操作條件與進流水質對NF薄膜去除農藥的影響

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摘 要

本研究探討不同操作條件(壓力和溫度)和進流水質(進流濃度、pH和背景離子)，對農藥(包括Monocrotophos、Atrazine、Diuron和Isoproturon)去除率的影響。NF-270薄膜對Monocrotophos、Atrazine、Diuron和Isoproturon的去除率分別高達99%、96%、56%、83%。若增加壓力或降低溫度，此四種農藥的去除率均隨之增加。若提高進流濃度，只有Atrazine去除率會降低。本研究也討論了其去除率變化的趨勢或原因。Monocrotophos和Atrazine會以帶電的離子狀態存在，與薄膜產生靜電作用，導致去除率提高；至於Diuron和Isoproturon兩種農藥並不會解離，故調整pH值對其去除率影響不明顯。 由數據趨勢與統計檢定的結果來看，當背景離子硫酸鈉存在時，Isoproturon之去除率減少；而背景離子氯化鈉存在時，Monocrotophos農藥之去除率明顯減少。其他農藥/背景離子系統的去除率則和單獨農藥之去除率沒有顯著差異。最後，本研究以文獻中所提出的模式為基礎加以修改，用來描述農藥去除率與穩態清水通量間的關係。不論是對於單獨農藥或農藥/背景離子系統，此模式都有不錯的預測結果。 關鍵字：NF270薄膜；Monocrotophos；Atrazine；Diuron Isoproturon；背景離子

關鍵詞 : 薄膜

目錄

封面內頁 簽名頁 授權書 …..iii 中文摘要 ..…..iv 英文摘要 ..... v 誌謝 ….....vi 目錄 .... vii 圖目錄 …...…x 表目錄 …....xii 第一章 前言……...……...01 1.1 研究緣起…….……..…01 1.2 研究目的……...……..…...02 1.3 研究內容……...……..…...02 第二章 文獻回顧……...……...04 2.1 薄膜的基本性質……...……...……..…04 2.1.1 薄膜的種類…….……..…..04 2.1.2 薄膜的材料與構造…….……..…..05 2.1.3 薄膜的操作參數…….……..…..06 2.2 溶質的去除機制與傳輸型式……..……..……..…...09 2.2.1 對無機物的去除…….…..…..11 2.2.2 對有機物的去除……..…..12 2.3 影響NF薄膜對溶質去除率的因素……13 2.3.1 操作條件對去除率的影響……..……..13 2.3.2 進流水質對去除率的影響……..……..17 2.3.3 溶質與NF膜的物化特性對去除率的影響..…21 2.4 質量傳輸與分離成效的預測模式……...24 第三章 實驗材料與研究方法……...……...35 3.1 研究流程…….…..35 3.2 實驗設備與材料……..…...…..35 3.2.1 實驗裝置……..…..…35 3.2.2 所使用的薄膜種類……40 3.2.3 試驗水樣……..…..….40 3.3 預備試驗…….....……..42 3.3.1 新薄膜的預備試驗……..…..….42 3.3.2 決定薄膜截留分子量(MWCO)…….....…43 3.4 試驗步驟……..……..……..44 3.5 分析方法……..…….....46 3.5.1 電導度(Conductivity)..…….……..46 3.5.2 單一農藥的分析-UV254吸光度……...…..…46 3.5.3 陰離子之分析…….…….……..…46 第四章 結果與討論……...……...48 4.1 預備試驗…….....…..48 4.1.1 基線水通量的測試……..……..……..…48 4.1.2 農藥對薄膜之吸附性的測試……...….49 4.2 薄膜對單一農藥之處理成效……..…….50 4.2.1 操作條件對農藥去除率的影響……..…...…....50 4.2.2 進流水質對農藥去除率的影響……...….55 4.2.3 物化特性對農藥去除率的影響……..…..……59 4.3 背景離子對農藥之處理成效的影響……...…64 4.3.1 背景離子硫酸鈉對農藥之處理成效的影響....64 4.3.2 背景離子氯化鈉對農藥之處理成效的影響....70 4.4 農藥去除率之迴歸模式的建立與驗證……...76 第五章 結論與建議……..……82 5.1 結論……..….82 5.2 建議……..….83

參考文獻

? 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。 ? 林樹慶，「以NF薄膜去除水中有機物:進流濃度與背景無機離子的影響」，碩士論文，大葉大學環境工程學系，彰化，民國93年6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92年8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91年8月。 ? 葉宣顯，「澄清湖高級淨水處理模型廠試驗研究」(第一年)，台灣省自來水公司專案計畫，成功大學環境工程學系，民國88年8月。 ? Agrawal, J.P. and Sourirajan, S.,

“ Reverse osmosis ” , Flow through porous media symposium, I & EC,61,Vol.11,pp62-89, 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 Engineering, Vol.116, pp.1-1200, 1999. ? Amy, G., “ Removal of dissolved organic matter by nanofiltration ” , Journal environmental Engineering, Vol.116, pp.1-1200, 1990. ? Anselme, C., Mandra, V., Baudin, I., Jacangelo, J. C. and Mallevialle, J., “ Optimum use of membrane processes in drinking water treatment ” , paper presented at the 19th IWA Congress, Budapest, Hungary, 1993. ? AWWA Membrane Technology Research Committee, “ Committee report:membrane processes ” , Journal of American Water Works Association, 1998. ? Bellona, C., Drewes, J. E., Xu, P. and Amy, G., “ Factors affecting the rejection of organic solutes during NF/RO treatment-a literature review ” , Water Research, Vol.38, pp.2795-2809, 2004. ? Blu, T. J., Tylor, J. S., Morris, K. E. and Mulford, L. A., “ DBP control by nanofiltration ” , cost and performance, Journal of American Water Works Association, Vol.84, pp.104-116, 1992. ? 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. ? Bowen, W. R. and Mohammad, A. W., “ A theoretical basis for specifying nanofiltration membrane-dye/salt/water streams ” , Desalination, Vol.117, pp.257-264, 1998. ? 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, 2002. ? van der Bruggen, B., Schaep J., Maes W., Wilms D. and Vandecasteele, C., “ Nanofiltration as a treatment method for the removal of pesticides from ground waters ” , Desalination, Vol.117, pp.139-147, 1998. ? Chellam, S., Jacangelo, J. G., Bonacquisti T. P. and Schaner, B. A., “ Effect of pretreatment on surface water nanofiltration ” , Journal of American Water Works Association, Vol. 89 pp.77-89, 1997. ? Chellam, S. and Taylor, J. S., “ Simplied analysis of contaminant rejection during ground and surface water nanofiltration under the information collection rule ” , Water Research, Vol.35, pp.2460-2474, 2001. ? Conlon, W. J. and McClellan, S. A., “ Membrane softening:a treatment process comes of age ” , Journal of American Water Works Association, Vol.81, pp.47-51, 1989. ? Dard, S., Cote, P., Seberac, P. and Ortiz, R. S., “ Drinking water production from high sulfate mine water by nanofiltration ” , In Proceeding AWWA Membrane Technology Conference, Reno, Nevada, 1995. ? 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 ” , Proceeding, Joint FS/AWWA, FPCA, and FW&PCOA, Fort Lauderdale, 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. ? Freger, V., Arnot, T.C. and Howell, J. A., “ Separation of concentrated organic/inorganic salt mixtures by nanofiltration ” , Journal of Membrane Science, Vol.178, pp.185-193, 2000. ? Gaid, A., Bablon, G., Turner, G. and Franchet, J., “ Performance of 3 years operation of nanofiltration plants ” , Desalination, Vol. 117 pp.149-158, 1998. ? 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. ? Giacomazzi, S. and Cochet, N., “ Environmental impact of diuron transformation:a review ” , Chemosphere, Vol.56, pp.1021-1032, 2004. ? Gill, william N., “ Review of reverse osmosis membranes and transport models ” , Chemical Engineering Communications, Vol.12,pp.279-363, 1981. ? Hu, J. Y., Ong, S. l.,Shan, J. H., Kang, J., B. and Ng, W.J., “ Treatability of organic fractions derived from secondary effluent by reverse osmosis membrane ” , Water Research, Vol.37, pp.4801-4809, 2003. ? Katsumata, H., Fujii, A., Kaneco, S., Suzuki, T. and Ohta, K., “ Determination of simazine in water samples by HPLC after preconcentration with diatomaceous earth, Talanta Vol.65, pp.129-134, 2005. ? 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 Journal of general physiology, Vol.45,PP.143-179. 1961. ? Kimura, S. and Sourirajan, S., “ Analysis of data in reverse osmosis withporous cellulose acetate membranes used ” , AIChE Journal, 13,Vol.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. ? Kosutic, K., Novak, I., Sipos, L. and Kunst, B., “ Removal of sulfates and other inorganics from potable water by nanofiltration membranes of characterized porosity ” , Separation and Purification Technology, Vol.37, pp.177-185, 2004. ? Koyuncu, I. and Topacik, D., “ Effect of organic ion on the separation of salts by nanofiltration membranes ” , Journal of Membrane Science, Vol.195, pp.247-263, 2002. ? Koyuncu, I., “ Reactive dye removal in dye/salt mixtures by nanofiltration membranes containing vinylsulphone dyes:Effects of feed concentration and cross flow velocity ” , Desalination, Vol.143, pp.243-253, 2002. ? Kunst, B., Arneri, G. and Vajnaht, Z., “ On the comparision of Reverse osmosis membrane performance ” , Journal of general physiology, Vol. 45 PP.143-179. 1961. ? Ku, Y., Wang, W. and Shen, Y. S., “ Reaction behavior of decomposition of monocrotophos in aqueous solution by UV and UV/O3 processes ” , Journal of Hazardous Materials, Vol.72, pp.25-37, 2000. ? Levenstein, R., Hasson, D. and Semiat, R., “ Utilization of the Donnan effect for improving electrolyte separation with nanofiltration membranes ” , Journal of Membrane Science, Vol.116, pp.77-92, 1996. ? Lonsdale, H.K., Merten, U. and Riley, R.L., “ Transport of cellulose acetate osmotic membranes ” , Journal of Applied Polymer Science, Vol.9, pp.1341-1362, 1965. ? Manttari, M., Pihlajamaki, A., Kaipainen, E. and Nystrom, M., “ Effect of temperature and membrane pre-treatment by pressure on the filtration properties of nanofiltration membranes ” , Desalination, Vol.145, pp.81-86, 2002. ? Mehiguene, K., Gerba, 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 modeling ” , Separation and Purification Technology, Vol.15, pp.181-187, 1999. ? 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 ” , Journal of Applied Polymer Science , Vol.19,PP.179-198. 1975. ? Nghiem, L. D., Schafer, A. I. and Waite, T.D., “ Adsorption of estrone on nanofiltration and reverse osmosis membranes in water and wastewater treatment ” , Water Science and Technology, Vol.46, pp.265-72, 2002. ? Ozaki, H., Sharma, K. and Saktaywin, W., “ Performance of an ultra-low-pressure reverse osmosis membrane (ULPROM) for separating heavy metal: effects of interference parameters ” , Desalination, Vol. 144, pp.287-94, 2002. ? Ozaki, H. and Li, H., “ Rejection of organic compounds by ultra-low pressure reverse osmosis membrane ” , Water Research, Vol. 36, pp.123-130, 2002. ? 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 ” , Water Science and Technology, Vol.38, pp.453-462, 1998. ? Ravanel, P., Liegois, M. H., Chevallier, D. and Tissut, M., “ Soil thin-layer chromatography and pesticide mobility through soil microstructures new technical approach ” , Journal of Chromatographya., Vol.864, pp.145-154, 1999. ? 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. ? Schaep, J., Bruggen, B. V., Uytterhoeven, S. and Croux, R., “ Removal of hardness from groundwater by nanofiltration ” , Desalination, Vol. 119, pp.295-302, 1998. ? Schutte, C. F., “ The rejection of specific organic compounds by reverse osmosis membranes ” , Desalination, Vol. 158, pp.285-294, 2003. ? Sherwood, T. K.,Brian, P. T. L. and Fisher, R. E., “ Desalination by Reverse Osmosis ” , I&EC Fund, Vol.6, pp.2-12, 1967. ? Sidherwood, T. K., Brian, P. T. L. and Fisher, R. E., “ Desalination by Reverse Osmosis ” , Industrial & Engineering Chemistry Fund., Vol.6, pp.2-120, 1967. ? Siddiqui, M., Amy, G., Ryan, J., and Odem, W., “ Membranes for the control of natural organic matter from surface wares ” , Water Research, Vol.34, pp.3355-3370, 2000. ? 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 Sudak, R. G., “ Removing color from a groundwater source ” , Journal of American Water Works Association, Vol.84, pp.79-87, 1992. ? Taylor, J., “ Applying membrane processes to groundwater sources for trihalomethane precursor control ” , Journal of American Water Works Association, Vol.79, pp.72, 1987. ? Teng, M. Y., “ The rejection of organic compound with adsorbent by nanofiltration from diluted solutions ” , presented at the 4th Conference on Membrane Science Technology in Taiwan, Taiwan, May 14, 2004. ? Vrijenhoek, E. M. and Waypa, J. J., “ Arsenic removal from drinking water by a “ loose ” nanofiltration membrane ” , Desalination, Vol.130, pp.265-277, 2000. ? Waypa, J. J., Elimelech, M. and Hering, J. G., “ Arsenic removal by RO and NF Membranes ” , Journal of American Water Works Association, Vol.89, pp.102-114, 1997. ? Wang, X. L., Wang, W. N. and Wang, D. X., “ Experimental investigation on separation performance of nanofiltration membranes for inorganic electrolyte solutions ” , Desalination, Vol.145, pp.115-122, 2002. ? Widmer, F. and Schirg, J., “ Charactetisation of nanofiltration membranes for the separation of aqueous dye-salt solutions ” , Desalination, Vol.89, pp.89-107, 1992. ? 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. ? Yang, M. H., Yen, H. Y. and Hsu, Y. T., “ A study of applied model analysis for separation if NaCl solution in reverse osmosis membrane ” , presented at the 4th Conference on Membrane Science Technology in Taiwan, Taiwan, May 14, 2004. ? Yoon, Y., Amy, G., Cho, J., Her, N. and Pellegrino, J., “ Transport of perchlorate (ClO4-) through NF and UF membranes ” , Desalination, Vol.147, pp.11-7, 2002.