

Short Communication

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SALT EFFECT ON THE SEPARATION OF XYLENE ISOMERS

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The salt effect in terms of the electrostatic energy between an ion and dipole interaction is given by the expression (1)

$$E_{e.1} = - \frac{q \mu \cos \theta}{D r^2} \left(\frac{\lambda}{\gamma} \right)^{3/8} \dots \dots \dots (1)$$

By assuming the dipole of the solvent μ being oriented along the line of the approach with the ion and the length of the dipole l , being smaller than the distance between the ion and dipole l , the expression [1] reduces to ;

$$E_{e.1} = - q \mu / D r^2 \dots \dots \dots (2)$$

$$E_{e.1} = - K \mu \dots \dots \dots (3)$$

The application of salt effect in the separation of a xylene isomer from isomeric xylene mixtures is presented in this study.

All data measurements were made using a modified Othmer Still [2], provided with a total reflux condenser. In the *para-meta* xylene mixture, (Table 1) salt ions appear to associate with the polar *meta* isomer, $\mu = 0.33$ D [3], thus

TABLE 1. THE SALT EFFECT ON THE SEPARATION OF ISOMERIC XYLENE MIXTURE.

Electrolyte	Ionic radius	Boiling point	Solubility p-m xylene	Para-meta mixture		Ortho-meta mixture
				(a) p-m xylene	(b) vapour composition p-xylene	(c) vapour composition p-xylene
	A°	°C	g/100 ml	%	%	%
—	—	139	—	50.3	51.5	—
LiCl	0.64	139	—	58.0	60.5	—
NaCl	0.95	139	0.006	60.5	62.5	—
ZnCl ₂	0.74	139	0.099	65.5	71.0	—
PbCl ₂	1.21	139	0.0065	60.5	60.0	—
AlCl ₃	0.5	139	—	53.0	60.0	—
BiCl ₃	1.20	139	0.0036	56.0	62.5	—
CH ₃ COOK	1.33	139	0.0075	63.0	60.5	—
CH ₃ COONa	0.95	139	—	60.5	62.0	—

(a) Solubility at 373 K. (b) *Para*-xylene:*meta*-xylene 1:1 (v/v); (c) *ortho*-xylene:*meta*-xylene 1:1 (v/v).

reducing its volatility in relation to *para* isomer ($\mu = 0$) which is salted out from its mixture. This behaviour of salt effect is evident in all electrolyte systems. Similar results for preferential ion association with a more polar component (*o*-xylene; $\mu = 0.51$ D) were observed in *ortho-meta* xylene system. Since

the salt effect is proportional to the dipole moment according to equation (3), the dipole moment of an isomer can thus be used for predicting the isomer which can be salted out from an isomeric mixture of xylenes. In general, the salt effect seems to depend upon the solubility of the salt in the liquid phase. Similar results of the salt effect on the enhancement of relative volatility of organo-aqueous mixtures as a function of the solubility of salts have been reported in the literature [3-11].

It appears (Fig. 1) that an ion of 0.8A° radius is most effective in salting out an isomer from a mixture of xylenes. Moreover the extent of xylene separation (Fig. 2 and 3) is found to be a function of (μ / r^2) as has been predicted in equation 2. The effect of smaller ions i.e. Li⁺=0.64 A° and Al³⁺=0.5A° on xylene separation is however unexpected as a smaller ion is expected to exert a stronger attractive force for

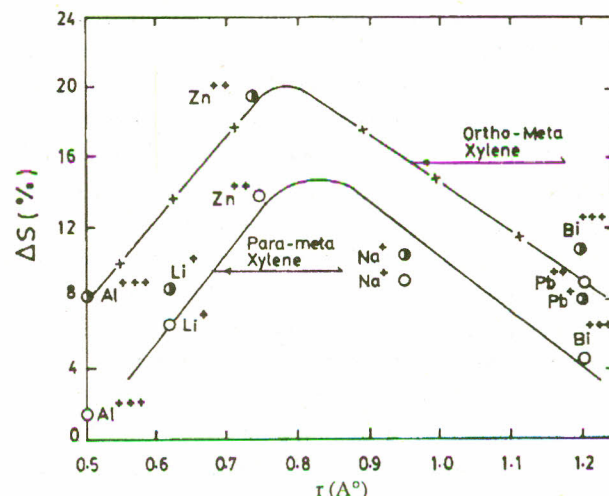


Fig. 1. Variations in xylene separation (ΔS) with ionic crystallographic radii.

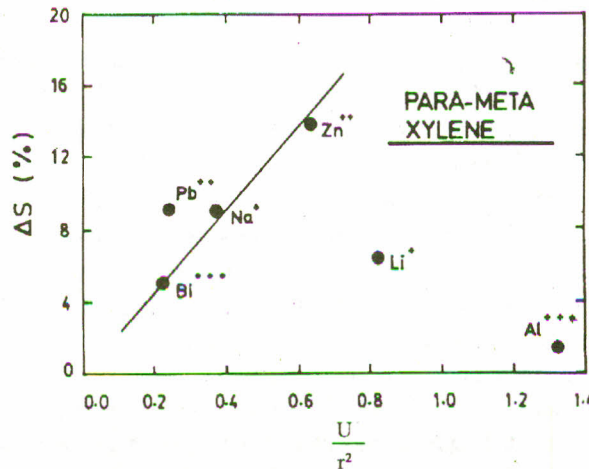


Fig. 2. Separation of *para*-xylene from a *p-m* xylene mixture as a function U/r^2 ; ($v=0.3$ for *m*-xylene)

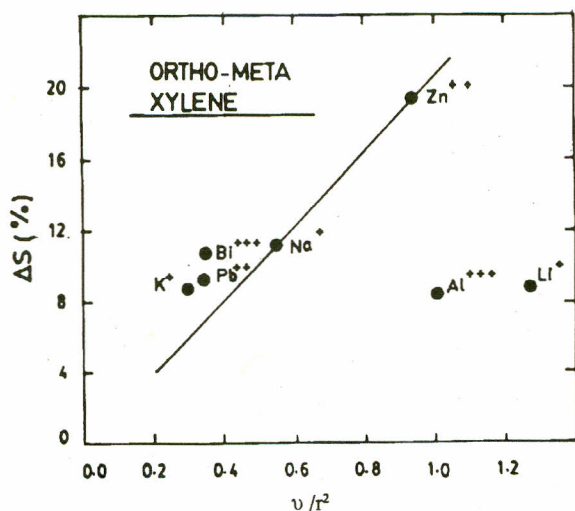


Fig. 3. Separation of *m*-xylene from a *o-m* xylene mixture as a function of v/r^2 ; ($v=0.51$ for *o*-xylene).

molecular association in solution.

Key words: Salt effect, Xylene isomers, Extractive distillation.

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