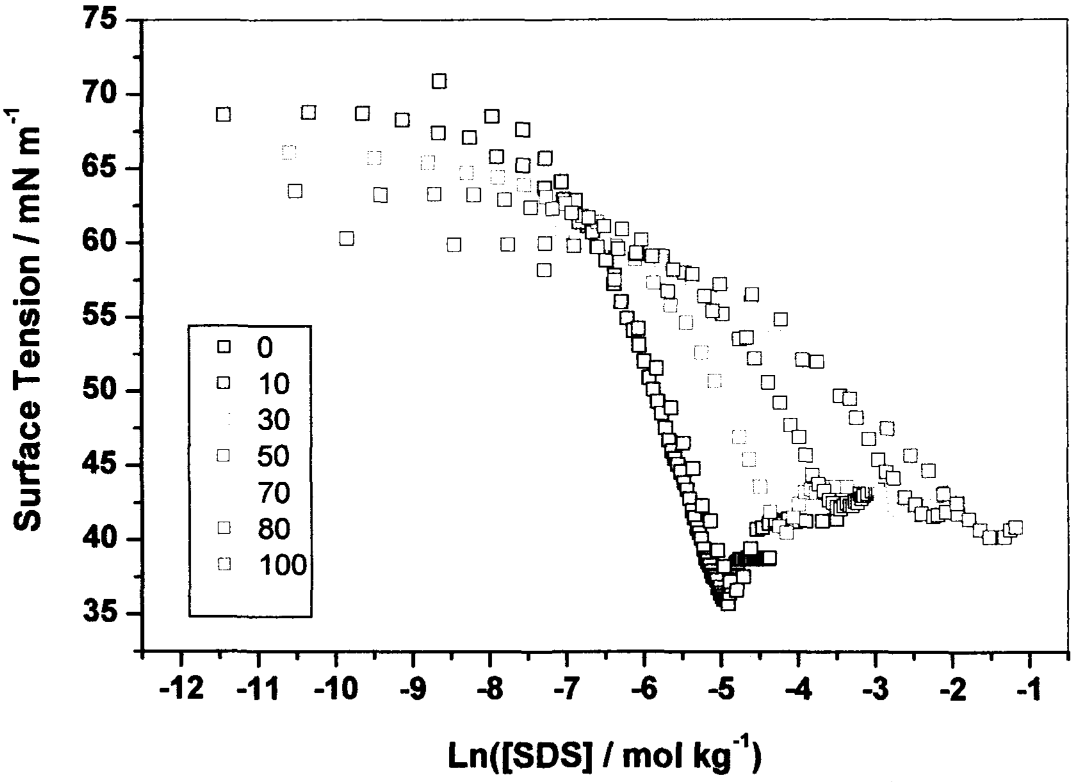

Fig. 5.4 Some representative plots of surface tension of SDS + water + FA system at 298 K as a function of SDS concentration. The weight percentages of FA are indicated in the inset. Surface tension data taken from reference 18.

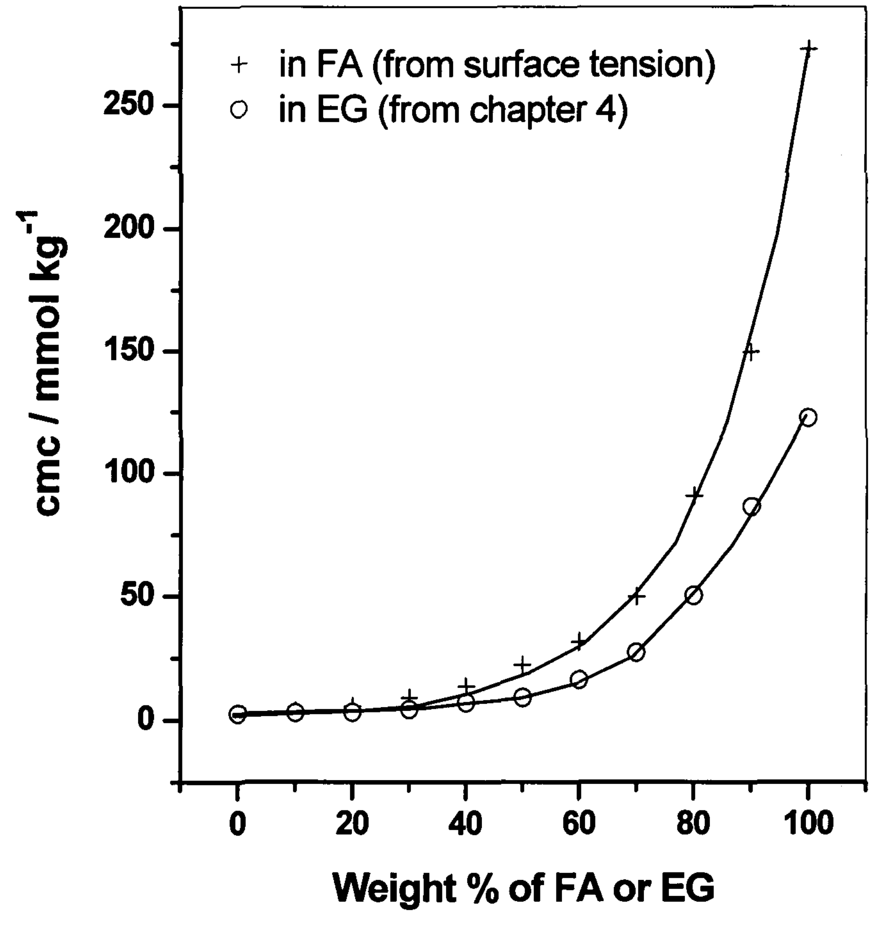

Fig. 5.5 Cmc of AOT in water + FA media at 298 K as a function of weight percentage of FA. Values of cmc of AOT in water + EG media (data from chapter 4) are also shown for comparison.

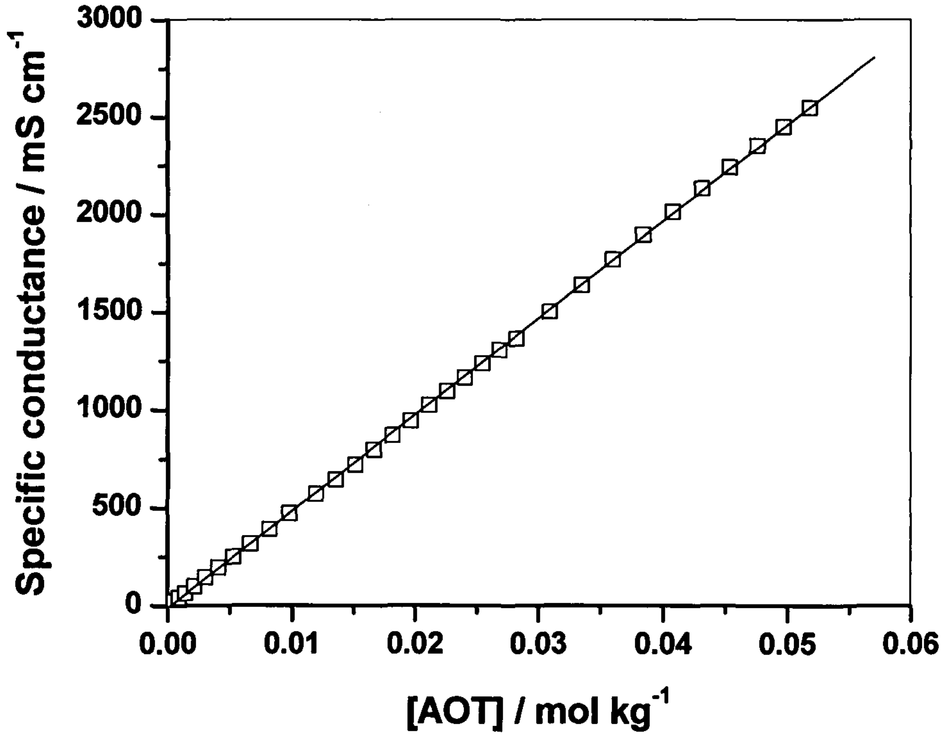

Fig. 5.6 A representative plot of specific conductance of AOT versus concentration of AOT in water + 50 % FA medium at 298 K

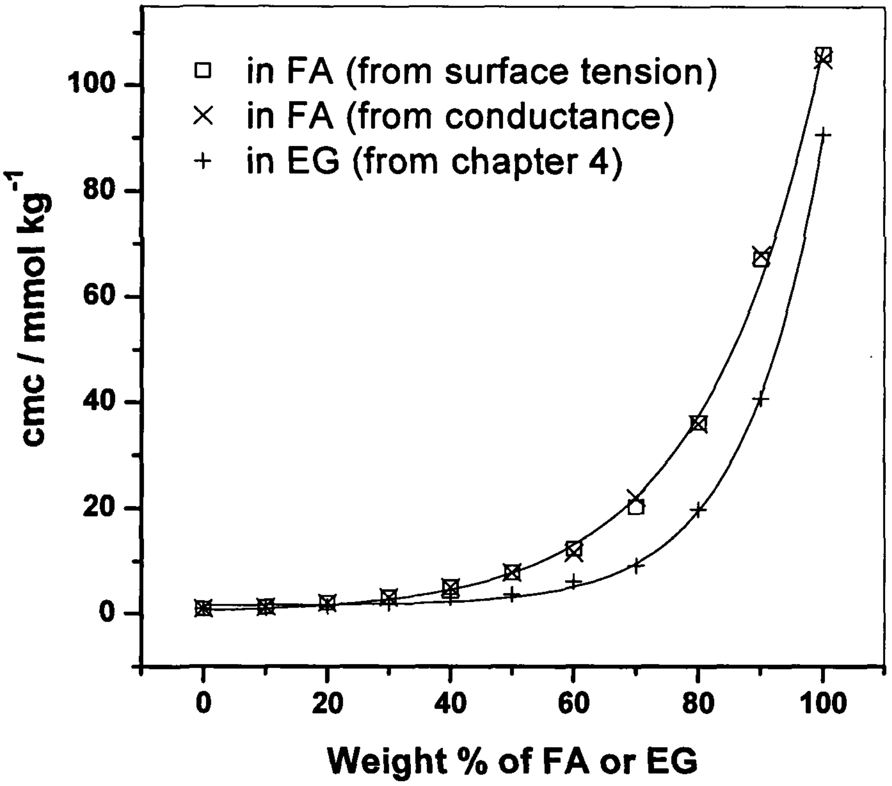

Fig. 5.7 Cmc of CPC in water + FA media at 298 K as a function of weight percentage of FA. Values of cmc of CPC in water + EG media (data from chapter 4) are also shown for comparison. Cmc value in 100 % FA from conductance data is taken from ref. 18.

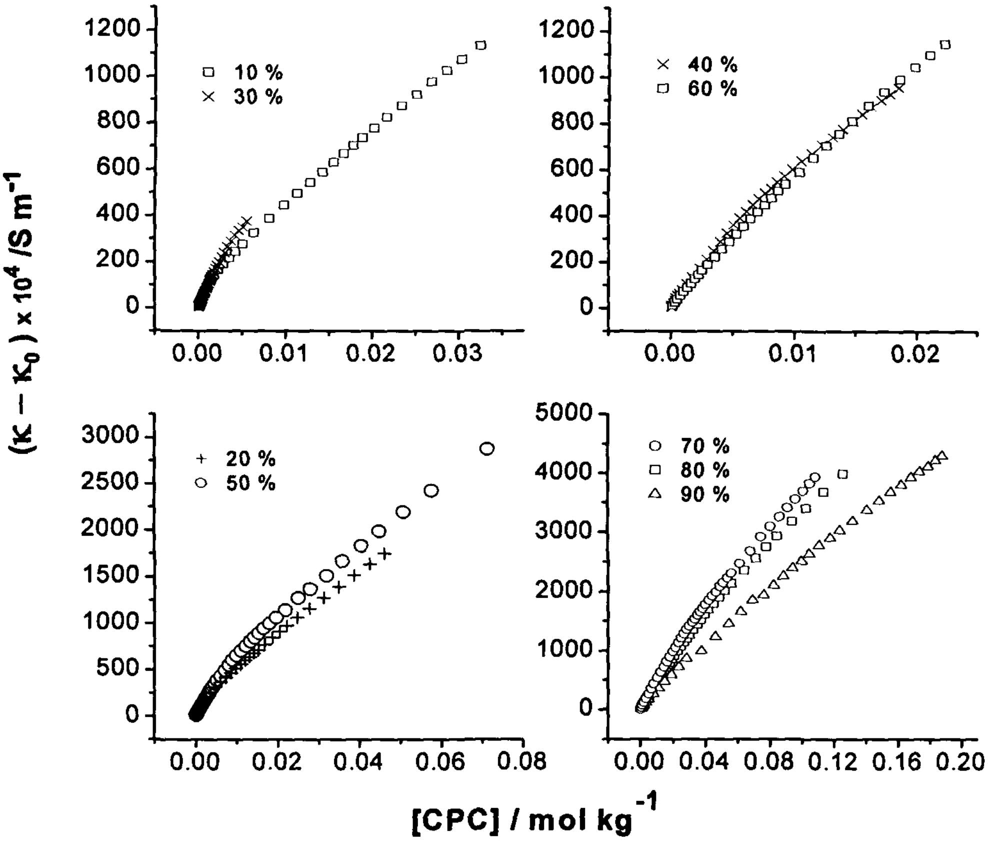

Fig. 5.8 Plots of specific conductance (κ; κ$_0$ is the specific conductance of the medium) of CPC in water + FA media at 298 K versus concentration of CPC. Values of weight percentage of FA are indicated in the inset.

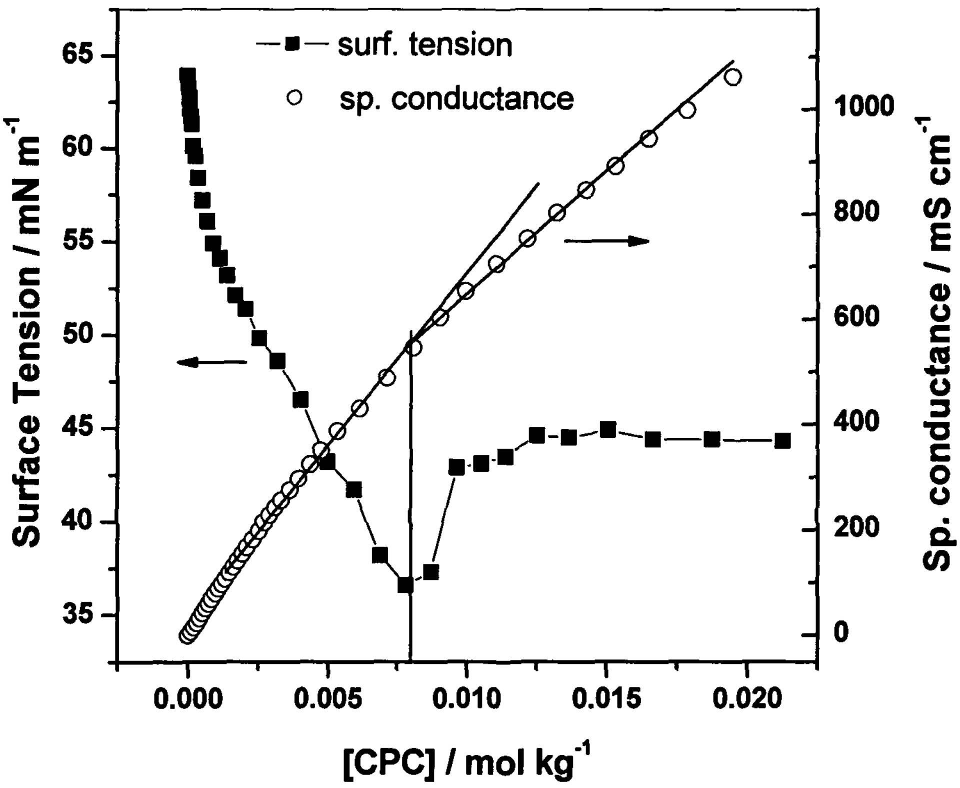

Fig. 5.9 Plots of surface tension and specific conductance of CPC versus concentration of CPC in water + 50 % FA medium at 298 K.

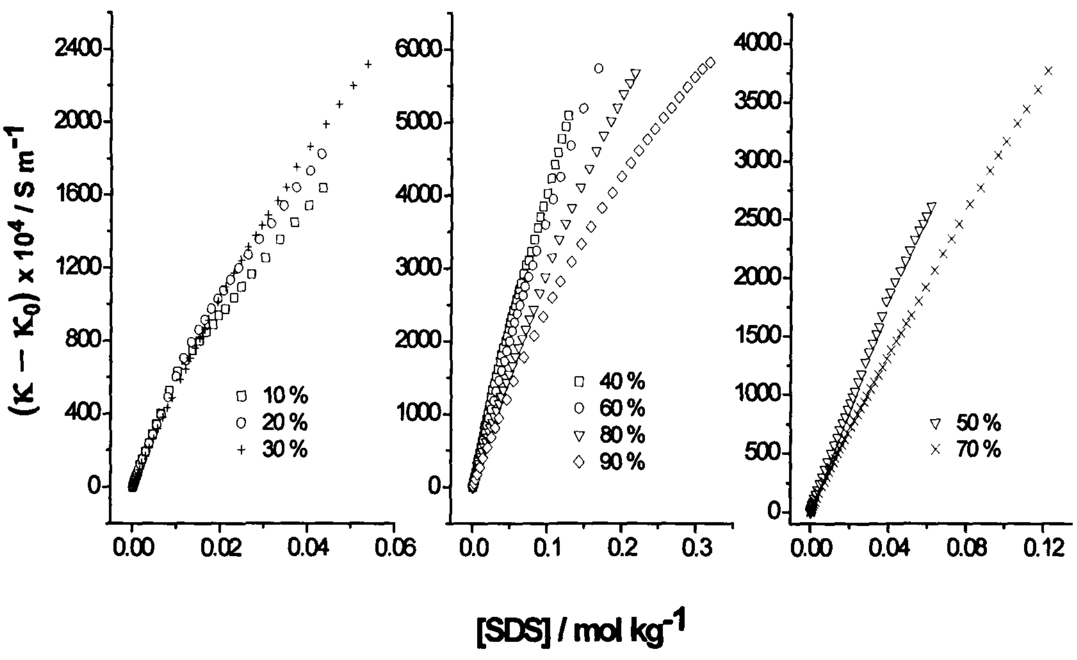

Fig. 5.10 Plots of specific conductance (κ; κ_0 is the specific conductance of the medium) of SDS in water + FA media at 298 K versus concentration of SDS. Values of weight percentage of FA are indicated in the inset.

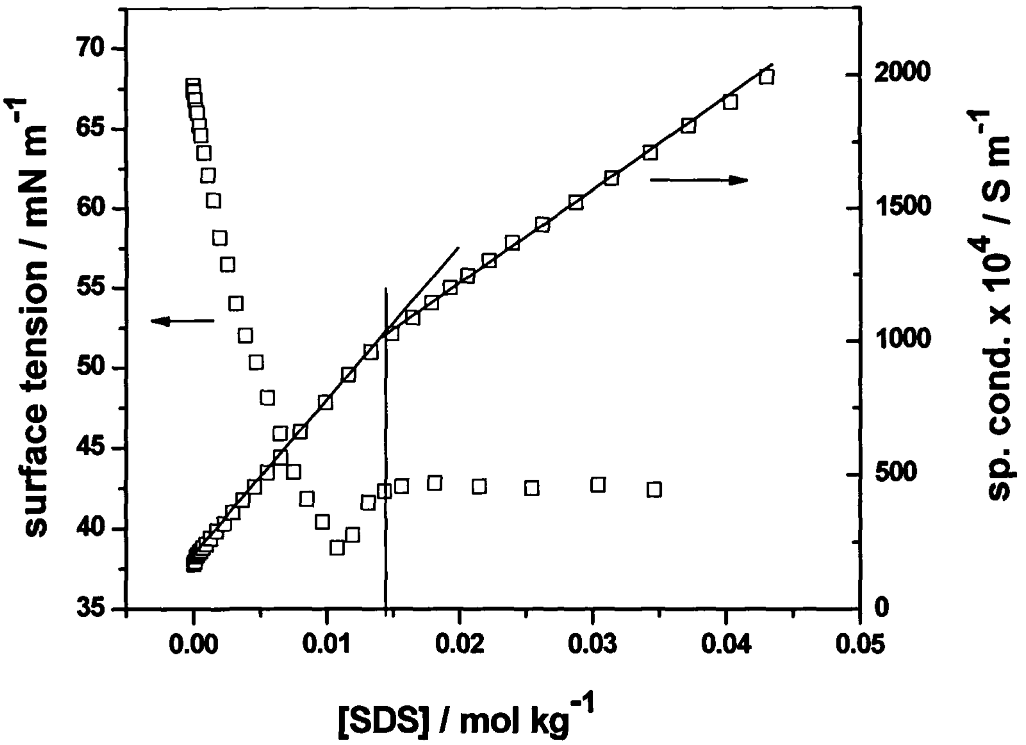

Fig. 5.11 Plots of surface tension and specific conductance of SDS versus concentration of SDS in water + 20 % FA medium at 298 K.

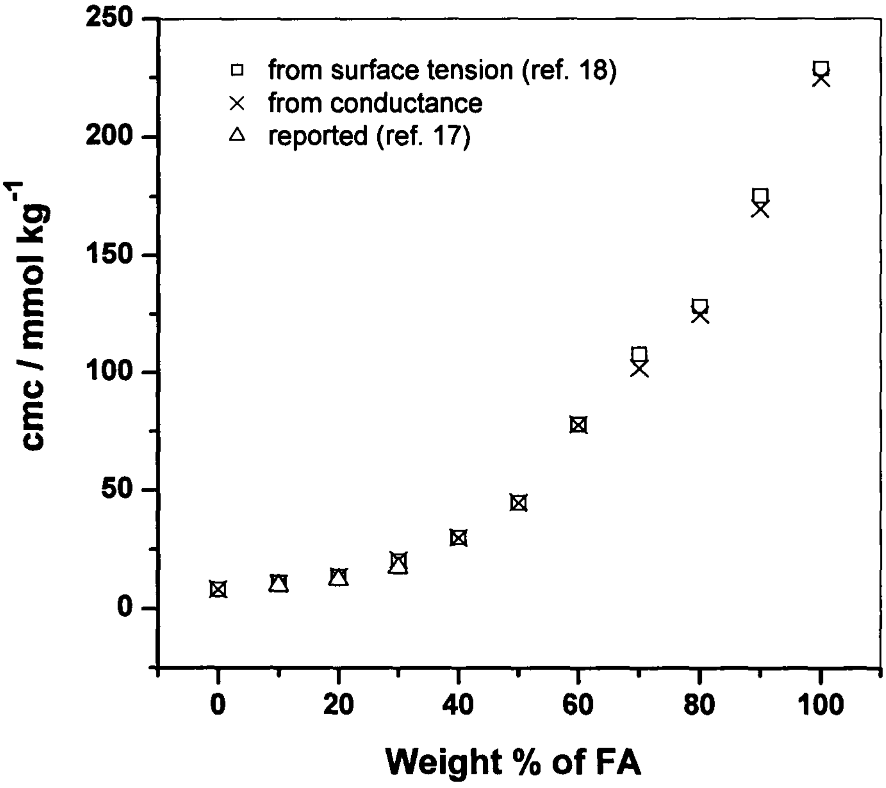

Fig. 5.12 Cmc of SDS in water + FA media at 298 K as a function of weight percentage of FA. Cmc value in 100 % FA from conductance data is taken from ref. 18

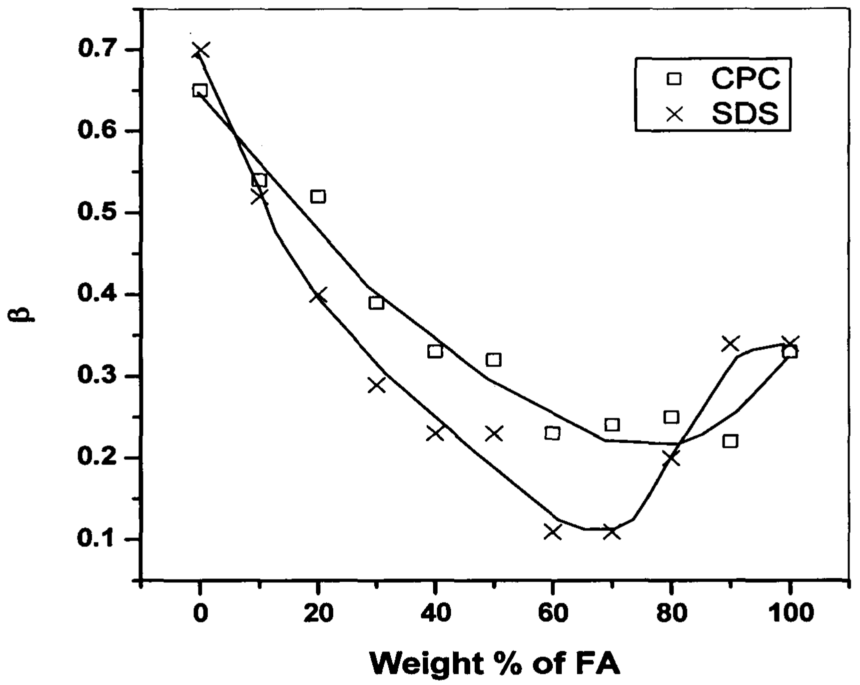

Fig. 5.13 Variation of counter ion binding constant of CPC and SDS with weight percentage of FA at 298 K.

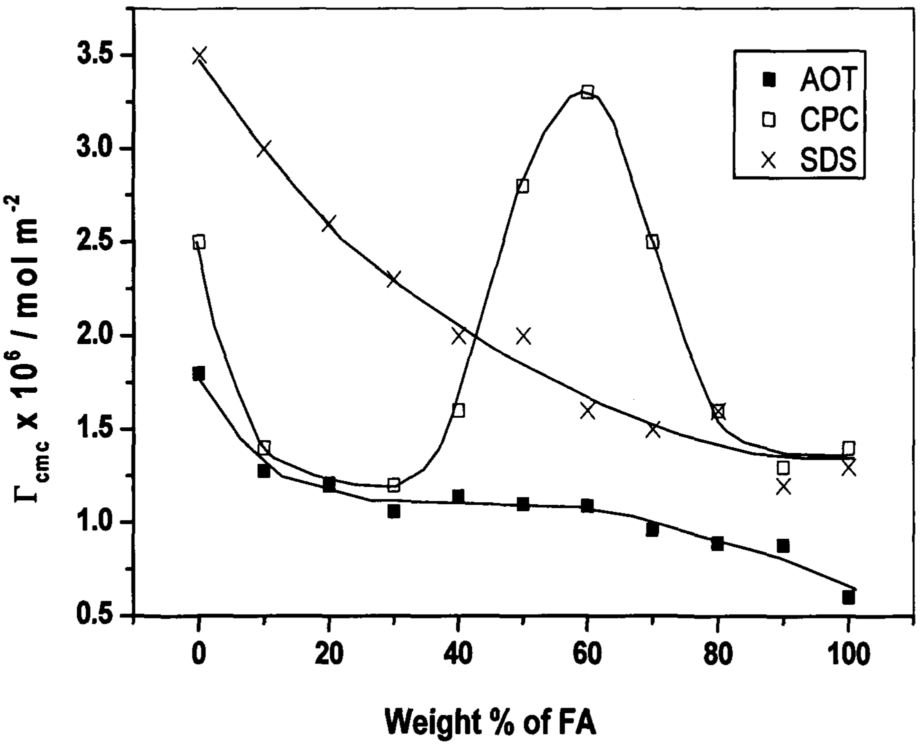

Fig. 5.14 Variation of surface excess of AOT, CPC and SDS with weight percentage of FA at 298 K.

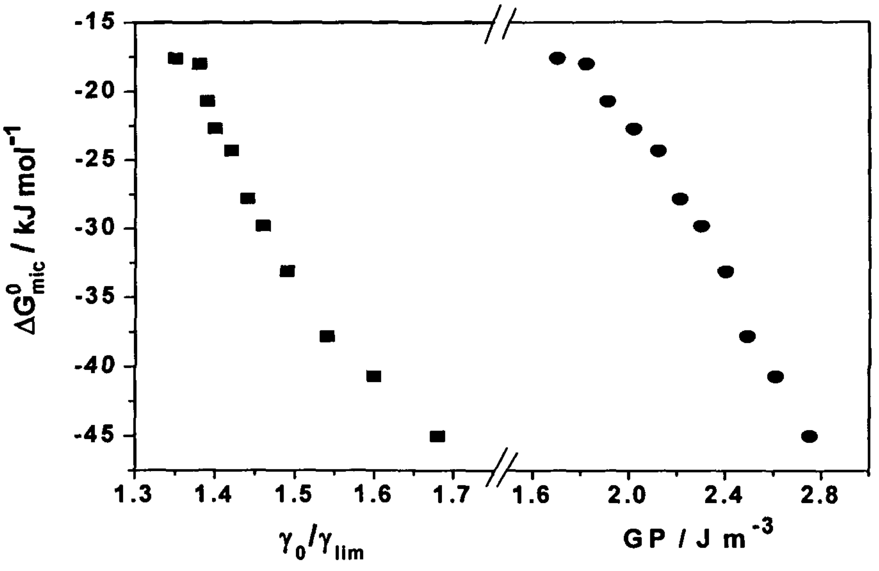

Fig. 5.15 Variation of standard free energy of micellization of CPC with GP and γ_0/γ_{lim} in water + FA at 298 K

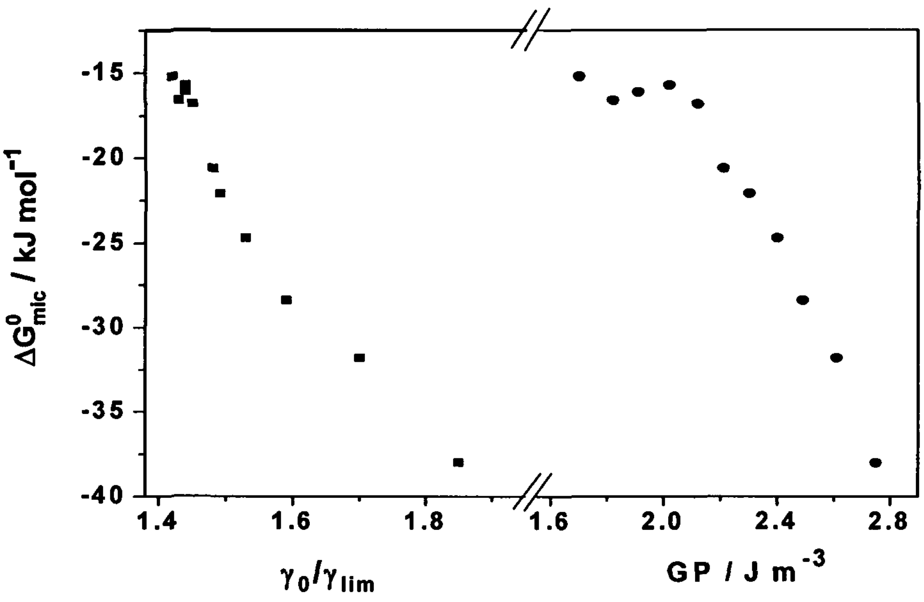

Fig. 5.16 Variation of standard free energy of micellization of SDS with GP and γ_0/γ_{lim} in water + FA at 298 K

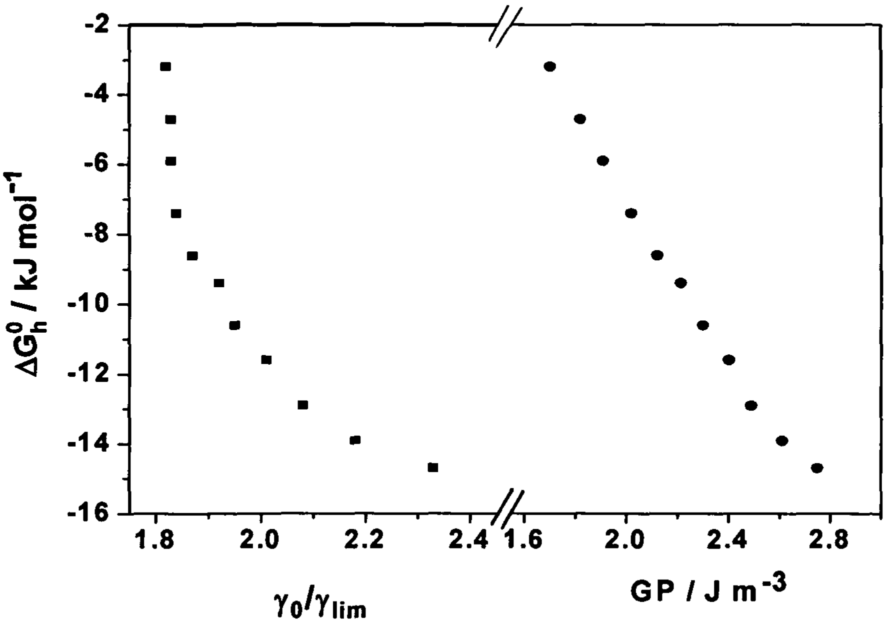

Fig. 5.17 Variation of standard hydrophobic free energy of AOT with GP and γ_0/γ_{lim} in water + FA at 298 K

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M.Sc	NEHU	2001	1stclass,7th	65.28

Research Publications

1. Specific Conductivity Maxima of Ionic Surfactants in Acetamide Melt

   S. Dev, **D. Das** and K.Ismail

   J. Chem. Eng. Data, **49,** 339 (2004)

2. Aggregation and adsorption properties of sodium dodecyl sulfate in water-acetamide mixtures

   D. Das and K.Ismail

   Journal of Colloid and Interface Science, **327,** 198 (2008)

Seminars/ Symposia / Conferences attended:

1. Attended the Seventy Second Annual Session of "The National Academy of Sciences, India" held at the North-Eastern Hill University, Shillong from Oct 25-27,2002.
2. Attended a one day workshop on "Science and Technology for the Better Quality of Life" organised by "Study Forum for Advanced Technology (N.E.) India" sponsored by Department of Atomic energy, Govt. of India, held at North-Eastern Hill University, Shillong on 25th February 2006.
3. Attended the "National Symposium on Advances in Chemistry and Environmental Impact" (2-3rd November 2006) organized by Department of Chemistry, North-Eastern Hill University, Shillong-793022, Meghalaya, India.
4. Attended and presented a paper at the "National Conference on Disperse Systems (NCDS 2006)" organized by the Department of Chemistry, Assam University in collaboration with Indian Society for Surface Science and Technology, Jadavpur University,Kolkata held from 23rd-25th November 2006.
5. Attended the 96th Indian Science Congress held at North-Eastern Hill University, Shillong from 3rd-7th January 2009.

Shillong
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Aggregation and adsorption properties of sodium dodecyl sulfate in water–acetamide mixtures

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ABSTRACT

The critical micelle concentration (cmc) of sodium dodecyl sulfate was determined in water + acetamide media from 0 to 70 wt% of acetamide and at temperatures in the range from 20 to 40 °C by using conductance, surface tension, and fluorescence methods. The cmc increases with increase in acetamide concentration and the reported [M.S. Akhter, Colloids Surf. A 121 (1997) 103] decrease in cmc was not observed. The limiting surface tension at the cmc does not have any dependence on the amount of acetamide added. The cmc data as a function of temperature were used to estimate the free energy, enthalpy, and entropy terms for micellization. Enthalpy–entropy compensation takes place during micellization. Counterion binding constant, surface excess, and aggregation number of SDS decrease with increasing acetamide concentration and become almost constant for weight percentages of acetamide greater or equal to 30. Pyrene appears to move from the interior of the SDS micelle to the micellar interface at about 30 wt% acetamide. The empirical relations reported by Aguiar et al. [J. Aguiar, P. Carpena, J.A. Molina-Bolivar, C. Carnero Ruiz, J. Colloid Interface Sci. 258 (2003) 116] between the parameters of a sigmoid-type expression for the ratio of fluorescence emission intensities of pyrene and surfactant properties are found to be applicable to SDS in water + acetamide medium below 20 wt% acetamide only. Standard free energy of micellization has linear correlations with reciprocal of dielectric constant and Gordon parameter of the solvent. The water + acetamide medium behaves similar to mixed solvents containing water and any polar liquid nonaqueous solvent and this study highlights the significance of solvophobicity.

1. Introduction

Hydrophobic interaction is a type of solvent–solute interaction where the solute has either full or partial hydrophobicity. When the solutes are amphiphilic in nature, hydrophobic interaction leads to two significant phenomena, viz. adsorption and aggregation. This interaction is not water specific and therefore solvophobic interaction is used as a general term. Thus, self-organization of amphiphiles takes place only in the presence of a solvent and as a result solvent properties can greatly influence the adsorption and aggregation phenomena. Studies are therefore made on the aggregation behavior of surfactants by altering the solvent property and such studies provide us information of both fundamental and applied importance. Solvent property can be varied in different ways, for example, (i) by taking pure solvents of different polarity, (ii) by taking mixed solvents containing either mixtures of water and nonaqueous solvent or mixtures of two nonaqueous solvents, and (iii) by adding electrolytes or nonelectrolytes to water or any other solvent of interest. Water is an important solvent from biological and industrial points of view and is used in different human activities. Therefore, investigations about the micellization characteristics of different types of surfactants are still carried out mostly in water and in aqueous media containing additives that can alter the water structure. Despite extensive studies made on the micellization behavior of surfactants in different types of media, it is still not exactly clear which property of a solvent controls the micellization process. However, hydrogen bonding between the solvent molecules has been reported to be a prerequisite for aggregation of surfactants [1]. In recent years there has been a renewed interest on the study of adsorption and aggregation of surfactants in solvent media containing a binary mixture of water and a polar nonaqueous solvent as evident from published papers [2–14]. Carrying out investigation on the effect of added nonelectrolytes on the micellization of surfactants is also equally important so as to gather knowledge about the role of solvent structure on aggregation phenomenon. Several such studies were carried out in aqueous medium and the commonly used nonelectrolytes are alcohols and urea. Acetamide (AA) is another nonelectrolyte which has two sites for hydrogen bonding and there are two reports [15,

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Table 1

Critical micelle concentration (cmc ± 0.1 mmol kg^{-1}) of SDS in aqueous medium as functions of temperature and acetamide amount

Weight % AA	Temperature (°C)				
	20	25	30	35	40
0	8.4[a]/8.4[b]	8.2/8.1/8.4[c]	8.4/8.3	8.6/8.6	8.8/8.7
10	10.1/9.5	10.6/10.0/10.7	11.1/10.2	11.2/10.8	11.3/11.0
20	13.8/–	14.3/14.0/13.8	15.0/15.0	15.5/15.7	16.6/16.5
30	21.5/22.2	22.4/22.6/20.6	23.0/24.0	26.2/26.0	27.3/27.0
40	26.8/25.5	27.3/27.0/29.0	28.4/28.0	30.2/30.0	31.8/31.5
50	32.7/34.0	39.6/40.0/42.6	49.8/51.0	55.0/55.0	57.8/58.0
60	62.0/63.0	67.2/67.0/67.9	74.3/–	90.7/90.0	106.5/105.0
70	90.7/90.0	96.3/95.0/97.0	104.4/105.0	135.3/135.0	154.1/153.0

[a] From surface tension.
[b] From conductance.
[c] From fluorescence.

16] in the literature about the micellization of ionic surfactants in water + AA medium. In this medium Emerson and Holtzer [15] reported an increase in the cmc of SDS with increasing AA whereas Akhter [16] reported a decrease in the cmc and in both studies only the conductance method was used. We have therefore made a detailed study of the micellization behavior of sodium dodecyl sulfate (SDS) in water + AA medium by using surface tension, conductance, and fluorescence methods.

2. Materials and methods

In this study SDS (Aldrich, ⩾99%), AA (Fluka, ⩾99%), pyrene (Fluka), and cetylpyridinium chloride (CPC; Sigma) were used without further purification. Conductance measurements were made using a Wayne Kerr B905 automatic precision bridge and a dip-type cell. Surface tension measurements were made by the Wilhelmy plate method using a K11 Krüss tensiometer. A Hitachi F4500 FL spectrophotometer was used to record the fluorescence emission intensities of pyrene. Density measurements were made using an Anton Paar DMA 5000 density meter. A Haake DC10 circulation bath was used for maintaining the temperature. Milli-Q grade water was used for preparing solutions. Concentration of AA in water is expressed in weight percentage.

3. Results and discussion

3.1. Critical micelle concentration determination

3.1.1. Conductance

Representative plots of specific conductance versus concentration at 25 °C are shown in Fig. S1 (supplementary material) and from such plots the values of cmc of SDS were determined as functions of temperature (from 20 to 40 °C) and AA concentration. These values of cmc are given in Table 1. Although dielectric constant of the water + AA medium was reported [17] to increase up to the addition of about 70% (≈0.4 mole fraction) AA, conductance of SDS solution of a particular concentration decreases with increase in the AA concentration similar to the case in other media containing water and nonaqueous solvents [2,6,9–14,18,19].

3.1.2. Surface tension

Representative plots of surface tension versus concentration at 25 °C are shown in Fig. S2 (supplementary material). SDS sample used in this study exhibits surface tension minima when the AA amount in the mixed solvent is less than 50%. For the sample of SDS used in the present study it was observed that the cmc values determined by the conductance method are comparable to the SDS concentration at which surface tension starts becoming almost constant. Similar observation was reported by Lin et al. [20] also. Accordingly, cmc values were estimated from the surface tension plots and are listed in Table 1. In Fig. 1 we have shown the change in surface tension that takes place on adding AA to water in the presence and absence of SDS. Surface tension decreases on adding AA to water and passes through a minimum at 30% AA in the absence of SDS and at less than 30% AA in the presence of SDS. In the light of the reported [21,22] information about the structure of water + AA system the decrease in surface tension up to 30% AA may be ascribed to loosening of the ice-like structure of water by the addition of AA, which would decrease the energy required for taking water molecules to the air–water interface and the increase in surface tension above 30% AA may be attributed to the formation of new water–AA mixed structures. In the presence of amphiphiles due to hydrophobic interactions the rupture of tetrahedral configurations of water may take place at lower concentrations of added AA and this could be the reason for the shifting of the surface tension minimum in Fig. 1 to lower AA concentrations on adding SDS. The limiting surface tension at the cmc (40 ± 2 mN m^{-1}) is, however, found to have no dependence on the amount of added AA. Recently Eastoe and co-workers [3] also reported a weak dependence of limiting surface tension of nonionic surfactants on solvent in water + ethylene glycol (EG) mixture.

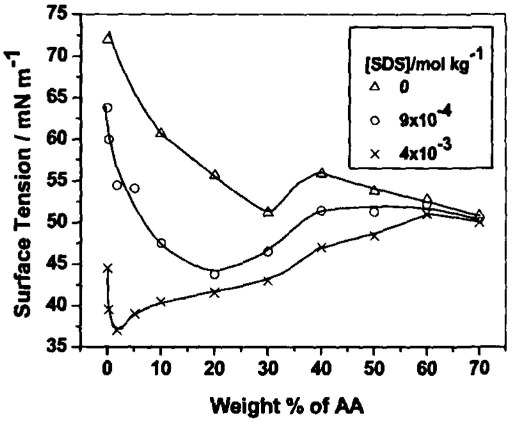

Fig. 1. Variation of surface tensions of water and SDS solutions at 25 °C as a function of acetamide concentration.

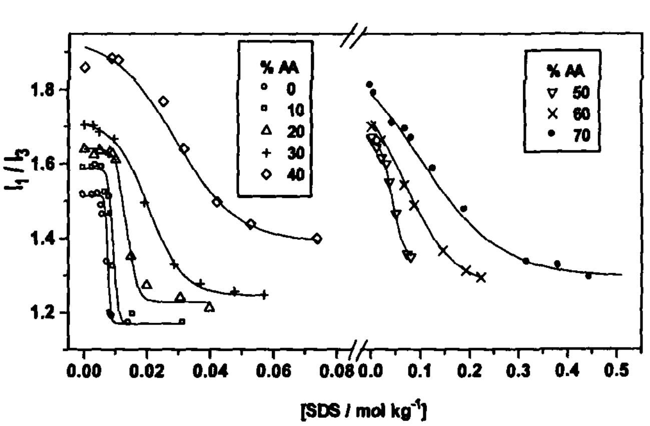

Fig. 2. Variation of I_1/I_3 of pyrene with SDS concentration at 25 °C in water + AA media containing varying amounts of AA. Solid lines correspond to calculated values of I_1/I_3 from Eq. (1) using parameters listed in Table 2.

3.1.3. Fluorescence

Fluorescence emission measurements of pyrene made at 25 °C are shown in Fig. 2 as plots of I_1/I_3 versus SDS concentration. I_1 and I_3 refer to the intensities of pyrene emission spectra at 374 and 384 nm, respectively. The values of cmc at 25 °C were estimated from these plots using the treatment reported by Aguiar

Table 2
Values of the fitted parameters of Eq. (1) for SDS in aqueous medium as a function of acetamide amount at 25 °C

Weight % AA	A_1	A_2	$10^3 b$ (mol kg^{-1})	x_0 (mol kg^{-1})	$x_0 + 2b$ (mol kg^{-1})	x_0/b
0	1.515	1.170	0.40	0.0076	0.0084	19.0
10	1.587	1.170	0.72	0.0093	0.0107	12.9
20	1.641	1.227	1.52	0.0138	0.0168	9.1
30	1.716	1.245	5.50	0.0206	0.0316	3.7
40	1.940	1.390	9.80	0.0290	0.0486	3.0
50	1.675	1.339	12.0	0.0426	0.0666	3.6
60	1.810	1.271	49.8	0.0679	0.1679	1.4
70	1.940	1.295	82.2	0.0970	0.2614	1.1

et al. [23] and are listed in Table 1. The cmc values determined from the three methods are found to be comparable. The nature of the variation of I_1/I_3 with SDS concentration is considered to be sigmoid type and the data were fitted to

$$I_1/I_3 = \{(A_1 - A_2)/(1 + \exp[(x - x_0)/b])\} + A_2. \qquad (1)$$

In Eq. (1) x represents SDS concentration, x_0 is the value of x corresponding to the center of the sigmoid, A_1 and A_2 are the upper and lower limits of the sigmoid, respectively, and b is a term that reflects the range of x where sudden change of I_1/I_3 occurs. The values of the parameters of Eq. (1) obtained from the fitting are given in Table 2. Aguiar et al. [23] made very interesting conclusions from the analysis of the I_1/I_3 data, which are (i) for ionic surfactants cmc $= x_0 + 2b$ and $x_0/b > 10$, and (ii) for nonionic surfactants cmc $= x_0$ and $x_0/b < 10$ (the value was typically in the range of 3 to 5). Aguiar et al. [23] showed that these conclusions hold well in water, water + EG, and water + urea media. In the case of the present system of study it can be seen from Table 2 that the empirical correlations made by Aguiar et al. [23] for ionic surfactants are applicable in pure water and 10% AA medium only. On the other hand, when the amount of AA in the solvent medium becomes equal to or more than 30%, cmc and x_0/b of SDS take up the values that are characteristic of nonionic surfactants. The behavior of SDS in 20% AA medium appears to be a borderline case, because cmc is nearly equal to x_0 as well as $x_0 + 2b$ and $x_0/b \approx 10$. Moreover, the nature of the plots given in Fig. 2 indicates that micelle formation of SDS is accompanied by a sudden decrease in the 1:3 intensity ratio of pyrene in media containing up to 20% AA, which is a characteristic of ionic surfactant, but when the media contain 30% or more AA the micellization process of SDS occurs in a gradual manner, which is a characteristic of nonionic surfactant. The present study therefore reveals that the characteristics of the parameters of Eq. (1) for ionic surfactant, particularly x_0 and b parameters, are strongly dependent on the nature of the surfactant as well as on the nature of the solvent. The influence of the solvent was not observed by Aguiar et al. [23] in the systems investigated by them.

3.2. *Critical micelle concentration trend*

3.2.1. *Temperature dependence*

The variation of cmc with temperature is shown in Fig. S3 (supplementary material). In the presence of AA the cmc minimum of SDS observed in water at about 298 K disappears and instead cmc increases monotonically with temperature in the range from 20 to 40 °C. On increasing the temperature two opposing effects operate in the surfactant solution: (i) the degree of hydration of the head group decreases, thereby favoring micellization, and (ii) the ordered structure of solvent molecules around the hydrophobic tails breaks, thereby disfavoring micellization. In solvents containing water + AA or water + nonaqueous solvent the second effect seems to predominate over the first one, thereby resulting in an increase of cmc with increase in temperature.

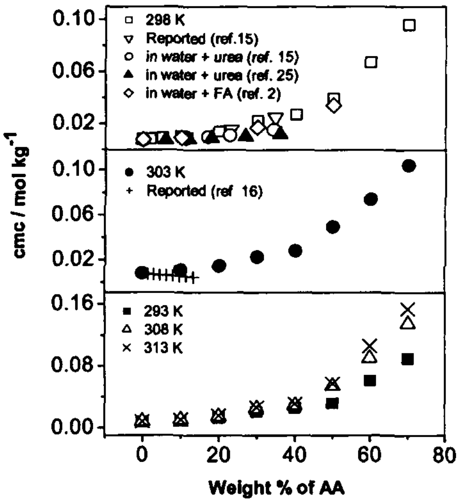

Fig. 3. Critical micelle concentrations of SDS in water + AA medium at different temperatures and in water + urea and water + FA media at 298 K as a function of % AA.

3.2.2. *Dependence on acetamide content*

The dependence of cmc on the amount of AA can be seen from Fig. 3. On addition of AA, cmc increases relatively slowly up to about 45% AA and above this the increase in cmc becomes sharp. This type of trend in the variation of cmc is common in mixed solvents containing water and nonaqueous solvent. By the addition of AA two opposing effects start operating. First, due to the addition of lipophilic nonelectrolyte the solvophobicity of the medium decreases and this increases the solubility and the cmc of the surfactant. Secondly, due to the increase in dielectric constant of the medium by the addition of AA the electrostatic repulsive interaction between the head groups of the ionic surfactant decreases and this, in turn, favors micellization. In the present system the first effect dominates and therefore accounts for the increase of cmc with increase in the amount of AA. In Fig. 3 we have compared the reported [15,16] cmc with the present values. The cmc values reported (the highest AA concentration was 34.6%) by Emerson and Holtzer [15] are in good agreement with the present values. On other hand, Akhter [16] reported a decrease in cmc with increase in the amount of AA (Fig. 3) in the concentration range from 0 to 13.4% AA, which is in contrary to what was observed by us as well as by Emerson and Holtzer [15]. To verify further the trend in the variation of cmc between 0 and 10% AA, we determined the cmc of SDS in water + AA media containing 0.3, 1.8, and 5.1% of AA at 25 °C by using the surface tension method and obtained the values of cmc as equal to 8.5, 8.7, and 9.5 mmol kg^{-1}, respectively. Thus, no decrease in cmc with increasing amount of AA was observed even in the range from 0 to 10% AA. It has been reported [24] that the conductance method may give sometimes erroneous cmc values, particularly when the medium is nonaqueous, because ion–ion interaction can also cause a break in the conductivity versus surfactant concentration. This may be a probable reason for the anomalous decrease in cmc with increase in AA content in the range of 0 to 13.4% reported by Akhter [16]. For comparison sake, we also plotted in Fig. 3 the reported [2,15,25] cmc values of SDS at 298 K in water + urea and water + formamide (FA) media, which are similar to the water + AA media. Since the cmc values of SDS in water + urea [15,25] and water + FA [2] media are relatively lower, water + AA media are less solvophobic than water + urea/FA media.

3.3. *Polarity*

The values of I_1/I_3 at the cmc of SDS as a function of AA amount in the solution are shown in Fig. 4. This value in water

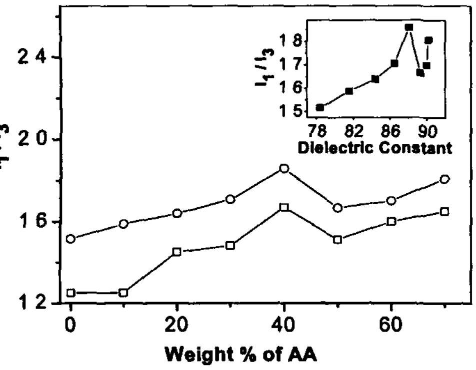

Fig. 4. Variation of I_1/I_3 of pyrene with AA concentration in the absence of SDS (open circles) and in the presence of SDS at cmc (open squares) in water + AA medium. Inset shows the variation of I_1/I_3 of pyrene in water + AA medium (solid squares) as a function of dielectric constant (data from Ref. [17]) of the medium.

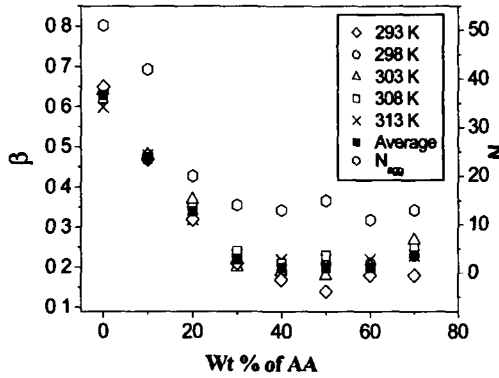

Fig. 5. Counterion binding constant and aggregation number (at 298 K) of SDS in water + AA medium.

is equal to 1.25 which is in agreement with the value reported by Aguiar et al. [23] and slightly high compared to the value 1.14 reported by Kalyanasundaram and Thomas [26]. The I_1/I_3 value reflects the polarity of the medium around pyrene and therefore from Fig. 4 the following inferences can be made: (i) Pyrene resides in the micelle core up to 10% AA since in this region addition of AA hardly affects the value of I_1/I_3, which is in conformity with the observation made by Kalyanasundaram and Thomas [26]. (ii) When the amount of AA exceeds 10%, pyrene moves from the core to the palisade layer, thereby accounting for the increase in I_1/I_3 between 10 and 20% AA and it resides at the palisade layer up to 30% AA since negligible change occurs in the value of I_1/I_3 between 20 and 30% AA. With increase in AA, the area per head group of the micelle increases due to decrease in the aggregation number (see Section 3.5) and this may cause water molecules along with some AA molecules to penetrate into the palisade layer of the micelle, thereby facilitating movement of pyrene from the core to the palisade layer. (iii) From 30 to 70% AA the trends in the variation of I_1/I_3 with AA concentration are similar in the absence and presence of SDS micelle, thereby indicating that pyrene is located at the surface of the micelle.

3.4. Counterion binding

The counterion binding constant, β, was calculated from the relation $\beta = 1 - S_2/S_1$, where S_1 and S_2 are the slopes of the conductivity versus concentration plot below and above the cmc, respectively and the values of β obtained thus are shown in Fig. 5. The dependence of β on temperature is found to be weak and not regular and therefore in every water + AA medium we determined an average value of β. With increase in AA content, β initially decreases and remains almost constant beyond 30% of AA. In media containing water + polar nonaqueous solvent it has been reported [2,8–12,14,18,19,27] that β either decreases or remains almost constant with increase in the content of the nonaqueous component. The decrease of β with decrease in water content of the medium irrespective of decrease or increase of dielectric constant of the medium indicates that β is controlled more by the solvophobicity of the medium. In water + AA medium both solvophobicity and polarity favor a decrease in β. An exceptional case of increase in β with decrease in the water content has also been reported for CPC in water + glycerol medium [27]. In the region of 30–70% AA, the surface area of the head group of the SDS micelles is large, causing AA molecules along with water molecules to penetrate into the palisade layer, which in turn poses a steric hindrance to the binding of counterion to the micelle. This may be the reason for having almost constant value for β above 30% AA.

A plot of S_1 and S_2 versus AA amount has also been shown in Fig. S4 (supplementary material). In water + alcohol systems the plots of S_1 and S_2 versus alcohol content were reported [28,29] to be linear and at a certain concentration of alcohol S_1 becomes equal to S_2. In water+AA medium such plots are not linear and S_1 does not tend to become equal to S_2. Therefore, the conductance method can be used for determining the cmc of ionic surfactants even at high AA concentration; however, the solubility problem must be overcome. In fact, in pure AA melt conductance method was successfully used to determine the cmc of ionic surfactants [30,31].

3.5. Aggregation number, size, and shape

The aggregation numbers, N_{agg}, of SDS in water and water + AA media were determined from the fluorescence quenching data by using

$$\ln[I_0/I_q] = [Q]N_{agg}/(c - \text{cmc}) \tag{2}$$

I_0 and I_q represent intensity of fluorescence emission of pyrene in the absence and presence of quencher CPC, respectively, and [Q] refers to quencher concentration. Plots of Eq. (2) are shown in Fig. S5 (supplementary material) and from the slopes of these plots the values of N_{agg} were determined, which are listed in Table S1 (supplementary material). The aggregation number of SDS decreases with the addition of AA (Fig. 5), which is similar to the trend observed for N_{agg} by the addition of nonaqueous solvent to water [2,9,10,12,18]. The value of N_{agg} appears to reach an almost constant value equal to 13±2 when the AA amount becomes ⩾30% (Fig. 5). Decrease in N_{agg} of SDS by the addition of AA to water irrespective of the fact that dielectric constant of the medium increases indicates that the size of the micelle is predominantly controlled by the solvophobicity.

The volume (v) in Å^3 and length (l) in Å of the hydrocarbon chain of SDS were calculated from the Tanford's [32] equations $v = 27.4 + 26.9n$ and $l = 1.5 + 1.265n$, where n is the number of carbon atoms in the hydrocarbon chain. The radius (r) of the micelle, the surface area per head group (a_0), and the packing parameter (P) were calculated from the expressions $r = [3vN_{agg}/(4\pi)]^{1/3}$, $a_0 = 3v/r$ and $P = v/(a_0 l)$, respectively. The values of r, a_0, and P are given in Table S1. The values of P indicate that the shape of the micelle in the water + AA media is spherical since the geometrical condition for spherical micelle is $P \leqslant 1/3$. The surface area per head group increases by the addition of AA to water and attains an almost constant value when the AA concentration becomes ⩾30%.

3.6. Free energy, entropy, and enthalpy terms

The standard free energy of micellization per mole of surfactant, ΔG^0_{mic}, was evaluated from the expression, $\Delta G^0_{\text{mic}} = (1 + \beta)RT \ln X_{\text{cmc}}$, where X_{cmc} is cmc in mole fraction unit, R is the gas constant, and T is the absolute temperature. The calculated values of ΔG^0_{mic} are presented in Fig. S6 (supplementary material) as a function of temperature. With increasing concentration of AA ΔG^0_{mic} becomes less favorable to micellization. It is interesting to note that the values of ΔG^0_{mic} of SDS at 25 °C in 10 and 30 wt% water + FA media reported by Moya et al. [2] are surprisingly in good agreement with the corresponding values for SDS in water + AA medium. Standard entropy (ΔS^0_{mic}) and enthalpy (ΔH^0_{mic}) changes of micellization per mole of monomer were determined using the relations $\Delta S^0_{\text{mic}} = -(\partial \Delta G^0_{\text{mic}}/\partial T)_P$ and $\Delta H^0_{\text{mic}} = \Delta G^0_{\text{mic}} + T\Delta S^0_{\text{mic}}$, respectively. The values of ΔS^0_{mic} and ΔH^0_{mic} obtained thus are always approximate and they are found to be different from the calorimetrically determined values [33]. The computed values of ΔG^0_{mic}, ΔS^0_{mic}, and ΔH^0_{mic} are listed in Tables S2–S4 (supplementary material). From the values of ΔH^0_{mic} and ΔS^0_{mic} at 298 K it is clear that micellization becomes less favorable with increasing AA amount mainly due to decrease in entropy change, which in turn is due to decrease in solvophobicity. ΔS^0_{mic} was found to become even negative in 50% AA at temperatures $\leqslant$303 K and in 60 and 70% AA at temperatures $\geqslant$303 K. The type of sign reversal of ΔS^0_{mic} found in 60 and 70% AA was reported in several other systems [33–38] and is attributed to the decrease in the ordering of solvent molecules along the hydrocarbon tail and also to the decrease in the solvation of the hydrophilic head group as the temperature increases. However, the type of sign reversal observed in 50% AA has not been reported to our knowledge in any other system. In view of the fact that the values of ΔS^0_{mic} and ΔH^0_{mic} are approximate, further investigation is required to establish the type of trend observed for ΔS^0_{mic} in 50% AA. Despite such unexpected entropy–temperature dependence in 50% AA, a very good enthalpy–entropy compensation has been observed for micellization of SDS in water + AA medium at all concentrations of AA as shown in Fig. S7 (supplementary material). This enthalpy–entropy compensation relation is expressed as $\Delta H^0_{\text{mic}} = \Delta H^*_{\text{mic}} + T_c\Delta S^0_{\text{mic}}$. For SDS values of the slope T_c, known as compensation temperature, are found to be 308 K in water and 302 ± 2 K in water + AA media. These values of T_c are comparable with the value 304 ± 3 K reported [39] for sodium alkyl sulfates in aqueous medium. The intercept ΔH^*_{mic}, whose values are shown in Table S4, has a very good linear relation with ΔG^0_{mic} and is given by the expression $\Delta H^*_{\text{mic}} = 0.93 + 1.03\Delta G^0_{\text{mic}}$, where values at 298 K are used for ΔG^0_{mic}. Thus ΔH^*_{mic} indirectly reflects the free energy change of micellization in conformity with the significance attached to this parameter [39].

An attempt has been made to rationalize solvophobic effects in terms of the bulk phase properties by correlating ΔG^0_{mic} with dielectric constant (ε) and Gordon parameter. The Gordon parameter is defined as $\gamma/V^{1/3}$, where γ and V represent surface tension and molar volume of the solvent medium, respectively. V was calculated from the measured density values of water + AA system at 298 K. The Gordon parameter has values higher than the reported [40] limiting value 1.1 J m^{-3} needed for initiating micellization. ΔG^0_{mic} appears to vary almost linearly with Gordon parameter and $1/\varepsilon$ (Fig. 6) similar to the observation made by Moya et al. [2] in water + FA medium.

3.7. Adsorption behavior

Surface excess values of SDS at the air–solvent interface, Γ, were calculated from the surface tension data lying below cmc by using the expression, $\Gamma = -[1/(2RT)][d\gamma/d\ln c]$. The slope, $d\gamma/d\ln c$, was determined by fitting γ versus $\ln c$ data below cmc to a second order polynomial. The adsorption isotherms at 25 °C are shown in Fig. S8 (supplementary material) and the surface excess of SDS decreases with increase in the amount of AA, which may be explained as due to decrease in the solvophobicity of the medium on replacing water by AA. From Fig. S8 it can be observed that surface excess attains its maximum value, $\Gamma_{\max}$, before reaching cmc and the values of $\Gamma_{\max}$ at 25 °C are shown in Fig. 7. The value of $\Gamma_{\max}$ for SDS in water is in agreement with the reported [41] value. The adsorption decreases sharply by adding AA and beyond 30% AA $\Gamma_{\max}$ has negligible dependence on further addition of AA (Fig. 7). Beyond 30% AA there is almost no variation in $\Gamma_{\max}$, which is similar to the observation made recently by Eastoe and co-workers [3,7] about $\Gamma_{\max}$ of nonionic surfactants in aqueous EG medium. The SDS concentration, c_a, at which surface excess attains maximum value, is linearly dependent on cmc (Fig. 7) according to the relation $c_a\ (\text{mol kg}^{-1}) = 0.9045\text{cmc} - 0.0039$. Such type of relation between c_a and cmc was reported [42] for SDS in water in the presence of NaCl. Thus, micellization does not occur

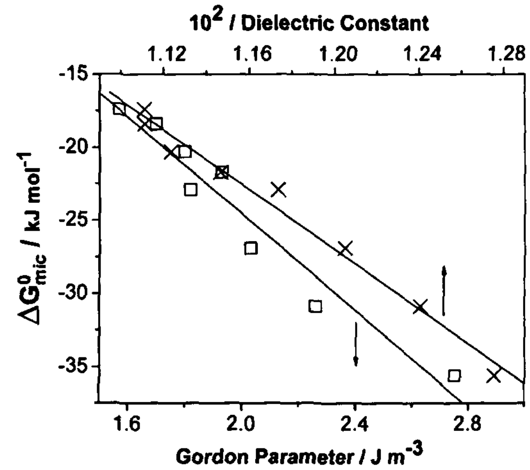

Fig. 6. Standard free energy of micellization of SDS in water + AA medium at 25 °C as functions of Gordon parameter and reciprocal of dielectric constant of the medium.

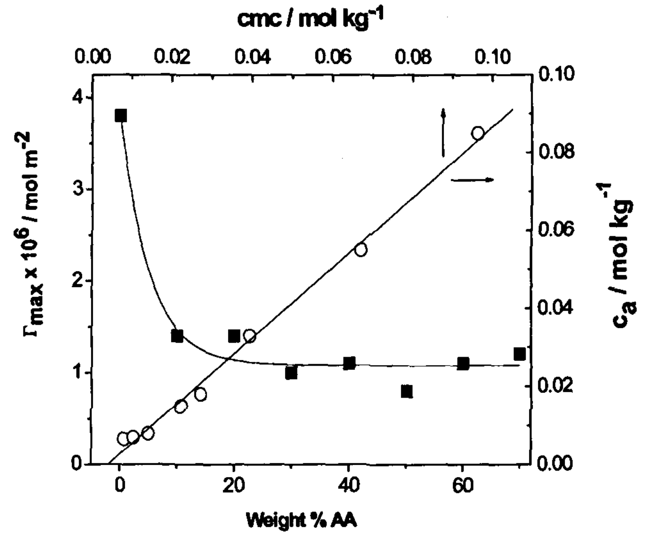

Fig. 7. Variation of maximum surface excess of SDS in water + AA medium as a function of AA concentration (solid squares) and of SDS concentration (c_a) at which surface excess becomes maximum with cmc of SDS (open circles) at 25 °C.

immediately after the attainment of saturation in adsorption at the air–solution interface.

The standard free energy of adsorption, ΔG^0_{ad} was calculated using the expression, $\Delta G^0_{ad} = \Delta G^0_{mic} - \pi_{cmc}/\Gamma_{max}$, where π_{cmc} is the surface pressure at cmc equal to $\gamma_{solvent} - \gamma_{cmc}$ [43]. The values of ΔG^0_{ad} are given in Table S2. ΔG^0_{ad} is about 10 kJ less than ΔG^0_{mic} and hence in a surfactant solution adsorption always precedes aggregation. Similar to ΔG^0_{mic}, the value of ΔG^0_{ad} increases by the addition of AA accounting thereby for less adsorption in water + AA medium

4. Summary

This study confirms that cmc of SDS in aqueous medium increases with increase in AA amount up to 70% and no decrease in cmc was observed in the region of 0 to 13.4% AA in contrary to the report made by Akhter [16]. A cmc minimum observed at 25 °C for SDS in water disappears on addition of AA and instead cmc monotonically increases with increase in temperature from 20 to 40 °C. The conductance method is shown to be applicable to study the micellization of ionic surfactants in water + AA medium even at high amounts of AA unlike the situation in water + alcohol medium.

The limiting surface tension at the cmc shows no dependence on the amount of AA, which is similar to the observation made by Eastoe and co-workers [3] in the case of nonionic surfactants in water + EG media. This is a notable observation in view of the fact that the initial values of surface tension of the solvent media are different and it envisages a probable correlation between the ratio of the initial to the limiting surface tension and the solvophobicity of a medium toward a particular surfactant. This may provide a new scale to express solvophobicity.

Standard entropy of micellization is found to be negative in 50% AA at temperatures ⩽30 °C and in 60 and 70% AA at temperatures ⩾30 °C. The type of sign reversal of standard entropy of micellization in 50% AA is not in accordance with the usual trend and further study is required to establish this new observation. The intercept of the enthalpy–entropy compensation relation is shown to be a linear function of the standard free energy change of micellization. Standard free energy of micellization shows a fairly good linear relation with reciprocal of dielectric constant and Gordon parameter of the water + AA medium.

Counterion binding constant, surface excess, and aggregation number of SDS decrease with increasing amount of AA up to 30% and remain almost constant thereafter. Such changes taking place in the different parameters at around 30% AA can be correlated to the destruction of the ice-like structure of water and formation of mixed water–AA structures which were reported [21] to occur above 30% AA. This type of approach of correlating adsorption and aggregation behaviors of a surfactant with the structure of mixed solvent medium would help in obtaining a better perception of the solvophobicity term. Furthermore, the empirical relations proposed by Aguiar et al. [23] for ionic surfactants based on the analysis of I_1/I_3 data are found to be applicable in the present system of study below 20% AA only.

It has been pointed out that micellization does not occur immediately after saturation in adsorption at the air–solution interface. Not much is known about the significance of the concentration gap between cmc and the concentration where surface excess attains a maximum value and the mechanism of surface tension reduction *in the region of this concentration gap. Menger and co-workers* [44] have also highlighted this aspect and further study on this area would throw more light on the linkage between adsorption and aggregation phenomena

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Supplementary material

The online version of this article contains additional supplementary material.

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