Removal of Organic Compounds in Water Using a NF Membrane：Effect of Feed Concentration and Co-existing Inorganic Ions

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ABSTRACT

The research investigates the effect of feed concentration ferulic acid bis phenol A by on the removal of NF membrane. In addition, effect of co-existing inorganic ions (such as NaCl and Na2SO4) is also discussed. Rejection of ferulic acid、bis phenol A、NaCl and Na2SO4 are by NF-270 greater than 70%、99%、60%、95%, respectively. Results also show increasing the feed concentration of the organic compound usually leads to the decrease of rejection, which can be explaned by the increase of concentration driving force across the membrane. The relationship between rejection and permeate flux was developed based on the irreversible thermodynamics approach and was modified to extend the applicability to both the single and binary mixed systems.

Keywords : NF-270 membrane ; ferulic acid ; bis phenol A ; feed concentration ; co-existing inorganic ions

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REFERENCES

? 王志仁，「薄膜處理技術去除天然有機物之研究」，碩士論文，國立台北科技大學環境規劃與管理研究所，台北，民國91年8月。? 台灣省自來水公司專案計畫，「澄清湖高級淨水處理模型廠試驗研究」(第一年)，計畫主持人:葉宣顯教授，成功大學環境工程學系，民國88年8月。? 杜亮明，「薄膜程序應用於淨水之探討」，碩士論文，國立台灣大學環境工程學研究所，台北，民國88年6月。? 高山鎮，「薄膜阻塞控制之研究」，碩士論文，國立成功大學環 境工程學研所，民國89年6月。? 郭文正與曾添文，「薄膜分離」，高立圖書有限公司，民國77年1月。? 陳柔閔，「無機離子於NF薄膜之傳輸與分離成效的研究」，碩士論文，大葉大學環境工程學系，彰化，民國91年8月。? 國科會專題研究計畫，「前處理對NF薄膜程序影響之研究」，計畫主持人:葉宣顯教授，成功大學環境工程學系，計畫編號:NSC 88-2211-E-006-023，民國88年7月。? 童士庭，「濃度極化現象對NF薄膜之分離成效的影響」，碩士論文，大葉大學環境工程學系，彰化，民國90年8月。? 環保署研究計畫，「水源鹽化對加氯消毒副產物生成之影響與改善對策及研究」期末報告，計畫主持人:蔣本基教授，台灣大學環境工程學研究所，計畫編號:EPA-89-U3J1-03-003，民國89年7月。? Agrawal, J. P. and Sourirajan, S.,“ Reverse osmosis ”, Flow through porous media symposium, I & EC, Vol.61, No.11, pp.62-89, 1969. ? Ahn, K.-H., Song, K.-G., Cha, H.-Y. and Yeom, I.-T.,“ Removal of ions in nickel electroplating rinse water using low-pressure nanofiltration ”, Desalination, Vol.122, pp.77-84, 1999. ? Amy, G.,“ Removal of dissolved organic matter by nanofiltration ”, Journal of Environmental Engineerining, Vol.116, pp.1-1200, 1990. ? AWWA Membrane Technology Research Committee,“ Committee report:membrane processes ”, Journal of American Water Works Association, 1998. ? Boussahel, R., Bouland, S., Moussaoui, K. M. and Montiel, A.,“ Removal of pesticide residues in water using the nanofiltration process ”, Desalination, Vol.132, pp.205-209, 2000. ? van der Bruggen, B., Braekn L. and Vandecasteele, C.,“ Evaluation of parameters describing flux decline in nanofiltration of aqueous solutions containing organic compounds ”, Desalination, Vol.147, pp.281-288, 2002a. ? van der Bruggen, B., Braekn L. and Vandecasteele, C.,“ Flux decline in nanofiltration due to adsorption of organic compounds ”, Separation and Purification Technology, Vol.29, pp.23-31, 2002b. ? van der Bruggen, B. and Vandecasteele, C.,“ Flux decline during nanofiltration of organic components in aqueous solution ”, Environ. Sci. Technol., Vol.35, pp.3535-3540, 2001. ? Bowen, W. R. and Mohammad, A. W.,“ A theoretical basis for specifying nanofiltration membranes-dye/salt/water streams ”, Desalination, Vol.117, pp.257-264, 1998. ? Clark, S., et al.,“ Low-cost membrane filtration in offing ”, Waterworld News, Jan/Feb, pp.17-18, 1992. ? Conlon, W., et al.,“ Membrane softening comes of age ”, Journal AWWA, Vol.81, pp.11-47, 1989. ? Dey, T. K., Ramachandhran, V. and Misra, B. M.,“ Selectivity of anionic species in binary mixed electrolyte systems for nanofiltration membranes ”, Desalination, Vol.127, pp.165-175, 2000. ? Edwards, E.,“ THM control using membrane technology ”, Proceedings, Joint FS/AWWA, FPCA, andFW&PCOA, Fort Lauderdale, FL, 1988. ? Escobar, I. C., Hong, S. and Randall, A. A.,“ Removal of assimilable organic carbon and biodegradable dissolved organic carbon by reverse osmosis and nanofiltration membranes ”, Journal of Membrane Science, Vol.175, pp.1-17, 2000. ? Garba, Y., Taha, S. Gondrexon, N., Cabon, J. and Dorange, G.,“ Mechanisms involved in cadmium salts transport through a nanofiltration membrane:characterization and distribution ”, Journal of Membrane Science, Vol.168, pp.135-141, 2000. ? Kedom, O. and Katchalsky, A.,“ Thermodynamics analysis of the permeability of biological membranes to non-electrolytes ”, Bio- chimica et biophysica acta, Vol.27, pp.229, 1958. ? Kedom, O. and Katchalsky, A.,“ The physical interpretation of the phenomenological coefficients of membrane permeability ”, The J. of general physiology, Vol.45, pp.143-179, 1961. ? Kimura, S. and Sourirajan, S.,“ Analysis of data in reverse osmosis with porous cellulose acetate membranes used ”, AIChE J., Vol.13, NO.3, pp.497-503, 1967. ? Kiso, Y., Nishimura, Y., Kitao, T. and Nishimura, K.,“ Rejection properties of non-phenylic pesticides with nanofiltration membranes ”, Journal of Membrane Science, Vol.171, pp.229-237, 2000. ? Kiso, Y., Kon, T., Kitao, T. and Nishimura, K.,“ Rejection properties of alkyl phthalates with nanofiltration membranes ”, Journal of Membrane Science, Vol.182, pp.205-214, 2001a. ? Kiso, Y., Sugiura, Y., Kitao, T. and Nishimura, K.,“ Effects of hydrophobicity and molecular size on rejection of aromatic pesticides with nanofiltration membranes ”, Journal of Membrane Science, Vol.192, pp.1-10, 2001b. ? Koyuncu, I.,“ Reactive dye removal in dye/mixtures by nanofiltration membrances containing vinylsulphone dyes:effects of feed concentration and cross flow velocity ”, Desalination, Vol.143, pp.243-253, 2002. ? Koyuncu, I. and Topacik, D.,“ Effect of organic on the separation of salts by nanofiltration membrances ”, Desalination, 16, pp.169-177 ,1975. ? Kunst, B., Arneri, G. and Vajnaht, Z.,“ On the comparision of Reverse osmosis membrane performance ”, The J. of general physiology, Vol.45, pp.143-179, 1961. ? Lonsdale, H. K., Merten, U. and Riley, R. L.,“ Transport of cellulose acetate osmotic membranes ”, J. Appl. Pol. Sci., Vol.9, pp.1341-1362, 1965. ? Merten, U.（Ed.）,“ Desalination by reverse osmosis ”, The MIT press cambridge, Mass., 1965. ? Matsuura, T., Pageau, L. and Sourirajan, S.,“ Reverse osmosis separation of inorganic solutes in aqueous solutions using porous cellulose acetate membranes ”, J. Appl. Pol. Sci., Vol.19, pp.179-198, 1975. ? Mehiguene, K., Garba, Y., Taha, S., Gondrexon, N. and Dorange, G.,“ Influence of operating conditions on the retention of copper and cadmium in aqueous solutions by nanofiltration:experimental results and modelling ”, Separation and Purification Technology, Vol.15, pp.181-187, 1999. ? Pontalier, P.-Y., Ismail, A. and Ghoul, M.,“ Mechanisms for the selective rejection of solutes in nanofiltration membranes ”, Separation and Purification Technology, Vol.12, pp.175-181, 1997. ? Ratanatamskul, C., Urase, T. and Yamamoto, K.,“ Description of behavior in rejection of pollutants in ultra low pressure nanofiltration ”, Wat. Sci. Tech., Vol.38, pp.453-462, 1998. ? Reiss, C. R., Taylor, J. S. and Robert, C.,“ Surface water treatment using nanofiltration — pilot testing results and design considerations ”, Desalination, Vol.125, pp.97-112, 1999. ? Roudman, A. R. and Digiano, F. A.,“ Surface energy of experimental and commercial nanofiltration membranes:effects of wetting and natural organic matter fouling ”, J. Membr. Sci., Vol.175, pp.61-73, 2000. ? Sherwood, T. K., Brian, P. T. L. and Fisher, R. E.,“ Desalination by Reverse Osmosis ”, I&EC Fund., Vol.6, pp.2-12, 1967. ? Siddiqui, M.,“ Membrane technology for the control of natural organic matter from surface water ”, Water

Quality and Technology for the 21st Century, 2000. ? Small, P. A., “ Factors affecting the solubility of polymers ”, J. Appl. Chem., Vol.3, pp.71, 1953. ? Spiegler, K. S., “ Transport processes in ionic membranes ”, Trans. Faraday Soc., Vol.54, pp.1409, 1958. ? Spiegler, K. S. and Kedom, O., “ Thermodynamics of hyperfiltration （reverse osmosis）:criteria for efficient membranes ”, Desalination, Vol.1, pp.311-326, 1966. ? Tan, L., and Sudar, R., “ Color removal from groundwater by membrane processes ”, Journal AWWA, Vol.83, pp.1-79, 1992. ? Taylor, J., “ Applying membrane processes to groundwater sources for trihalomethane precursor control ”, Journal of American Water Works Association, Vol.79, pp.72, 1987. ? Thanuttamavong, M., Yamamoto, K., Oh, J. I., Choo, K. H. and Choi, S. J., “ Rejection characteristics of organic and inorganic pollutants by ultra low-pressure nanofiltration of surface water for drinking water treatment ”, Desalination, Vol.145, pp.257-264, 2002. ? Xu, Y. and Lebrum, R., “ Comparison of nanofiltration properties of two membranes using electrolyte and non-eletrolyte solutes ”, Desalination, Vol.122, pp.95-106, 1999. ? Soltanidel M., and Gill, W. N., “ Review of reverse osmosis membranes and transport models ”, Chemical Engineering Department Iown State University Ames, 1981. ? Widmer, F. and Schirg, P., “ Characterisation of nanofiltration membranes for the separation of aqueous dye-salt solutions ”, Desalination, Vol.89, pp.89-107, 1992. ? Vezzani, D. and Bandini, S., “ Donnan equilibrium and dielectric exclusion for characterization of nanofiltration membrance ”, Desalination, Vol.149, pp.477-483, 2002.