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A Process of Solvent Extraction: If Distribution Ratio Exists for Miscible Solvents

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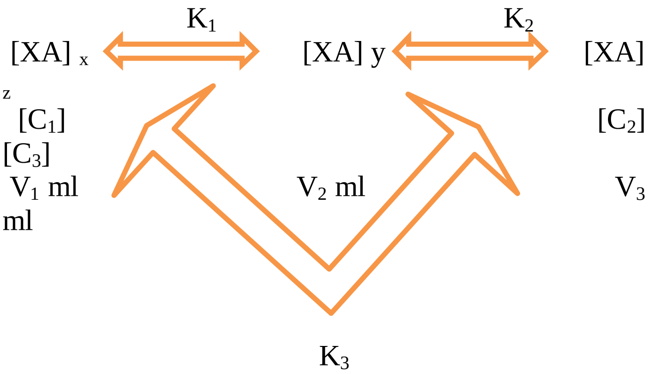
ABSTRACT: It is well-known that the Nernst's Distribution Law is applicable only when a solute does not associate or dissociate in a immiscible solvents, but if the distribution ratio exists for miscible solvents the Nernst's distribution law may be valid, if it so the process of an extraction of solute from miscible solvents also possible. This paper gives nth an extraction equation of solutes from miscible solvents.

Keywords: Miscible solvents, Nernst's Distribution law, Solvent extraction.

INTRODUCTION: Is there possible to exist distribution coefficient? (R. Sanjeev *et. al*) If so, the possibility of a process of solute extracted from miscible solvents. Considering XA is the solute distributes itself in x (non-polar), y (polar) and z (non-polar) solvents.



According to the law of mass action, the Distribution ratio for this system as,

$$K_1 = \frac{[XA]y}{[XA]x}$$

$$K_2 = \frac{[XA]z}{[XA]y}$$

The distribution ratio K_1 & K_2 for a solute which distributes in two non-miscible solvents x and y respectively. The distribution ratio K_3 can be calculated with the help of K_1 & K_2.

$$K_3 = K_1 \text{ X } K_2$$

$$K_3 = \frac{[XA]y}{[XA]x} \text{ X } \frac{[XA]z}{[XA]y}$$

$$K_3 = \frac{[XA]z}{[XA]x}$$

The process extraction of solute from the miscible solvents x & z. It is significant to know how much solvent. How many treatments are required to accomplish the desired degree of separation of the solute, if the distribution ratio exists for miscible solvents?

THEORETICAL METHOD: Consider the solution containing W g of the solute in V_2 ml of the solution. This solution is shaken with V_1 ml and V_3 ml of pure miscible solvents (x & z) until the distribution equilibrium is attained.

$(W-W_1)$ gm & $(W-W_2)$ gm of the solute extracted after the first extraction (or present in V_1 ml and V_3 ml solvents respectively). W_1 gm & W_2 gm of the solute un-extracted (or present in the original solution). The concentration of the solute in x, y & z as,

$$C_1 = \frac{[W-W1]}{[V1]} ,$$

$$C_2 = \frac{[W1]}{[V2]} \text{ --------- (In terms of } K_1\text{),}$$

$$C_2 = \frac{[W2]}{[V2]} \text{ --------- (In terms of } K_2\text{),}$$

$$C_3 = \frac{[W-W2]}{[V3]}$$

Where, C_1 = Total concentration of solute in solvent x.
C_2 = Total concentration of solute in solvent y.
C_3 = Total concentration of solute in solvent z.

The solute does not associate or dissociate in the solvents, the Nernst's Distribution equation as,

a).

$$K_1 = \frac{[C2]}{[C1]}$$

$$K_1 = \frac{W1}{V2} \text{ X } \frac{V1}{[W-W1]} ,$$

$$K_1\ x\ V_2\ x\ [W-W_1] = W_1\ x\ V_1$$
$$(K_1\ x\ V_2\ x\ W) - (K_1\ x\ V_2\ x\ W_1) = (W_1\ x\ V_1)$$
$$(K_1\ x\ V_2\ x\ W) = (W_1\ x\ V_1) + (K_1\ x\ V_2\ x\ W_1)$$
$$(K_1\ x\ V_2\ x\ W) = W_1\ (V_1 + K_1V_2)$$
$$W_1 = W\ \{\frac{K1\ V2}{(K1V2+V1)}\}\ \text{----------}\ (1)$$

b).

$$K_2 = \frac{[C3]}{[C2]}$$
$$K_1 = \frac{[W-W2]}{V3}\ X\ \frac{V2}{W2}\ ,$$
$$K_2\ x\ V_3\ x\ W_2 = (W-W_2)\ x\ V_2$$
$$(K_2\ x\ V_3\ x\ W_2) = (W\ x\ V_2) - (W_2\ x\ V_2)$$
$$(K_2\ x\ V_3\ x\ W_2) + (W_2\ x\ V_2) = (W\ x\ V_2)$$
$$W_2\ [K_2\ V_3 + V_2] = V_2\ x\ W$$
$$W_2 = W\ \{\frac{V2}{(K2V3+V2)}\}\ \text{-----------}\ (2)$$

From the equation (1) & (2), W^1 gm of the solute un-extracted after first extraction as,

$$W^1 = W_1 + W_2$$
$$W^1 = W\ \{\frac{K1\ V2}{(K1V2+V1)}\} + W\ \{\frac{V2}{(K2V3+V2)}\}$$
$$W^1 = W\ \{\frac{K1\ V2}{(K1V2+V1)} + \frac{V2}{(K2V3+V2)}\}$$

It is evident that this result can generalize for nth extraction of the solute from the miscible solvent. Hence, after nth extraction of the solute from the miscible solvent. W_n^1 gm of solute remaining in the solution and it is formulated as,

$$W_n^1 = W\ \{\frac{K1\ V2}{(K1V2+V1)} + \frac{V2}{(K2V3+V2)}\}^n$$

The weight of solute extracted from the solution is written as,

$$W\text{-}W_n^1 = W\text{-}W\ \{\frac{K1\ V2}{(K1V2+V1)} + \frac{V2}{(K2V3+V2)}\}^n$$
$$W\text{-}W_n^1 = W\ [1-\ \{\frac{K1\ V2}{(K1V2+V1)} + \frac{V2}{(K2V3+V2)}\}^n]\ \text{-------}\ (3)$$

$W\text{-}W_n^1$ (3) equation may be possible for used weight of solute extracted from the miscible solvents

CONCLUSION: This is the sophisticated method for extraction of a solute from a solution by using two miscible solvents, but if it possible only when the distribution ratio exists for a miscible solvents.

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