

分离工程

反渗透、纳滤过程的物理化学研究 (II) 多孔荷电膜的溶质分离规律

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摘要

在多孔膜溶质的脱除率方程和溶液渗透通量方程的基础上由溶液电中性条件导出了荷电膜的单价电解质、中性分子混合溶液体系离子的脱除率方程, 中性分子的脱除率方程, 溶液渗透体积通量方程和离子、中性分子的浓缩比表达式。由方程的函数性质讨论了荷电膜的单价电解质、中性分子混合溶液的溶质组分脱除率和溶液渗透体积通量随离子浓度、pH值的变化规律。预测了盐和中性分子的脱除率和溶液渗透体积通量随浓度变化曲线出现极大和极小值的现象, 由此得出了下列结果: 随pH值的增加, 单价电解质溶液的阳离子、阴离子和氢离子的脱除率变化顺序为由 $R_{M^+} > R_{X^-} > R_{H^+}$ 变化到 $R_{M^+} = R_{X^-} > R_{H^+}$ 再变化到 $R_{X^-} > R_{M^+} > R_{H^+}$, 离子脱除率变化曲线将出现极大和极小值; 有机酸的总脱除率表达式阐明了文献中的可电离有机分子与pH值的关系式中参数的物理意义, 解释了该关系式的对氨基苯甲酸水溶液的脱除率随pH值变化的拟合曲线高于脱除率实验值的原因, 解释了对氨基苯甲酸的甲醇溶液的溶质脱除规律; 离子的浓缩比依赖于料液中离子组成和离子所对应盐的浓缩比。

关键词 [反渗透](#) [纳滤](#) [吸附-扩散](#) [荷电膜](#)

分类号

Physical chemistry study on RO and NF process (II) Solute separation on porous charged membrane

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Abstract

The equations of rejection of monovalent electrolyte ion, rejection of neutral molecule and solution permeation flux for multi-solute solution on porous charged membrane, and then expression of molecule concentration ratio were derived based on the equations of solute rejection and solution permeation flux on porous membrane under the zero charged condition. Based on the function properties of equations, the relationships of monovalent electrolyte ion and neutral molecule rejection vs solute concentration and permeation flux vs solute concentration were discussed for multi-solute solution. The minimal and maximal values were predicted on the curves monovalent electrolyte ion rejection and neutral molecule rejection vs solute concentration and permeation flux vs solute concentration. The following conclusions were obtained: (1) As pH value increased, the order of cation and anion rejection was from $R_{M^+} > R_{X^-} > R_{H^+}$ to $R_{M^+} = R_{X^-} > R_{H^+}$ again to $R_{X^-} > R_{M^+} > R_{H^+}$. The minimal and maximal value of ion rejection could be observed on the curves of ion rejection vs pH value. (2) The equation of total organic acid rejection could explain the physical significance of parameters of the related expressions reported in reference. It could explain the reason for the predicted curve of rejection vs pH value for PABA solution by such expressions in reference was higher than the experimental values. The rejection of PABA in methyl alcohol solution was discussed. (3) The concentration ratio of ion could depend on the ion composition and the concentration ratio of corresponding salt. R_{M^+}

Key words [reverse osmosis](#) [nanofiltration](#) [adsorption-diffusion](#) [charged membrane](#)

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