

APPLICATION OF SEMI PERMEABLE MEMBRANE FOR PURIFICATION OF POLLUTED WATER

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INTRODUCTION

As its name implies, waste water is grossly undervalued as a potential resource. All too frequently wastewater is ignored and left to drain away which is the main cause of river water pollution. Smart and sustained investment in wastewater management will generate multiple dividends in society, the economy and the environment. It can involve both private and public sectors, fulfilling public needs as well as social equity and enhance food security. They should be designed to (I) reduce the volume and extent of water pollution through preventative practices (II) capture water once it has been polluted, (III) treat polluted water using appropriate technologies and techniques for return to the environment, (IV) where feasible safely reuse and recycle wastewater thereby conserving water and nutrients and (V) provided a platform for the development of new and innovative technologies and management practices. If investments such as these are scaled up appropriately they will generate social, economic and environmental dividends far exceeding original investments for years to come. Membrane technologies are the most common technology of desalination. The synthetic membranes are the most widely used membranes in the desalination process.

Environment belongs to all and is thus important for all. Whatever be the occupation or age of person, he or she will be affected by environment and will also affect the environment by his or her deeds. In order to make the people aware about those aspects of environment with which they are so intimately associated, it is very important to make everyone environmentally educated. Due to absence of defined strategies it becomes difficult to prevent water pollution from non-point sources. For controlling water pollution from point sources, treatment of waste water is essential before being discharged. The river water polluted by industrial or municipal discharge at one point would seriously affect the downstream aquatic life¹.

In order to understand the mechanism of transport through the artificial membranes, a number of studies have been made of artificial membranes²⁻⁵. In this paper membrane

potentials developed across strontium phosphate parchment supported membrane using various 1:1 electrolytes are reported. The thermodynamically effective fixed charge density, which is an important parameter governing membrane phenomena has been evaluated by the developed fixed charge theories of T.M.S.^{6,7}, Kobatake et. al.⁸⁻⁹ and Tasaka¹⁰.

METHODOLOGY

The experimental membrane was prepared by depositing strontium phosphate precipitate with in the matrix of parchment paper.^{11,12} The electrical potential were measured by setting an electrochemical cell of the type :-



dipped in a water thermostat maintained at 25°C. Membrane potential were measured by maintaining a 10-fold difference in the electrolyte concentrations.

RESULTS AND DISCUSSION

The membrane potential data obtained with strontium phosphate parchment supported membrane using various 1:1 electrolyte solutions are plotted as a function $\log (C_1 + C_2)/2$ with the ratio $v = C_2/C_1$, fixed at 10 and are shown in fig-1.

The membrane potential (ΔE_m) in millivolts according to TMS theory^{6,7} applicable to a highly idealized system, is given by the following equation, at 25°C.

$$\Delta E_m = 59.46 \left[\log \frac{C_1 \sqrt{(4C_2^2 + \bar{X}^2)} + \bar{X}}{C_2 \sqrt{(4C_1^2 + \bar{X}^2)} + \bar{X}} + \bar{U} \log \frac{\sqrt{(4C_1^2 + \bar{X}^2)} + \bar{X}\bar{U}}{\sqrt{(4C_2^2 + \bar{X}^2)} + \bar{X}\bar{U}} \right] \quad \text{..... (1)}$$

$$\text{where } \bar{U} = \frac{\bar{u} - \bar{v}}{\bar{u} + \bar{v}} \quad \text{..... (2)}$$

\bar{u} and \bar{v} are the mobilities of the cation and the anion respectively, in the membrane phase (bars refer the parameters in the membrane phase); \bar{X} is the effective fixed charge on the membrane expressed in equivalent/litre of solution.

Kobatake et. al.⁸⁻⁹ on the basis thermodynamics of irreversible processes derived the following equation for the membrane potential (ΔE_m) which arises between two solutions of 1:1 electrolyte of different concentration C_1 and C_2 that are separated by a negatively ionizable membrane.

$$\Delta E_m = - \left(\frac{RT}{F} \right) \left[\frac{1}{\beta} \ln \frac{C_2}{C_1} - \left(1 + \frac{1}{\beta} - 2\alpha \right) \times \ln \left(\frac{C_2 + \alpha\beta\theta}{C_1 + \alpha\beta\theta} \right) \right] \quad \text{..... (3)}$$

When the salt concentration C_2 becomes high, equ. (3) becomes.

$$\frac{1}{t_{app}^-} = \frac{1}{1 - \alpha} + \frac{(1 + \beta - 2\alpha\beta)(v - 1)\alpha}{2(1 - \alpha)^2 \ln v} \frac{\theta}{C_2} \quad \text{..... (4)}$$

where t_{app}^- is the apparent transference number of coins in a negatively charged membrane defined.

They also developed another method to evaluate the fixed charge density which is based on the permselectivity of membrane. The value of permselectivity (P_s) were calculated with the help of following equation.

$$P_s = \frac{1}{(4\xi^2 + 1)^{1/2}} \equiv \frac{(1 - t_{app}^- - \alpha)}{\alpha - (2\alpha - 1)(1 - t_{app}^-)} \quad \dots\dots (5)$$

where $\xi = C / \bar{X}$ being the average concentration of bathing electrolyte solution.

When C and \bar{X} are of the same magnitude, ξ becomes equal to 1 and P_s to 0.448 according to the equation (5). The magnitude of concentration corresponding the value of P_s can be taken as a measure of \bar{X} .

The value of P_s evaluated by substituting the value of t_{app}^- and α , have been plotted as a function of $\log (C_1 + C_2)/2$ shown in Fig. 2. This value of concentration is equal to the fixed charge density. The concentration corresponding to 0.448. P_s has been taken as a measure of the magnitude of \bar{X} . The value of \bar{X} for various electrolyte, are given in table. Further, the plots of P_s vs $(1 + 4\xi^2)^{-1/2}$ are drawn for membrane with electrolyte and shown in Fig 3. It is evident from the graph that the line nearly pass through the origin with unit slope thereby confirming the applicability of Kamo equation (4) to these membranes.

Another expression, useful for the evaluation of (ΔE_m) has been derived by Tasaka et. al.¹⁰ as :

$$-\Delta E_m = \frac{RT}{F} \left(\frac{\nu}{\nu - 1} \right) \left(\frac{\bar{X}}{2} \right) \frac{1}{C_2} \quad \dots\dots (7)$$

which predicts a linear relationship between ΔE_m and $1/C_2$ and allow the evaluation of \bar{X} from the slope of straight line plot fig. 4 given in table 1.

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Table 1: COMPARISON OF CHARGE DENSITIES BY DIFFERENT METHODS FOR VARIOUS MEMBRANE ELECTROLYTES SYSTEM

Membrane	Electrolytes	TMS		Kobatake	Tasaka (equ 6)
		\bar{u} / \bar{v}	\bar{X}	Ps Vs log $(C_1+C_2)/2 \bar{X}$	\bar{X}
Strontium Phosphate	KCl	1.8	0.0063	0.0158	0.0190
	NaCl	1.2	0.0068	0.0794	0.0028
	LiCl	1.4	0.0199	0.0630	0.0220
	NH ₄ Cl	1.2	0.0316	0.0316	0.0023