

UNIVERSIDAD DE CANTABRIA

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS INDUSTRIALES Y DE
TELECOMUNICACIONES

DEPARTAMENTO DE INGENIERÍA QUÍMICA Y QUÍMICA INORGÁNICA



**VALORIZACIÓN DE EFLUENTES DE DECAPADO
ÁCIDO METÁLICO. RECUPERACIÓN DE ZINC**

**TESIS DOCTORAL PRESENTADA POR HENAR SAMANIEGO PEÑA
PARA OPTAR AL TÍTULO DE
DOCTORA POR LA UNIVERSIDAD DE CANTABRIA**

Directoras de tesis:

Dra. Inmaculada Ortiz Uribe

Dra. M^a Fresnedo San Román San Emeterio

Junio 2006

CAPÍTULO 7: BIBLIOGRAFÍA

7. BIBLIOGRAFÍA

- 📖 Abellan, M.J. **2005**. *Recuperación del cobre empleado como catalizador en procesos de oxidación avanzada utilizando contactores de membranas*. Tesis Doctoral. Universidad de Cantabria. Santander, España.
- 📖 Alamdari, E.K., Sadrnezhad, S.K. **2000**. *Thermodynamics of extraction of MoO_4^{2-} from aqueous sulfuric acid media with TBP dissolved in kerosene*. Hydrometallurgy., 55: 327-341.
- 📖 Alexander, P., Callahan, R. **1987**. *Liquid-liquid extraction and stripping of gold with microporous hollow fibers*, J. Membr. Sci., 35: 57-71.
- 📖 Alguacil, F.J. **2002a**. *Facilitated transport and separation of manganese and cobalt by supported liquid membranes*. Hydrometallurgy, 65:9-14.
- 📖 Alguacil, F.J. **2002b**. *The phosphine oxides Cyanex 921 and Cyanex 923 as carriers for facilitated transport of gold (I) cyanide aqueous solutions*. Hydrometallurgy, 66:117-123.
- 📖 Alguacil, F.J., Alonso, M. **1999**. *The effect of ammonium sulphate and ammonia on the liquid-liquid extraction of zinc using LIX 54*. Hydrometallurgy, 53: 203-209.
- 📖 Alguacil, F.J., Alonso, M. **2005**. *Separation of zinc(II) from cobalt(II) using supported liquid membrane with DP-8R (di(2-ethylhexyl)phosphoric acid) as a carrier*. Sep. & Purif. Technol., 41: 179-184.
- 📖 Alguacil, F.J., Alonso, M., Sastre, A.M. **2005**. *Facilitated supported liquid membrane transport of gold (I) and gold (III) using Cyanex[®] 921*. J. Membr. Sci. Disponible on-line.
- 📖 Alguacil, F.J., Martínez, S. **2001**. *Solvent extraction equilibrium of zinc(II) from ammonium chloride medium by CYANEX 923 in Solvesso 100*. Journal of Chemical Engineering of Japan, 34: 1439-1442.
- 📖 Alonso, A.I., Galán, B., Irabien, A., Ortiz, I. **1997a**. *Separation of Cr (VI) with Aliquat 336: Chemical equilibrium modeling*. Sep. Sci. & Technol., 32(9):1543-1555.

- 📖 Alonso, A., Galan, B., Gonzalez, M. and Ortiz, I. **1999**. *Experimental and theoretical analysis of a non-dispersive solvent extraction pilot plant for the removal of Cr (VI) from a galvanic process wastewater*. Ind. Eng. Chem. Res., 38: 1666-1675.
- 📖 Alonso, A.I., Irabien, A., Ortiz, I. **1996**. *Nondispersive Extraction of Cr(VI) with Aliquat 336: Influence of carrier concentration*. Sep. Sci. & Technol., 31(2): 271-282.
- 📖 Alonso, A. Ortiz, I., Galan, B. Irabien, A., **1993**. *Viability and stability study of the recovery of Cr (VI) with hollow fiber contactors*. Latin Am. App. Res., 23: 179-184.
- 📖 Alonso, A.I., Pantelides, C.C. **1996**. *Modelling and simulation of integrated membrane processes for the recovery of Cr (VI) with Aliquat 336*. J. Mem. Sci., 110:151-167.
- 📖 Alonso, A., Urriaga, A., Irabien, A., Ortiz, I., **1994**. *Extraction of Cr (VI) with Aliquat 336 in hollow fiber contactors: mass transfer analysis and modelling*. Chem. Eng. Sci., 49: 193-203.
- 📖 Alonso, A.I., Urriaga, A.M., Zamacona, S., A. Irabien, I. Ortiz. **1997b**. *Kinetic modelling of cadmium removal from phosphoric acid by non-dispersive solvent extraction*. J. Membr. Sci., 130: 193-203.
- 📖 Arous, O., Gherrou, A., Kerdjoudi, H. **2004**. *Removal of Ag(I), Cu(II) and Zn(II) ions with supported liquid membrane containing cryptands as carriers*. Desalination, 161: 295-303.
- 📖 Baker, R.W. **2004**. *Membrane Technology and Applications*. 2ª edición. Wiley. Chichester.
- 📖 Bayer A. G. **2002**. *TBP: Technical Information*. Bayer A. G.
- 📖 Balakhonov V.G., Nikitin S.D., **1990**. *Effect of pH on the solubility of tri-n-butylphosphate in aqueous electrolyte solutions*. Radiokhimiya, 32(3): 66-70.
- 📖 Barba, A., Llorens, M., Marcos, C., Perez-Ruzafa, A. **2004**. *Medio Ambiente y Desarrollo Sostenible*. Ed. Marín, D.

- 📖 Barron Zambrano JA, Avila-Rodriguez M., Saucedo T., Navarro R., Sastre A.M. **1999**. *Liquid-liquid extraction of zinc(II) by solvating extractants from HCl/H₂SO₄ mixed media*. Proceedings ISEC99. 2000 Society of Chemical Industry.
- 📖 Bart, H.J., Marr, R., Scheks, J., Konkar, M. **1992**. *Modelling of solvent extraction equilibria of zinc(II) from sulphate solutions with bis-(2ethyl)-phosphoric acid*. Hydrometallurgy, 31:13-28.
- 📖 Bartowska, M., Regel-Rosocka, M., Szymanowski, J. **2002**. *Extraction of zinc(II), iron(III) and iron(II) with binary mixtures containing tributyl phosphate and di(2-ethylhexyl)phosphoric acid or CYANEX 302*. Physicochemical Problems of Mineral Processing, 36: 217-224.
- 📖 Belousov E.A., Aloyanikov, I. **1974**. *Mechanism of Zn (II) extraction from aqueous solutions of hydrogen chloride by TBP*. Zhurnal Neorganicheskoi Khimii, 19(6):1592-1596,
- 📖 Bocquet, S., Torres, A., Sanchez, J., Ríos, G.M., Romero, J. **2005**. *Modeling the mass transfer in solvent-extraction processes with hollow-fiber membranes*. AIChE J., 51(4): 1067-1079.
- 📖 Bogacki, M.B., Zhivoka, S., Kyuchoukov, G., Szymanowsky, J. **2000**. *Modeling of Copper (II) and Zn(II) Extraction from Chloride Media with KELEX 100*. J. Ind. Eng. Chem. Res., 39(6): 740-745.
- 📖 Borkowski, M., Ferraro, J.R., Chiarizia, R., McAlister, D.R. **2002**. *FT-IR study of tirad phase formation in the U(VI) or Th(IV) HNO₃, TBP/alkane systems*. Solvent Extr. Ion Exch., 20: 313-330.
- 📖 Breembroek, G.R.M, van Straalen, A., Witkamp, G.J., van Rosmalen, G.M. **1998**. *Extraction of cadmium and Koper using hollow fiber supported liquid membranes*. J. Membr. Sci., 146:185-195.
- 📖 Bressa, M., Butinelli, D., Giavarini, C. **1979a**. *Estrazione selettiva dello con tributilfosfato da soluzioni acide industriali*. La Chimica e l'industria, 61(12).

- 📖 Bressa, M., Butinelli, D., Giavarini, C. **1979b**. *Selective solvent extraction of Zn with TBP from industrial acid solution*. *Chimica e Industria*, 61(12): 893-897.
- 📖 Bringas E., Ortiz I., **2002**. *Recuperación de zinc de efluentes de decapado ácido: Estudio preliminar*. Trabajo Fin de Carrera, Ingeniero Químico.
- 📖 Brisk, M. L., McManamey. **1969**. *Liquid extraction of metals from sulphate solutions by alkylphosphoric acids*. *J. Appl. Chem.*, 19, april.
- 📖 Brooks, C.S. **1995**. *Hydrometallurgical treatment of zinc waste dusts*. *Sep. Sci. & Technol.*, 30(7-9): 2055-2073.
- 📖 Butinelli, D., Di Corcia, A., Giavarini, A., Sambarino E. **1980**. *Experiments on a pilot plant for Zinc recovery from waste electrolytes and acid industrial effluents using TBP*. *Industria Mineraria*, 19(10): 998-1002.
- 📖 Calzada, M. Enero **2004**. Separación-concentración de Cr (VI). *Análisis y modelado de tecnologías basadas en reacciones de intercambio iónico*. Tesis Doctoral. Universidad de Cantabria, Santander, España.
- 📖 Campderrós, M.E., Marchase, J. **2000**. *Facilitated transport of niobium(V) and tantalum(V) with supported liquid membrane using TBP as carrier*. *J. Memb. Sci.*, 164: 205-210.
- 📖 CAR/PL, **2000**. *Alternativas de prevención de la contaminación en el sector de tratamiento de superficies*.
- 📖 Celgard. *Información técnica de los módulos de fibras huecas*.
- 📖 Chang, C.M., Gu, H., O'Keefe, T.J. May **1996**. *Review of the galvanic stripping process for use in treating oxidized metal wastes*. Proceedings of the HSRC/WERC Joint Conference on the Environment, published in hard copy and on the Web by the Great Plains/Rocky Mountain Hazardous Substance Research Center.
- 📖 Chapman, T.W. **1987**. *Extraction-metals processing. Handbook of Separation Process Technology*. Capítulo 8. Willey-Interscience, New York. (R.W. Rousseau,)

- Cheng, C. Y. **2000**. *Purification of synthetic leach solution by solvent extraction using D2EHPA*. Hydrometallurgy, 56: 369-386.
- Chiarizia, R.; Jensen, M.P.; Borkowski, M.; Ferrano, J.R.; Thyagarajan, P.; Littrell, K.C. **2003**. *Third phase formation revisited: the U(VI), HNO₃-TBP, n-dodecane system*. Sovent Extr. Ion Exch. 21: 1-27.
- Cierpezewski, R.; Miesiac, I.; Regel-Rosocka, M.; Sastre, A.M.; Szymanowski, J. **2001**. *Recovery of zinc (II) from hydrochloric acid solutions*. XVI-th ARS SEPARATORIA Borowno, Poland.
- Cierpezewski, R.; Miesiac, I.; Regel-Rosocka, M.; Sastre, A.M.; Szymanowki, J. **2002**. *Removal of Zinc (II) from Spent Hydrochloric Acid Solutions from Zinc Hot Galvanizing Plants*. Ind. Eng. Chem. Res., 41: 598-603.
- Coheloso, I., Silcivestre, P., Viegas, R., Crespo, J., Larrondo, M. **1997**. *Membrane-based solvent extraction and stripping of lactate in hollow fiber contactor*. J. Membr. Sci., 134: 19-32.
- Cussler, E.L. **1984**. *Difussion mass transfer in fluid systems*. Cambridge University Press, New York.
- Cussler, E.L., **1997**. *Diffusion. Mass transfer in fluid systems*. 2^a edición. Cambridge University Press, New York.
- Dahuron, L., Cussler, E. **1988**. *Protein Extractions with Hollow Fibers*. AIChE J., 34: 130.
- Daiminger, U.A., Geist, A.G., Nitsch, W., Plucinski, P.K. **1996**. *Efficiency of hollow fiber modules for non- dispersive chemical extraction*. Ind. Eng. Chem. Res., 35: 184-191.
- Danesi, P.R. **1984a**. *A simplified model for the coupled transport of metals ions trough hollow-fiber supported liquid membranes*. J. Membr. Sci., 20:231-248.
- Danesi, P.R. **1984b**. *Separation of metal species by supported liquid membranes*. Sep. Sci. & Technol., 19(1&2):857-894.

- 📖 Danesi, P.R., Cianetti, C., **1984c**. *Multistage separation of metal ions with a series of complementary supported liquid membranes*. J. Membr. Sci., 20:201-213.
- 📖 De Gyves, J., De San Miguel, R. **1999**. *Metal ions separation by supported liquid membranes*. Ind. Eng. Chem. Res., 38: 2182-2202.
- 📖 Dimitrov, K., Alexandrova, S., Sabomi, A., Debay, E., Boyadzhiev, L. **2002**. *Recovery of zinc from chloride media by batch pertraction in a rotating film contactor*. J. Membr. Sci., 207: 119-127.
- 📖 Dindore, V.Y., Brilman, D.W.F., Versteeg, G.F. **2005**. *Modelling of cross-flow membrane contactors: mass transfer with chemical reactions*. J. Membr. Sci., 255: 275-289.
- 📖 Ding, H., Carr, P., Cussler, E. **1992**. *Racemic leucine separation by hollow fiber extraction*. AIChE J., 38:10.
- 📖 Eliceche, A., Alonso, A., Ortiz, I., **2000**. *Optimal operation of selective membrane separation processes for wastewater treatment*. Computers and Chemical Engineering, 24: 2115-2123
- 📖 Escalante, H., Alonso, A., Ortiz, I., Irabien, A. **1998**. *Separation of L-Phenylalanine by non-dispersive extraction and backextraction. Equilibrium and kinetic parameters*. Sep. Sci. & Technol., 33 :119-139.
- 📖 Flett, D.S. **1983**. *Ion exchange membranes*. Ellis Horwood publisher.
- 📖 Forrest, V. M. P., Scargill, D., Spickernell, D.R. **1969**. *The extraction of zinc and cadmium by tri-n-butyl phosphate from aqueous chloride solutions*. Journal of Inorganic & Nuclear Chemistry, 31: 187-197.
- 📖 Gabelman, A., Hwuang, S. **1999**. *Hollow fiber membrane contactors*. J. Membr. Sci., 159: 61-106.
- 📖 Galan, B., San Roman, F., Irabien, A., Ortiz, I. **1998**. *Viability of the Separation of Cd from highly concentrated Ni-Cd mixtures by non dispersive solvent extraction*. Chem. Eng. J., 70: 237-243.

- Galán, B., Urtiaga, A.M., Alonso, A.I., Irabien, A., Ortiz, I. **1994**. *Extraction of anions with Aliquat 336: Chemical equilibrium modelling*. Ind. Eng. Chem. Res., 33:1765-1770.
- Gawronsky, R., Wrzesinca, B. **1999**. *Kinetics of solvent extraction in hollow fiber contactors*. J. Membr. Sci., 168: 213-222.
- González, F., Avila, M., **1996**. *Liquid-liquid extraction of metal ions from mixed hydrochloric acid-sulphuric acid media by TBP*. Proceedings ISEC96 . Melbourne, Australia.
- González, M. A. Octubre **1998**. *Planta piloto de extracción L-L no dispersiva: construcción, Funcionamiento y Aplicaciones*. Tesis Doctoral Universidad de Cantabria, Santander, España.
- González, M.J., Luque, S., Álvarez, J.R., Coca, J. **2004**. *Simulation of integrated extraction and stripping processes using membrane contactors*. Desalination. 163: 1-12.
- Hann, A.B., Bartels, P.V., Graau, J. **1998**. *Extraction of metal ions from waste water. Modelling of the mass transfer in a supported-liquid-membrane process*. J. Membr. Sci., 45: 281-297.
- He, T., Versteeg, L.A.M., Mulder, M.H.V., Wessling, M. **2004**. *Composite hollow fiber membranes for organic solvent-bases liquid-liquid extraction*. J. Membr. Sci., 234:1-10.
- Hellis, M., Mu, D., Kentish, S.E., *The selective extraction of Zn from Hot Dip Galvanising Pickle Effluent*. Paper 519, University of Melbourne.
- Hirato, T., Wu, Z.C., Yamada, Y., Mahima, H. **1992** *Improvement of the stripping characteristics of Fe(III) utilizing a mixture of di (2-ethylhexyl) phosphoric acid and tri-n-butyl phosphate*. Hydrometallurgy, 28: 81-93.
- Ho, W.S., Wang, B., Neumuller, T.E., Roller, J. **2001**. *Supported liquid membranes for removal and recovery of metals from waste water and process streams*. Environmental Progress, 20(2):117-121.

- 📖 Ho, W.S., Poddar, T.K. **2001**. *New membrane technology for removal and recovery of chromium from waste waters*. Environmental Progress, 20(1): 44-52
- 📖 Ho, W.S.W., Sirkar, K.K. **1992**. *Membrane Handbook*, Chapman & Hall, New Cork.
- 📖 Honjo, T., Ozakaki, A., Terada, K. **1985**. *Extraction of manganese(II), iron(II), cobalt(II), nickel(II), copper(II), zinc(II), and cadmium(II) into 1,2-dicloroethane with 4,7-diphenyl-1,10-phenanthroline and perchlorate*. Talanta, 32(8): 771-777.
- 📖 Hossain, M. **2005**. *Reactive extraction of amino acids and dipeptides using an extra-flow hollow-fiber module*. Sep. & Purif. Technol., 42 (3): 227-236.
- 📖 Huang, H.J., Yang, S.T., Ramey, D.E. **2004**. *A hollow-fiber membrane extraction process for recovery and separation of lactic acid from aqueous solution*. Applied biochemistry and biotechnology, 113: 671-688.
- 📖 Hughes, M. A., Kuipa, P. K. **1996**. *Kinetics and mechanism of copper extraction with dialkylphosphoric acids and hydroxyoximes studied by a rotating diffusion cell*. Ind. Eng. Chem. Res., 35: 1976-1984
- 📖 IHOBE, S.A., **1997**. *Galvanizado en Caliente*. Sociedad Pública Gestión Ambiental, Gobierno Vasco.
- 📖 IHOBE, S.A., **2002**. *Recubrimientos Electrolíticos*. Sociedad Pública Gestión Ambiental, Gobierno Vasco.
- 📖 Illias, S., Scimmel, K.A., Yezek, P.M. **1999**. *Non-dispersive liquid-liquid extraction of copper and zinc from aqueous solution by DE2EHPA and LIX 54 in a hollow fiber membrane module*. Sep. Sci. & Technol., 34(6-7): 1007-1020.
- 📖 Jha, M.K., Kumar, V., Singh, R.J. **2001**. *Review of hydrometallurgical recovery of zinc from industrial wastes*. Resources, Conservation and Recycling, 33: 1-22.
- 📖 Jha, M. K.; Kumar, V.; Singh, R.J. **2002**. *Solvent extraction of zinc from chloride solutions*. Solvent Extraction and Ion Exchange. 20 (3): 389-405.

- 📖 Jia, Q., Zhan, C., Li, D., Niu, C. **2004**. *Extraction of zinc(II) and cadmium(II) by using mixtures of primary amine N1923 and organophosphorous acids*. Sep. Sci. & Technol., 39(5): 1111-1123.
- 📖 Juang, R.S., Chang, Y.T. **1992**. *Effects of tri-n-butylphosphate and 2-ethyl-1-hexanol on the extraction of zinc with di(2-ethylhexyl)phosphoric acid*. Journal of Chemical Engineering of Japan, 25(3): 339-341.
- 📖 Juang, R.S., Huang, H.C. **1999**. *Non-dispersive extraction separation of metals using hydrophilic microporous and cation exchange membranes*. J. Membr. Sci., 156: 179-186.
- 📖 Juang, R.S., Huang, H.L. **2002**. *Modeling of nondispersive extraction of binary Zn(II) and Cu(II) with D2EHPA in hollow fiber devices*. J. Membr. Sci., 208: 31-38.
- 📖 Juang, R.S., Kao, H.C., Wu, W.H. **2004**. *Analysis of liquid membrane extraction of binary Zn(II) and Cd(II) from chloride media Aliquat 336 based on thermodynamic equilibrium models*. J. Membr. Sci., 228: 169-177.
- 📖 Karungo, S.B., Mohapatra, R. **1995**. *Coupled transport of zinc(II) through a supported liquid membrane containing bis(2,2,4-trimethyl pentyl) phosphinic acid in kerosene*. J. Membr. Sci., 105(3): 217-226.
- 📖 Katsuta, S., Tsuchiya, F., Takeda, Y. **2000**. *Equilibrium studies on complexation in water and solvent extraction of zinc(II) and cadmium(II) with benzo-18-crown-6*. Talanta, 51: 637-644.
- 📖 Kertes, A.S., Halpern, M. **1961**. *Hydrochloric Acid Promoted Hydrolysis of Tri-n-butyl Phosphate*. J. Inorg. Nucl. Chem., 20: 117-126.
- 📖 Kertesz, R., Schlosser, S. **2005**. *Design and simulation of two phase hollow fiber contactors for simultaneous membrane based solvent extraction and stripping of organic acids and bases*. Sep. & Purif. Technol., 41: 275-287.
- 📖 Kertesz, R., Simo, M., Schlosser, S. **2005**. *Membrane-based solvent extraction and stripping of phenylalanine in HF contactors*. J. Membr. Sci., 257: 37-47.

- 📖 Kiani, A., Bhave, R., Sirkar, K. **1984**. *Solvent Extraction with immobilized interfaces in a microporous hydrophobic membrane*. J. Membr. Sci. 20 :125-145.
- 📖 Kim, K. W., Lee, E.H., Shin, Y.J., Yoo, J.H., Park, H.S. **1995**. *Removal of residual uranium in simulated radwaste solution by TBP*. Sep. Sci. & Technol., 30(17): 3351-3362.
- 📖 Kim, V., Bukar, N.V., Olenicheva, O.O., Sinegribova, O.A. **2001**. *Surface active phosphor- organic extractants: association, micelle and microemulsion formation*. XVI-th ARS SEPARATORIA. Borwno, Poland.
- 📖 Kirschling, P., Nowak, K., Miessiac, I., Nitsch, W., Szymanowsky, J. **2001**. *Membrane Extraction-Stripping Process for Zinc(II) Recovery from HCl Solution*. Solvent Extraction Research and Development, 8: 135-143.
- 📖 Klaassen, K., Jansen, A.E. **2001**. *The membrane contactors: Environmental applications and possibilities*. Environmental Progress, 20(1): 37-43.
- 📖 Klaassen, K., Jansen, A.E., **1996**. *Selective recovery of heavy metals with emulsion petrtraction*. Minerals Metals an Environment II. The Institution of Mining and Metallurgy, Londres.
- 📖 Klaassen, K., Jansen, A.E., **2004**. *Selective recovery of heavy metals with emulsion petrtraction*. Libro de Resúmenes de Euromembrane 2004: p.428. Hamburgo (Alemania), 28 Septiembre-1 Octubre.
- 📖 Klaassen, R., Jansen, A.E., Bult, B.A., Oesterholt, F.I.H.M., Schneider, J. **1994**. *Removal of hydrocarbons from wastewater by petrtraction*, Proceedings: p.316. 7th Intern Symp on Synthetic Membranes in Science and Industry, University of Tübingen, Tübingen, Germany.
- 📖 Klocker, H., Sainz Díaz, C.I., Marr, R., Bart, H.J. **1992**. *New approach in the modelling of extraction equilibrium of zinc with bis (2-ethylhexyl)_phosphoric acid*. Hydrometallurgy, 31: 13-28.
- 📖 Kubisová, L., Sabolová, E., Schlosser, S. Marták, J., Kertész, R. **2002**. *Membrane based solvente extraction and stripping of a heterocyclic carboxylic acid in hollow fiber contactors*. Desalination, 148:205-211.

- 📖 Kubisova, L., Sabolova, E., Schlosser, S., Marták, J., Kertész, R. **2004**. *Mass-transfer in membrane based solvent extraction and stripping of 5-methyl-2-pyrazinecarboxylic acid and co-transport of sulfuric acid in HF contactors*. Desalination. 163(1-3): 27-38.
- 📖 Kumar, A., Haddad, R., Benzal, G., Ninou, R., Sastre, A.M. **2000**. *Use of modified membrane carrier system for recovery of gold cyanide from alkaline cyanide media using hollow fiber supported liquid membranes: feasibility studies and mass transfer modelling*. J. Membr. Sci., 174: 17-30
- 📖 Kyuchoukov, G., Mishonov, I. **1999**. *On the extraction of copper and zinc from chloride media by mixed extractant*. Solv. Extr. Res. Dev.-Japan, 6: 1-11.
- 📖 Kyuchoukov, G., Zhivkova, S., Borowiak-Resterna, A., Szymanowski, J. **2000**. *Separation of copper(II) and zinc(II) from chloride solutions with alkyl-8-hydroxyquinoline in various stages of extraction: stripping process*. Ind. Eng. Chem. Res., 39: 3896-3900.
- 📖 Li, K., Tai, M.S.L., Teo, W.K. **1994**. *Design of a CO₂ scrubber for self-contained breathing systems using a microporous membrane*. J. Memb. Sci., 86: 119-125.
- 📖 Li, T., Deen, N.G., Kuipers, J.A.M. **2005**. *Numerical investigation of hydrodynamics and mass transfer for in-line fiber arrays in laminar cross-flow at low Reynolds numbers*. Chemical Engineering Science. 60: 1837-1847.
- 📖 Lin, S.H., Juang, R.S. **2001**. *Mass-transfer in hollow-fiber modules for extraction and back-extraction of copper (II) with LIX 64N carriers*. J. Membr. Sci., 188: 251-262.
- 📖 Luo, F., Li, D., Wei, P. **2004**. *Synergistic extraction of zinc(II) and cadmium(II) with mixtures of primary amine N1923 and neutral organophosphorous derivatives*. Hydrometallurgy, 73: 31-40.

- 📖 Mansur, M.B., Slater, M.J., Biscaia, E.C. **2002**. *Kinetic analysis of the reactive liquid-liquid test system ZnSO₄/D2EHPA/n-heptane*. Hydrometallurgy. 63(2): 107-116.
- 📖 Marchese, J., Campderrós, M. **2004** *Mass transfer of Cadmium ions in a hollow-fiber module by pertraction*. Desalination. 164: 141-149.
- 📖 Matsumoto, M., Otono, T., Kondo, K. **2001**. *Synergistic extraction of organic acids with tri-n-octylamine and tri-n-butyl phosphate*. Sep. & Purif. Technol., 24: 337-342.
- 📖 Miesiac, I., Kirschling, P., Szymanowski, J. **2002**. *Extraction of Zinc(II) from Hydrochloric Acid Solutions in Membrane Contactors*. Metallurgical High Technology and New Materials of Heavy Nonferrous Metals. P.118-127. Yunan Science and Technology Press, Pen Jinhui, Ma Keyi.
- 📖 Miesiac, I., Szymanowski, J. **2004**. *Separation of Zinc(II) from Hydrochloric Acid Solutions in a Double Lewis Cell*. Solvent Extracion and Ion Exchange, 2: 243-265.
- 📖 Miralles, N., Sastre, A.M., Aguilar, M., Cox, M. **1992**. *Solvent extraction of zinc(II) by organophosphorous acids compounds from perchlorate solutions*. Solvent extraction and ion exchange, 10(1): 51-68.
- 📖 Mishonov, I.V., Alejski, K., Szymanowski, J. **2004**. *A contributive study on the stripping of zinc(II) from loaded TBP using an ammonia/ammonium chloride solution*. Solvent Extraction and Ion Exchange, 22 (2): 219-241.
- 📖 Morris, D. F. C.; Short, E. L. **1962**. *Zinc chloride and zinc bromide complexes. Part II. Solvent-extraction studies with zinc-65 as tracer*. Journal of the Chemical Society, 2662-2671.
- 📖 Mulder, M. **1996**. *Basic principles of membrane technology*. 2^a edición, Kluwer. Dordrecht.
- 📖 Nagaosa, Y., Binghua, Y. **1997**. *Extraction equilibria of some transition metal ions by bis(2-ethylhexyl)phosphonic acid*. Talanta, 44(3): 327-337.

- 📖 Nakashio, F., Sato, H., Kondo, K., Inoue, K., Kawano, Y. **1986**. *Solvent extraction of zinc from chloride media with secondary long-chain alkylamine*. *Solvent Extr. Ion Exch.*, 4: 757-770.
- 📖 Niemczewska, J., Cierpiszewski, R., Szymanowski, J. **2003**. *Extraction of zinc(II) from model hydrochloric acid solutions in Lewis cell*. *Physicochemical Problems of Mineral Processing*, 37: 87-96.
- 📖 Niemczewska, J., Cierpiszewski, R., Szymanowski, J. **2004**. *Mass transfer of zinc(II) extraction from hydrochloric acid solution in the Lewis cell*. *Desalination*, 162: 169-177.
- 📖 Nitsch, W., Plucinski, P. **1990**. *Two-phase kinetics of the solubilization in reverse micelles*. *J. Colloid Interface Sci.*, 136: 338-351.
- 📖 Noble, R.D., Way, J.D., Bunge, A.L., **1986**. *Liquid Membranes*. In *Solvent Extr. Ion Exch.*, 10:63-103. Marcus (ed.), Marcel Dekker, New York.
- 📖 Noble, R.N. **1995**. *Membrane Separation Technology*. Elsevier. Amsterdam.
- 📖 Ochkin, A.V., Nechaevsky, S., *Method of extraction equilibrium description in systems of TBP with chlorides*. *Proceedings CHISA 2000*.
- 📖 Ortiz, I., Amin, S., De Ortiz, E.S.P. **1899**. *Estudio del proceso de permeación de Zn a través de membranas líquidas en un tanque agitado*. *Anales de química*, 84: 106-110.
- 📖 Ortiz, I., Bringas, E., San Román, M.F., Urriaga, A. M. **2004**. *Selective Separation of Zinc and Iron from Spent Pickling Solutions by Membrane-Based Solvent Extraction: Process Viability*. *Sep. Sci. & Technol.*, 39: 1-15.
- 📖 Ortiz, I., Bringas, E., San Roman, M.F., Urriaga, A.M. **2004**. *Selective separation of Zinc and iron from spent pickling solutions by membrane-based solvent extraction: process viability*. *Sep. Sci & Technol.*, 39(10):2441-2455.
- 📖 Ortiz I., Galán B., Irabien A. **1996a**. *Membrane Mass Transport Coefficient for the Recovery of Cr (VI) in Hollow Fiber Extraction and Back-Extraction Modules*. *J. Membr. Sci.*, 118: 213-221.

- 📖 Ortiz, I., Galán, B., Irabien, A. **1996b**. *Kinetic analysis of the simultaneous nondispersive extraction and back-extraction of chromium (VI)*. Ind. Eng. Chem. Res., 35: 1369-1377.
- 📖 Ortiz, I., Galan, B., San Roman, F. Ibañez, R. **2001a**. *Kinetic of separating multicomponent mixtures by non-dispersive solvent extraction: Ni and Cd*. AIChE J., 47:895-905.
- 📖 Ortiz, I, San Roman, M.F., Corvalan, S.M., Eliceche, A.M. **2003**. *Modeling and optimisation of an emulsion pertraction process for removal and concentration of Cr(VI)*. Ind. Eng. Chem. Res., 42:5891-5899.
- 📖 Ortiz, I., San Roman, F. **2002**. *Analysis of the back-extraction of cadmium-nickel-D2EPHA organic phases*. Sep. Sci. Technol., 37(3):607-625.
- 📖 Ortiz, I., San Roman, F., Galán, B. **2001b**. *Kinetics of the recovery of Cd from highly concentrated solutions by non-dispersive solvent extraction*. Chem. Eng. J., 81: 129-136.
- 📖 Ortiz, I., Wongswan, S., Pérez de Ortiz, E.S. **1988**. *A systematic method for the study of the rate-controlling mechanisms in liquid membrane permeation processes. Extraction of Zinc by Bis(2-ethylhexyl)phosphoric acid*. Ind. Eng. Chem. Res., 27:1696-1701.
- 📖 Osseo-Asare, K. **1991**. *Aggregation, reversed micelles and microemulsions in liquid-liquid extraction: the tri-n-butyl phosphate-diluent-water electrolyte system*. Adv. Colloid Interface Sci., 37: 123-173.
- 📖 Osseo-Asare, K. **2002**. *Microemulsion and tirad phase formation*. Proceedings ISEC 2002, Cape Town, 2: 118-124.
- 📖 Out, E.O., Westland, A.D. **1989**. *Liquid-liquid extraction of some M(II) and M(III) ions with 2-hethylhexylhydrogenphenyl phosphate*. Polyhedron., 8(1): 1307-1313.
- 📖 Owusu, G. **1998**. *Selective extraction of Zn and Cd from Zn-Cd-Co-Ni-sulphate solution using di-2-ethylhexyl phosphoric acid extractant*. Hydrometallurgy, 47: 205-215.

- 📖 Pierre, F.X., Souchon, I., Athes-Dutuor, V., Marin, M. **2002**. *Membrane-based solvent extraction of sulfur aroma compounds: influence of operating conditions on mass transfer coefficients in a hollow fiber contactor*. *Desalination*, 148:199-204.
- 📖 Pierre, F.X., Souchon, I., Marin, M. **2001**. *Recovery of sulfur aroma compounds using membrane-based solvent extraction*. *J. Membr. Sci.*, 187: 239-253.
- 📖 Prasad, R., Sirkar, K. **1988**. *Dispersión free solvent extraction with microporous hollow fiber modules*. *AIChE J.*, 34:177-188.
- 📖 Principe F., Demopoulos G.P. **2002**. *The solubility and stability of organophosphoric acid extractants in H₂SO₄ and HCl media*. *Hydrometallurgy*, 68: 115-124.
- 📖 Qdais, H.A., Moussa, H. **2004**. *Removal of heavy metals from wastewater by membrane processes: a comparative study*. *Desalination*, 164: 105-110.
- 📖 Rituper, R. **1990**. *Procesos de regeneración de baños agotados de decapado. Una técnica limpia y rentable para la protección del medio ambiente*. *Ingeniería química*, 125-129.
- 📖 Regel, M., Sastre, A. M., Szymanowski, J. **2001**. *Recovery of zinc(II) from HCl spent pickling solutions by solvent extraction*. *Environmental Science & Technology*, 35: 630-635.
- 📖 Regel, M., Sastre, A. M., Szymanowski, J. **2002**. *Zinc(II) extraction from hydrochloric acid solutions with basic and solvating extractants*. *XVII-th ARS SEPARATOORIA* Borowno, Poland.
- 📖 Regel, M., Szymanowski, J. **2005**. *Iron Transfer to the Organic Phase During Zinc(II) Extraction from Spent Pickling Solutions with Tributyl Phosphate*. *Solvent Extr. Ion Exch.*, 23: 411-424.
- 📖 Regel-Rosocka, M., Miesiac, I., Cierpiszewski, R., Mishonov, I., Alejski, K., Sastre, A.M., Szymanowski, J. **2003**. *Recovery of zinc(II) from spent hydrochloric acid solutions from zinc hot-dip galvanizing plants*. *Hydrometallurgy*, 2: 1577-1591.

- 📖 Regel-Rosocka, M., Miesiac, I., Sastre, A.M., Szymanowski, J. **2002**. *Screening of reagents for recovery of zinc(II) from hydrochloric acid spent pickling solutions*. Proceeding of the international solvent extraction conference, ISEC 2002.
- 📖 Regel-Rosocka, M., Zawistowski, P., Sastre, A.M., Szymanowski, J. **2003**. *Selection of extractants for dispersive extraction of zinc(II) from hydrochloric acid solutions*. Polish Journal of Applied Chemistry. XLVII(2): 83-94
- 📖 Reis, M.T., Carvalho, J.M. **2004**. *Modelling of zinc extraction from sulphate solutions with bis(2-ethylhexyl)tiophosphoric acid by emulsion liquid membranes*. J. Membr. Sci., 237: 97-107.
- 📖 Rice, N.M., Smith, M.R. **1975**. *Recovery of zinc, cadmium, and mercury (II) from chloride and sulphate membrane by solvent extraction*. J. Appl. Chem. Biotechnol. 25: 379-402.
- 📖 Rodríguez de San Miguel, E., Aguilar, J.C., Bernal, J.P., Ballinas, M.L., Rodríguez, M. T. J., Gyves, J., Schimmel, K. **1997**. *Extraction of Cu(II), Fe(III), Ga(III), Ni(II), In(III), Co(II), Zn(II), and Pb(II) with LIX 984[®] dissolved in n-heptane*. Hydrometallurgy, 47:19-30.
- 📖 Rodríguez de San Miguel, J.C., Aguilar J.C., Rodriguez, M.T.J., Gyves, J. **2000**. *Solvent extraction of Ga(III), Cd(II), Fe(III), Zn(II), Cu(II) and Pb(II) with ADOGEN 364 dissolved in kerosene from 1-4 mol dm⁻³ HCl media*. Hydrometallurgy, 57: 151-165.
- 📖 Rovira, M., Sastre, A.M. **1998**. *Modelling of mass transfer in facilitated supported liquid-membrane transport of palladium (II) using di-(2-ethylhexyl) thiophosphoric acid*. J. Membr. Sci., 149 (2): 241-250.
- 📖 Rozenblat, M., Regel-Rosocka, M., Szymanowski, J. **2004**. *Metal removal from spent pickling solutions of high zinc(II) concentration*. Physicochemical problems of mineral processing, 38: 121-129.
- 📖 Salazar, E., Ortiz, I., Urriaga, A.M. **1992**. *Equilibrium and Kinetics of Cr(VI) Extraction with Aliquat 336*. Ind. Eng. Chem. Res., 31: 1516-1522.

- Salgado, A. L., Veloso, A. M.O., Pereira, D. D., Gontijo, G. S., Salum, A., Mansur, M. B. **2003**. *Recovery of zinc and manganese from spent alkaline batteries by liquid-liquid extraction with CYANEX 272*. Journal of powersources, 115: 367-373
- San Martín, M., Bart, H.J. **1994**. *Recovery of zinc from spent pickling baths with Amberlite LA-2. Influence of modifier on the extraction equilibrium*. Chem. Eng. Technol., 17: 397-400.
- San Roman, M.F. **1999**. *Separación de mezclas Ni-Cd mediante extracción L-L- no dispersiva*. Tesis doctoral. Universidad de Cantabria. Santander España.
- San Roman, M.F. **1999**. *Separación de mezclas Ni-Cd mediante extracción L-L- no dispersiva*. Tesis doctoral. Universidad de Cantabria. Santander España.
- Sanad, W., Flex, H., Marei, S.A. **1993**. *Kinetics of zinc (II) chloride extraction with tributyl phosphate*. Journal of Radionalytical and Nuclear Chemistry 170 (1): 253-241.
- Sarangji, K., Das, R.P. **2004**. *Separation of copper and zinc by supported liquid membrane using TOPS-99 as mobile carrier*. Hydrometallurgy, 71: 335-342.
- Sastre, A.M., Szymanowski, J. **2003**. *Regeneration of waste hydrochloric acid solutions containing iron and zinc ions from zinc plating plants*. Nato Science Programme 2000-2003. SfP 972398.
- Sastre, A. Madi, J.L. Cortina, N., Miralles, N. **1998**. *Modelling of mass transfer in facilitated supported liquid-membrane transport of gold (III) using phospholene derivatives as carriers*. J. Membr. Sci., 138 (1): 57-65
- Schoner, P., Plucinski, P., Nitsch, W., Daiminger, U. **1998**. *Mass transfer in the shell side of cross flow hollow fiber modules*. Chemical Engineering Science, 53: 2319-2326.

- 📖 Semmens, M.J., Quin, R., Zander, A. **1989**. *Using a microporous hollow-fiber membrane to separate VOCs from water*. J. Am. Water Work Assoc., 81: 162-167.
- 📖 Sengupta, A., Basu, R., Sirkar, K. **1988**. *Separation of solutes from aqueous solutions by contained liquid membranes*. AIChE J., 34:1698-1708.
- 📖 Simonin, J.P., Hendrawan, H., Dardoize, F., Clodic, G. **2003**. *Study of salt effects on the kinetics of extraction of cobalt (II) and zinc(II) at trace level by D2EHPA in n-dodecane*. Hydrometallurgy, 69(1-3): 23-28.
- 📖 Singh, D., Singh, O.V., Tandon, S.N. **1980**. *Extraction of zinc thiocyanate complex by tributyl phosphate in benzene*. Analytica Chimica Acta., 115: 369-372.
- 📖 Singh, R.K., Dahdke, P.M. **2002**. *Extraction and separation studies of zinc(II) and copper(II) with D2EHPA and PC-88A from perchlorate media*. J. Serb. Chem. Soc., 67(1): 41-51
- 📖 Sixiu, S., Ying, W., Quiseng, S., Yonguy, Y., Jinglan, S. **1995**. *Studies on the extraction of Zn(II) by CYANEX 272. Extraction kinetics*. Wenhua Shandong Daxue Xuebao, Ziran Kesueban, 30(3): 312-317.
- 📖 Soldenhoff, K., Shamieh, M., Manis, A. **2005**. *Liquid-liquid extraction of cobalt with hollow fiber contactor*. J. Membr. Sci., 252: 183-194.
- 📖 Soldenhoff, K., Shamieh, M., Manis, A. **2005**. *Liquid-liquid extraction of cobalt with hollow fiber contactor*. J. Membr. Sci., 252: 183-194.
- 📖 Swain, B., Sarangi, K., Das, R.P. **2004**. *Separation of cadmium and zinc by supported liquid membrane using TOPS-99 as mobile carrier*. Sep. Sci. & Technol., 39(9): 2171-2188.
- 📖 Tai, C. Y., You, G., Chen, S. **2000**. *Kinetics study on supercritical fluid extraction of zinc(II) ion from aqueous solution*. Journal of Supercritical Fluids, 18: 201-212.
- 📖 Jiang, T., Yuanfu, S. **1992**. *Extraction of Zn by TBP from chloride liquors*. Gaoxiao Huaxue Gongcheng Xuebao, 6(1): 70-74.

- 📖 Tondre, C., Derouiche, A. **1990**. *Mechanism of solute transfer across water / oil interfaces in biphasic microemulsion systems*. J. Phys. Chem., 94: 1624-1626.
- 📖 Torz, M., Alejski, J., Szymanowsky, J. **2002**. *Recovery of zinc(II) from model hydrochloric acid solutions in hollow fiber modules*. Physicochemical Problems of Mineral Processing, 36: 101-113.
- 📖 Torz, M., Alejski, J., Szymanowsky, J. 2003. **2003**. *Extraction of Zinc(II) in hollow fiber modules*. Polish Journal of Chemical Technology, 5(4): 65-66.
- 📖 *Ullmann's Encyclopedia of Industrial Chemistry*. 7^a Edición **2005**. John Wiley & Sons.
- 📖 Urtiaga, A., Abellán, M. J., Irabien, J. A., Ortiz, I. **2005**, *Membrane Contactors for the Recovery of Metallic Compounds. Modelling of Copper Recovery from WPO Processes*. J. Membr. Sci., 257(1-2): 161-170.
- 📖 Urtiaga, A.M., Alonso, A., Ortiz, I., Daoud, J.A., El-Reefy, S.A., Pérez de Ortiz, S., Gallego, T. **2000a**. *Comparison of liquid membrane processes for the removal of cadmium from wet phosphoric acid*. J. Membr. Sci., 164: 229-240
- 📖 Urtiaga, A.M., Irabien, J.A. **1993**. *Internal mass transfer in hollow fiber supported liquid membranes*. AIChE J., 39: 521-525.
- 📖 Urtiaga, A., Muela, C., Ortiz, I. **2002**. *Catalyst recovery from Wet Peroxide oxidation process by means of non-dispersive solvent extraction*. ISEC 2002 Proceedings of the International Solvent Extraction Conference, 2: 846-851. Chris van Rensburg publication Ltd, Melville Sudafrica 2002.
- 📖 Urtiaga, A., Ortiz, I., Irabien, A. **1990**. *Phenol recovery with liquid membranas*. I.Chem. E. Symposium Series, 119, 35-46.
- 📖 Urtiaga, A., Ortiz, I., Irabien, A. **1992a**. *Supported liquid membranes for the separation concentration of phenol I. Viability and mass transfer evaluation*. Ind. Eng. Chem. Res., 31:877-886.
- 📖 Urtiaga, A., Ortiz, I., Salazar, E., Irabien, A. **1992b**. *Supported liquid membranes for the separation-concentration of phenol II. Mass transfer*

- evaluation according to fundamental equations. Ind. Eng. Chem. Res.*, 31: 1745-1753.
- 📖 Urtiaga, A., Ruiz, G., Ortiz, I. **2000b**. *Kinetic analysis of the vacuum membrane distillation of chloroform from aqueous solutions. J. Membr. Sci.*, 165(1): 99-110.
- 📖 Vajda, M., Havalda, I., Macek, R. **2004**. *Membrane-based solvent extraction and stripping of zinc in a hollow-fibre contactor operating in a circulating mode. Desalination*, 163: 19-25.
- 📖 Van de Voorder, I., Pinoy, L., Ketelaere, R.F. **2004**. *Recovery of nickel by supported liquid membrane (SLM) extraction. J. Membr. Sci.*, 234:11-21.
- 📖 Venkateswaran, P., Palanivelau, K. **2005**. *Studies on recovery of hexavalent chromium from plating waste water by supported liquid membrane using tri-n-butyl phosphate as carrier. Hydrometallurgy*, 78: 107-115.
- 📖 Walsh, A.J., Monbouquette, H.G. **1993**. *Extraction of Cd²⁺ and Pb²⁺ from diluted aqueous solution using metal-sorbing vesicles in a hollow-fiber cartridge. J. Membr. Sci.*, 84:107-121.
- 📖 Wassink, B., Dreisinger, D., Howard, J. **2000**. *Solvent extraction separation of zinc from nickel and cobalt using Aliquat 336, a strong base anion exchanger, in the chloride and thiocyanate forms. Hydrometallurgy*, 57: 235-252.
- 📖 Wojtaszak, A., Miesiac, I., Szymanowski, J. **2000**. *Extraction of zinc(II), iron(II) and iron(III) from hydrochloric acid solutions. Physicochem. Problems Mineral. Proc*, 25: 31-37.
- 📖 Yang, D., Majumdar, S., Kovenklioglu, S. and Sirkar, K.K. **1995**. *Hollow fiber contained liquid membrane pervaporation system for the removal of toxic volatile organics from wastewater. J. Membr. Sci.*, 103:195-210.
- 📖 Yang, M., Cussler, E. **1986** *Designing Hollow-Fiber Contactors' AIChE J.*, 32: 1910-1916.

- 📖 Yang, X.J., Fane, A.G. **1999**. *Performance and stability of supported liquid membrane using LIX 984N for copper transport*. J. Membr. Sci., 156:251-263.
- 📖 Yang, Z.F., Guha, A.K., Sirkar, K.K. **1996a**. *Simultaneous and synergistic extraction of cationic and anionic heavy metallic species by a mixed solvent extraction system and a novel contained liquid membrane device*. Ind. Eng. Chem. Res., 35:4214-4220.
- 📖 Yang, Z. F., Guha, A., Sirkar, K.K. **1996b**. *Novel membrane-based synergistic metal extraction and recovery processes*. Ind. Eng. Chem. Res., 35:1383-1394.
- 📖 Yeh, H., Huang, C. **1995**. *Solvent extraction in multipass parallel-flow exchangers of microporous hollow-fiber modules*. Sep. Sci. Technol., 33(5): 757-765.
- 📖 Yun, C., Prasad, R., Sirkar, K. **1992**. *Membrane solvent extraction of priority organic pollutants from aqueous waste streams*. Ind. Eng. Chem. Res. 31:1709-1717.
- 📖 Yun, C., Prasad, R., Sirkar, K. **1993**. *Hollow fiber solvent extraction removal of toxic heavy metals from aqueous waste streams*. Ind. Eng. Chem. Res., 32: 1186-1194.
- 📖 Zhao, R., Pan, P. **2001**. *A spectrophotometric study of Fe(II)-chloride complexes in aqueous solutions from 10-100°C*. Can. J. Chem., 79: 131-144.
- 📖 Zheng, J.M., Dai, Z.W., Wong, F.S., Xu, Z.K. **2005**. *Shell side mass transfer in a transverse flow hollow fiber membrane contactor*. J. Membr. Sci., 261: 114-120.
- 📖 Zhivkova, S., Dimitrov, K., Kyuchoukov, G., Boyadzhiev, L. **2004**. *Separation of zinc and iron by pertraction in rotating film contactor with Kelex 100 as a carrier*. Sep. & Purif. Technol., 37: 9-16.

- 📖 Zou, L., Chen, J., Huang, Y. **2004**. *An alternative way to separating Ir(IV) and Rh(III) ions from a mixed chloride solution with added stannous chloride*. *Hydrometallurgy*, 72: 31-37.
- 📖 Zou, L., Chen, J., Pan, X. **1998**. *Solvent extraction of rhodium from aqueous solution of Rh(III)-Sn(II)-Cl- system by TBP*. *Hydrometallurgy*, 50: 193-203.