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Adsorption of isomers of aminobenzoic acid at the mercury/solution interface

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The adsorption of ortho, meta and para isomers of aminobenzoic acid at Hg/1N HCl interface has been studied using capillary electrometer. All the three isomers are found to adsorb on both sides of electrocapillary curve. Adsorption is found to be more for the ortho isomer, followed by meta and para in the decreasing order. Thermodyanamic parameters like charge on the metal surface (q^M) and surface excess of organic molecule adsorbed (Γorg) have been evaluated. The adsorption data for the isomers have been analysed thoroughly to choose the best fit of isotherm for each isomer and all the three isomers are found to obey Temkin's adsorption isotherm. Free energies of adsorption for constant values of charge have been obtained for the isomers.

Key words: o, m, p amino benzoic acids, adsorption capillary electrometer

INTRODUCTION

The phenomenon of adsorption can be regarded as the competition between water molecules and organic molecules for sites on the metal surface. Substituent groups present on the organic molecules influence the extent of adsorption. It is of interest to see, whether the position of the substituent group in the molecule, i.e. o–, m– or p– has any effect on the adsorption characteristics. Attempts have already been made to study the adsorption of isomers of toluidine on mercury from KI solution [1] and also the adsorption of isomers of hydroxy benzoic acid on mercury from Na_2SO_4 solution [2]. A few workers have carried out the adsorption of aminobenzoic acid individually, but no attempt has been made to compare the adsorption characteristics of the three different isomers. In the present study, the adsorption behaviour of isomers of aminobenzoic acid 1N HCl has been carried out and results are reported.

EXPERIMENTAL

Lippmann's capillary electrometer, experimental cell and the electrical accessories used for the interfacial tension measurement are the same as that described elsewhere [3]. All the potentials were measured with reference to 1N calomel electrode. Measurements were carried out at 298 ± 1K.

RESULTS AND DISCUSSION

A close study of electrocapillary curves for isomers of aminobenzoic acid reveals the fact that all the isomers adsorb on both sides of electrocapillary curve and there is no desorption at the extremes of the curve. It is also found that adsorption is more for ortho isomer followed by meta and para in the decreasing order. This can be due to the ease of formation of NH_3^+ ion for ortho isomer by resonance.

The adsorption on the positive side may be due to the interaction of π- electrons of benzene ring with positively charged metal surface [4]. The adsorption of the negatively charged surface may be due to the formation of onium ions which adsorb on negatively charged surface. $q^M - E$ curves for the three isomers intersect at positive charges of +1 to $+2\mu C.cm^{-2}$. So maximum adsorption of these isomers occur around these charges, as in the case of other aromatic compounds.

Surface excess vs q^M curves for these isomers also show maximum value of surface excess around +1 to $+2\mu C.cm^{-2}$. Values of surface excess for different values of charge are found to be more for ortho isomer, followed by meta and para in the decreasing order.Similar observations have been reported earlier [2].

Fractional surface coverage θ for different values of q^M have been evaluated for isomers using the equation $\Gamma/\Gamma_m = \theta$, where is Γ_m the maximum value of surface excess. The adsorption data obtained has been analysed both graphically and also using a specially formulated computer programme [5]. The isotherm has been graphically tested by plotting θ against log C for different values of q^M. A family of straight lines is obtained, thereby proving that the adsorption of all the isomers obey

Temkin's adsorption isotherms. Considering the computer programme, the inputs are C and Γ at different values of q^M and the output data are slope, intercept and correlation coefficient. Temkin's isotherm which gives the maximum value of correlation coefficient has been chosen as the best fit among the isotherms used for study.

Free energies of adsorption evaluated from intercept values of isotherm plots for different values of q^M, clearly bring out more adsorption on positively charged surface and less adsorption on the negatively charged surface.

CONCLUSION

Among the isomers, -ortho shows more adsorption than -m and -p and their adsorption obeys Temkin's isotherm.

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