

A STUDY ON pH AND SOLUBILITY OF AQUEOUS TETRAALKYLAMMONIUM HALIDES

ANIL KUMAR, TARUN AND NEETU SINGH

See end of article for authors' affiliations

Correspondence to :
ANIL KUMAR
Department of Chemistry,
D.A.V. (P.G.) College,
MUZAFFARNAGAR (U.P)
INDIA

Accepted : October, 2007

ABSTRACT

Present study embodies pH and solubility of aqueous solutions of tetramethyl and tetraethylammonium chlorides/ bromides/ iodides (abbreviated as : TMAC/ TMAB/ TMAI and TEAC/ TEAB/ TEAI, respectively). pH of the aqueous solutions has been measured at $40 \pm 0.05^\circ\text{C}$, whereas solubility of the aqueous salt solutions has been studied at $30^\circ\text{-}50^\circ\text{C}$. pH measurements are employed to evaluate hydrolysis constant, K_H , ionisation constant of base, K_b and degree of hydrolysis, X . The variation of these parameters as a function of salt concentration suggests that the salts hydrolyse appreciably at lower concentrations, i.e., pre-micellar region. The hydrolysis is subdued as the concentration of compounds increases and becomes almost negligible in the vicinity of critical micelle concentration, cmc.

The solubility of these compounds is found to increase with increasing temperature and varies as $\text{TMAC} > \text{TMAB} > \text{TMAI}$; and $\text{TEAC} > \text{TEAB} > \text{TEAI}$. The logarithm of solubility vs. inverse of absolute temperature ($\log S$ vs $1/T$) plots show an intersection of two straight lines at 45°C and 40°C (Krafft points) for tetra- methyl and tetraethylammonium halides, respectively, above which micellization begins. The apparent heat of solution, ΔH_{sol} and entropy of solution, ΔS_{sol} are computed.

Key words : Tetraalkylammonium halides, pH, Solubility, apparent heat of solution and entropy of solution.

The pH of sodium laurate is determined by Eagland and Franks¹ to ascertain the cmc. The pH is also employed² to find out the cmc of magnesium soap in water and methanol. Solubility behaviour of different heavy metal soaps has been explored³⁻¹⁰. Solubility and surface spectroscopy of zinc precipitates on calcite has been studied by Zachara *et al.*¹¹.

Present work on pH and solubility of aqueous tetraalkylammonium halides has been initiated with a view to study different aspects of their solution behaviour.

Experimental :

Tetraalkylammonium halides (TMAC/ TMAB/ TMAI and TEAC/ TEAB/ TEAI) were obtained from Sisco, Bombay (India). The compounds were recrystallized from ethanol-acetone mixture and dried under vacuum before use. All solutions were prepared by twice redistilling good quality distilled water over alkaline KMnO_4 .

The pH values of salt solutions were determined with a pH-meter (Systronics, pH-meter 324) using combined glass and calomel electrodes in a thermostatically

controlled bath at $40^\circ \pm 0.05^\circ\text{C}$. The asymmetric potential was adjusted by buffer solution of pH 9.2 obtained from B.D.H. The accuracy of the results was further checked by determining the pH of the known solutions. The solubility of salt solutions was determined by a gravimetric method. The saturated solutions were prepared by vigorous shaking of the excess salt in water in a 25 mL stoppered wide mouth bottle kept in a thermostatic bath ($\pm 0.05^\circ\text{C}$) at different temperatures. The clear supernatant saturated solution was taken out when equilibrium is attained.

RESULTS AND DISCUSSION

pH Measurements :

The pH of the aqueous tetraalkylammonium halide salt solutions are recorded in tables 1 and 2. The curves (Fig. 1,2) of pH vs. concentration C show a rapid fall in pH upto cmc (Table 3) for respective compounds, slowing down afterwards and finally increasing at still higher concentrations. pH vs $\log C$ (Fig 3,4) also indicate similar behaviour.

Tetramethyl and tetraethylammonium halides can well be represented by their general formulae as $(\text{CH}_3)_4\text{NX}$ and $(\text{C}_2\text{H}_5)_4\text{NX}$, respectively, where X is a halogen anion ($\text{Cl}^-/ \text{Br}^-/ \text{I}^-$). The hydrolysis of these compounds can be shown as :