

7. REFERENCES

- ACUAVALLE S.A ESP (1994). *Design Reports of the Municipal Wastewater Treatment Plants of Ginebra and Toro*. Santiago de Cali, Valle del Cauca, Colombia. (in Spanish).
- Agunwamba, J.C., Egbuniwe, N. and Ademiluyi, J.O. (1992). Prediction of the dispersion number in waste stabilisation ponds. *Wat. Res.* **26** (1), 85-89.
- Alberty, R.A. (1953). The relationship between Michaelis constants, maximum velocities and the equilibrium constant for an enzyme-catalysed reaction. *Jou. Am. Chem. Soc.* **75**, 1928-1932.
- Almasi, A. and Pescod, M.B. (1996). Wastewater treatment mechanisms in anoxic stabilisation ponds. *Wat. Sci. Tech.* **33** (7), 125-132.
- Alphenaar, P.A., Perez, M.C. and Lettinga, G. (1993). The influence of substrate transport limitation on porosity and methanogenic activity of anaerobic sludge granules. *Appl. Microbiol. Biotech.* **39**, 276-280.
- Anderson, G., Campos, C., Chernicharo, C. and Smith, L. (1991). Evaluation of the inhibitory effects of Lithium when used as a tracer for anaerobic digesters. *Wat. Res.* **25** (7), 755-760.
- Arceivala, S.J. (1981). *Wastewater Treatment and Disposal*. Marcel Dekker Inc. New York. USA.
- Arridge, H., Oragui, J.I., Pearson, H.W., Mara, D.D. and Silva, S.A. (1995). *Vibrio Cholerae* 01 and salmonellae removal compared with the die-off of faecal indicator organisms in waste stabilisation ponds in northeast Brazil. *Wat. Sci. Tech.* **31** (12), 249-256.
- Arthur, J.P. (1981). The development of design equations for facultative waste stabilisation ponds in semi-arid areas. *Proc. Instn. Civ. Engrs.* Part 2. **71**, 197-213.
- Avella, G.P. (2001). *Evaluation of the Hydrodynamic Behaviour of an UASB Reactor and its Influence on Organic Matter Removal*. M.Sc dissertation. Universidad del Valle, Instituto Cinara, Cali, Colombia. (in Spanish).
- Ayres, R.M., Alabaster, G.P., Mara, D.D. and Lee, D.L. (1992). A design equation for human intestinal nematode egg removal in waste stabilization ponds. *Wat. Res.* **26** (6), 863-865.
- Ayres, R.M. and Mara, D.D. (1996). Analysis of wastewater for use in agriculture – a laboratory manual of parasitological and bacteriological techniques. *World Health Organization*. Geneva, 1996.
- Azbar, N., Ursillo, P. and Speece, R.E. (2001). Effect of process configuration and substrate complexity on the performance of anaerobic processes. *Wat. Res.* **35** (3), 817-829.

- Babbitt, H.E. and Baumann, E.R. (1958). *Sewerage and Sewage Treatment*. John Wiley and Sons. Toronto, Canada.
- Bailey, J.E. and Ollis, D.F. (1986). *Biochemical Engineering Fundamentals*, 2nd ed. McGraw Hill, New York.
- Baleo, J.N., Humeau, P. and Le Cloirec, P. (2001). Numerical and experimental hydrodynamic studies of a lagoon pilot. *Wat. Res.* **35** (9), 2268-2276.
- Barber, W.P. and Stuckey, D.C. (1999). The use of the anaerobic baffled reactor (ABR) for wastewater treatment: a review. *Wat. Res.* **33** (7), 1559-1578.
- Barbosa, R.A and Sant' Anna, G.L. (1989). Treatment of raw domestic sewage in a UASB reactor. *Wat. Res.* **23** (12), 1483-1490.
- Barthakur, A., Munindra, B. and Devendra, S. (1991). Kinetic model for substrate utilization and Methane production in the anaerobic digestion of organic feeds. *Biotech. Prog.* **7** (4), 369-376.
- Bartone, C.R. (1985). Reuse of wastewater at the San Juan de Miraflores stabilisation ponds. *Bull. PAHO.* **19**, 147-164.
- Bitton, G. (1994). *Wastewater Microbiology*. John Wiley & Sons. New York, USA.
- Bolle, W.L., van Breugel, J., van Eybergen, G.C., Kossen, N.W.F. and Zoetemeyer, R.J. (1985). Modelling the liquid flow in up-flow anaerobic sludge blanket reactors. *Biotech. Bioeng.* **XXVIII**, 1615-1620.
- Bolle, W., van Breugel, J., van Eybergen, G., Koseen, N., and Van gils, W. (1986). An Integral dynamic model for the UASB reactor. *Biotech. Bioeng.* **28**, 1621-1636.
- Borzacconi, L., Lopez, I. and Viñas, M. (1995). Application of anaerobic digestion to the treatment of agro-industrial effluents in Latin America. *Wat. Sci. Tech.* **32** (12), 105-111.
- Brito, A.G. and Melo, L.F. (1999). Mass transfer coefficients within anaerobic biofilms: effects of external liquid velocity. *Wat. Res.* **33** (17), 3673-3678.
- Castillo, A., Llabres, P. and Mata-Alvarez, J. (1999). A kinetic study of a combined anaerobic-aerobic system for treatment of domestic sewage. *Wat. Res.* **33** (7), 1742-1747.
- Cenicaña (2000). *Annual Hydrometeorological Report from the Stations Network in the Geographic Region of River Cauca*. Santiago de Cali, Valle del Cauca, Colombia. (in Spanish).
- CEPIS. (1995). REPINDEX: Reuso de aguas residuales. Lima, Peru.
- Charpentier, J., Martin, G., Wacheux, H. and Gilles, P. (1998). ORP regulation and activated sludge: 15 years of experience. *Wat. Sci. Tech.* **38** (3), 197-208.
- Chen, Y.R. and Hashimoto, A.G. (1978). *Biotechnol. Bioeng. Symp.* **8**, 269-279.

- Chen, Y.R. and Hashimoto, A.G. (1980). *Biotech. Bioeng.* **22**, 2081-2090.
- Chernicharo, C.A., van Haandel, A., Mansur, M. and Cavalcanti, P.F. (1999). Sludge blanket anaerobic reactors. In: *Tratamento de Esgotos Sanitários por Processo Anaeróbio e Disposição Controlada no Solo*. (ed. J. R. Campos), 155-198. PROSAB, Rio de Janeiro, Brazil. (in Portuguese).
- Cherchinaro, C.A. and Cardoso, M.R. (1999). Development and evaluation of a partitioned UASB reactor for the treatment of domestic sewage from small villages. *Wat. Sci. Tech.* **40** (8), 107-113.
- Choi, E. and Rim, J.M. (1991). Competition and inhibition of sulphate reducers and methane producers in anaerobic treatment. *Wat. Sci. Tech.* **23** (10), 1259-1264.
- Chung, Y.C. and Neethling, J.B. (1990). Viability of anaerobic digester sludge. *Jou. Env. Eng. ASCE.* **116** (EE2), 330-342.
- Cohen, A., Breure, A.M., van Andel, J.G. and van Deursen, A. (1980). Influence of phase separation on the anaerobic digestion of glucose, I. Maximum COD-turn-over-rate during continuous operation. *Wat. Res.* **14**, 1439-1448.
- Collazos, C.J. (1986). *Report on the Operation of the Pilot Wastewater Treatment Plant La Rosita. Phase II. Corporación de Defensa de la Meseta de Bucaramanga.* Convenio CDMB-Gobierno Holandes. Bucaramanga, Colombia. (in Spanish).
- Correa, A.J. (1997). *Hydraulic Behaviour of the UASB Reactor No 1 at El Vivero Wastewater Treatment Plant in Cali.* B.Sc dissertation in Sanitary Engineering. Universidad del Valle, Cali, Colombia. (in Spanish).
- Dean, C. and Horan, N.J. (1995). *Applications of UASB Technology in Mauritius.* Research monographs in tropical public health engineering. Department of Civil Engineering, University of Leeds. Leeds, U.K.
- DFID (2000). Strategies for Achieving the International Development Targets. *Addressing the Water Crisis- Healthier and more productive lives for poor people.* Consultation Document. Department for International Development, London.
- DHI (1995). *Technical Reference Manual for MIKE 21.* Danish Hydraulic Institute, Copenhagen, Denmark.
- Diaz, C.M. and Howell, J.A. (1987). Stratified mixed-culture biofilm model for anaerobic digestion. *Biotech. Bioeng.* **32**, 348-355.
- Dixo, N., Gambrill, M., Catunda, P., and van Haandel, A. (1995). Removal of pathogenic organisms from the effluent of an upflow anaerobic digester using waste stabilization ponds. *Wat. Sci. Tech.* **31** (12), 275-284.
- Dolfing, J. and Bloemen, W. (1985). Activity measurements as a tool to characterize the microbial composition of methanogenic environments. *J. Microbiol. Methods.* **4** (1), 1-12.

- Droste, R.L. (1997). *Theory and Practice of Water and Wastewater Treatment*. John Wiley & Sons. New York, USA.
- Elefsiniotis, P. and Oldham, W.K. (1993). Anaerobic acidogenesis of primary sludge: The role of solids retention time. *Biotech. Bioeng.* **44** (1), 7-13.
- Feachem, R. and Cairncross, S. (1993). *Environmental Health Engineering in the Tropics*. John Wiley & Sons. 2nd. Ed. Chichester, England.
- Ferrara, R.A. and Harleman, D.R.F. (1980). Dynamic nutrient cycle model for waste stabilisation ponds. *Jou. Env. Eng. Div., Proc. Am. Soc. Civ. Eng.* **106**, 37-47.
- Ferrara, R.A. and Harleman, D.R.F. (1981). Hydraulic modelling for waste stabilisation ponds. *Jou. Env. Eng. Div. ASCE.* **107** (EE4), 817-830.
- Field, J.A (1994). Operational parameters of the anaerobic sludge bed in upflow reactors. In: *Manual del Curso Arranque y Operación de Reactores UASB*. Universidad del Valle-Universidad Agrícola de Wageningen-CVC. Cali, Colombia. (in Spanish).
- Florencio, L., Takayuki-Kato, M. and Cardoso, J. (2001). Domestic sewage treatment in full-scale UASB plant at Mangueira, Recife, Pernambuco. *Wat. Sci. Tech.* **44** (4), 71-77.
- Foresti, E. (2001). Perspectives of anaerobic treatment in developing countries. In: *Anaerobic Digestion for Sustainable Development: papers of the farewell seminar of Professor Gatze Lettinga*. (ed. J. van Lier and M. Lexmond), Wageningen, NL.
- Fritz, J.J., Middleton, A.C. and Meredith, D.D. (1979). Dynamic process modelling of wastewater stabilisation ponds. *JWPCF.* **51** (11), 2724-2743.
- Gloyna, E.F. and Espino, E. (1969). Sulphide production in waste stabilisation ponds. *Journal of the Sanitary Engineering Division. ASCE.* **95** (SA3), 607-628.
- Grady, C.P.L., Harlow, L.J. and Riesing, R.R. (1972). *Biotech. Bioeng.* **24**, 391-400.
- Grimason, A.M., Smith, H.V., Thitai, W.N., Smith, P.G., Jackson, M.H. and Girdwood, R.W.A. (1993). Occurrence and removal of *Cryptosporidium* spp. oocysts and *Giardia* spp. cysts in Kenyan waste stabilisation ponds. *Wat. Sci. Tech.* **27** (3-4), 97-104.
- Grimason, A.M., Smith, H.V., Young, G. and Thitai, W.N. (1996a). Occurrence and removal of *Ascaris* sp. ova by waste stabilisation ponds in Kenya. *Wat. Sci. Tech.* **33** (7), 75-82.
- Grimason, A.M., Wiandt, S., Baleux, B. Thitai, W.N., Bontoux, J. and Smith, H.V. (1996b). Occurrence and removal of *Giardia* sp. cysts by Kenyan and French waste stabilisation ponds systems. *Wat. Sci. Tech.* **33** (7), 83-89.

- Grin, P.C., Roersma, R.E. and Lettinga, G. (1983). Anaerobic treatment of raw sewage at lower temperatures. In: *Proceedings of the European Symposium on Anaerobic Wastewater Treatment*. Noordwijkerhout, NL.
- Grobicki, A. and Stuckey, D. (1991). Performance of the anaerobic baffled reactor under steady-state and shock loading conditions. *Biotech. Bioeng.* **37**, 344-355.
- Gu, R. and Stefan, H.G. (1995). Stratification dynamics in wastewater stabilization ponds. *Wat. Res.* **29** (8), 1909-1923.
- Guiot, S.R. (1991). Modelling of the upflow anaerobic sludge bed-filter system: A case with hysteresis. *Wat. Res.* **25** (3), 251-261.
- Haldane, J.B.S. (1930). *Enzymes*. Longmans, London.
- Hammad, S.M. (1996). Performance of a full scale UASB domestic wastewater treatment plant. *Journal of the IPHE, India.* **1**, 11-19.
- Han, K. and Levenspiel, O. (1987). Extended Monod kinetics for substrate, product and cell inhibition. *Biotech. Bioeng.* **32**, 430-437
- Harper, S.R. and Pohland, F.G. (1987). Enhancement of anaerobic treatment efficiency through process modification. *JWPCF.* **59** (3), 152-161.
- Harper, S.R. and Suidan, M.T. (1991). Anaerobic treatment kinetics: discussers report. *Wat. Sci. Tech.* **24** (8), 61-78.
- Haskoning (1989). *Anaerobic Treatment of Domestic Wastewater under Tropical Conditions*. Final technical report. Delft, NL.
- Haskoning and Euroconsult. (1990). *Monitoring Report of the 5 MLD UASB Treatment Plant at Kanpur*. Technical Report. Delft, NL.
- Henze, M. and Harremoës, P. (1983). Anaerobic treatment of wastewater in fixed film reactors-A literature review. *Wat. Sci. Tech.* **15** (1), 1-101.
- Heertjes, P.M. and Van der Meer, R.R. (1978). Dynamics of liquid flow in an up-flow reactor used for anaerobic treatment of wastewater. *Biotech. Bioeng.* **20**, 1577-1594.
- Heertjes, P.M. and Kuijvenhoven, L.J. (1982). Fluid flow pattern in upflow reactors for anaerobic treatment of beet sugar factory wastewater. *Biotech. Bioeng.* **XXIV**, 443-459.
- Hoeks, FWJMM., Ten Hoopen, HJG., Roels, J.A. and Kuenen, J.G. (1984). Anaerobic treatment of acid water (methane production in a sulphate rich environment). *Progr. Ind. Microbiol.* **20**, 113-119.
- Hoh, C.Y. and Cord-Ruwisch, R. (1996). A practical kinetic model that considers endproduct inhibition in anaerobic digestion processes by including the equilibrium constant. *Biotech. Bioeng.* **51** (5), 597-604.

- Horan, N.J. (1993). *Biological Wastewater Treatment Systems*. John Wiley & Sons. 1st. ed. Chichester, England.
- Idelovitch, E. and Michail, M. (1981). Nitrogen removal by free ammonia stripping from high pH Ponds. *JWPCF*. **53** (9), 1391-1401.
- Idelovitch, E. and Ringskog, K. (1997). *Wastewater Treatment in Latin America: Old and New Options*. The World Bank, Washington D.C.
- Iliuta, I., Thyron, F.C. and Muntean, O. (1998). Axial dispersion of liquid in gas-liquid co-current downflow and upflow fixed-bed reactors with porous particles. *Trans. Chem. Eng.* **76** (A), 64-72.
- Jacome, A.L. and Marin, C.S. (2001). *Evaluation of a Pilot-scale System for Domestic Wastewater Treatment: Septic Tank, Anaerobic Filter and Subsurface Wetland*. B.Sc dissertation in Sanitary Engineering. Universidad del Valle, Instituto Cinara, Cali, Colombia. (in Spanish).
- James, A. (1987). An alternative approach to the design of waste stabilisation ponds. *Wat. Sci. Tech.* **19** (12), 213-218.
- Jeyaseelan, S. (1997). A simple mathematical model for anaerobic digestion process. *Wat. Sci. Tech.* **35** (8), 185-191.
- Juanico, M. (1991). Should waste stabilisation ponds be designed for perfect mixing or plug-flow? *Wat. Sci. Tech.* **23**, 1495-1502.
- Kiely, G., Tayfur, G., Dolan, C. and Tanji, K. (1997). Physical and mathematical modelling of anaerobic digestion of organic wastes. *Wat. Res.* **31** (3), 534-540.
- Knörr, A.E. and Torrella, F. (1995). Microbiological performance and *Salmonella* dynamics in a wastewater depuration pond system of southeastern Spain. *Wat. Sci. Tech.* **31** (12), 239-248.
- Kvanli, A.H., Pavur, R.J. and Guynes, C.S. (2000). *Introduction to Business Statistics*. 5th ed. South-Western College Publishing, Cincinnati, USA.
- Lawrence, A.L. and McCarty, P.L. (1969). Kinetics of methane fermentation in anaerobic treatment. *JWPCF*. **41** (2), R1-R17.
- Lawrence, A.W., and McCarty, P.L. (1971). Kinetics of Methane Fermentation in Anaerobic Treatment. *J.W.P.C.F.* **41**, R1-R17.
- Lettinga, G., Van Velsen, A., Hobma, S., Zeeuw, W. and Klapwijk, A. (1980). Use of the upflow sludge blanket (USB) reactor concept for biological wastewater treatment, especially for anaerobic treatment. *Biotech. Bioeng.* **22**, 699-734.
- Lettinga, G., de Zeeuw, W. and Ouborg, E. (1981). Anaerobic treatment of wastes containing methanol. *Wat. Res.* **15**, 171-182.

- Lettinga, G., Roersma, R. and Grin, P. (1983). Anaerobic treatment of raw domestic sewage at ambient temperatures using a granular bed UASB reactor. *Biotech. Bioeng.* **25**, 1701-1723.
- Lettinga, G. (1995). Sustainable integrated biological wastewater treatment. In: *International Symposium on Technology Transfer: Achieving High Performance at Low Cost in Environmental and Sanitation Control Systems*. IAWQ. Salvador, Bahia. Brazil.
- Levenspiel, O. (1972). *Chemical Reaction Engineering*, 2nd ed. John Wiley & Sons, New York.
- Levenspiel, O. (1979). *The Chemical Reactor Omnibook*. OSU Book stores. Corvallis Oregon, USA.
- Levenspiel, O. (1999). *Chemical Reaction Engineering*, 3rd ed. John Wiley & Sons, New York.
- Lin, K. and Yang, Z. (1991). Technical review on the UASB process. *Int. Jou. Environ. Studies.* **39**, 203-222.
- Llorens, M. Sáez, J. and Soler, A. (1992). Influence of thermal stratification on the behaviour of a deep wastewater stabilisation pond. *Wat. Res.* **26** (5), 569-577.
- Long, T.U. (1990). *Modelling Processes in a UASB Reactor*. M.Sc. dissertation. IHE, Delft, NL.
- Lovley, D.R. (1985). Minimum threshold for hydrogen metabolism in methanogenic bacteria. *Appl. Env. Microbiol.* **49**, 1530-1531.
- Lovley, D.R., Dwyer, D.F. and Klug, M.J. (1982). Kinetic analysis of competition between sulphate reducers and methanogens for hydrogen in sediments. *Appl. Env. Microbiol.* **43**, 1373-1379.
- Man, A. W. A., Grin, P.C., Roesma, R.E., Grolle, K.C.F. and Lettinga, G. (1986). Anaerobic treatment of municipal wastewater at low temperatures. In: *Proceedings of Anaerobic Treatment a Grown-up Technology (AQUATECH 86)*, Amsterdam, NL.
- Mangelson, K.A. and Watters, G.Z. (1972). Treatment efficiency of waste stabilisation ponds. *J. San. Env. Eng. Div. ASCE.* **SA2**, 407-425.
- Manzi, V. (2000). *Evaluation of the Sludge Bed and Blanket Behaviour During Start-up of an UASB Reactor*. B.Sc dissertation in Sanitary Engineering. Universidad del Valle, Instituto Cinara, Cali, Colombia. (in Spanish).
- Mara, D.D., Pearson, H.W. and Silva, S.A. (1983). Brazilian stabilisation pond research suggests low-cost urban applications. *World Water.* **6** (7), 20-24.
- Mara, D.D. and Pearson, H.W. (1986). Artificial freshwater environments: Waste stabilisation ponds. In: *Biotechnology*. Vol 8. (ed. W. Schoenborn), pp. 177-206. Weinheim: VCH Verlagsgesellschaft.

- Mara, D.D., Pearson, H.W., Alabaster, G.P. and Mills, S.W. (1990). An evaluation of waste stabilisation ponds in Kenya. Final Report ODA Research Scheme R4442A. University of Leeds, Department of Civil Engineering, Leeds. England.
- Mara, D.D., Alabaster, G.P., Pearson, H.W. and Mills, S.W. (1992). *Waste Stabilisation Ponds: A Design Manual for Eastern Africa*. Lagoon Technology International. Leeds, England.
- Mara, D.D. and Mills, S.W. (1994). Who's afraid of anaerobic ponds?. *Wat. Qual. Int.* **2**, 34-36.
- Mara, D.D. (1996). *Low-cost Urban Sanitation*. John Wiley & Sons, Chichester, England.
- Mara, D.D., Pearson, H., Oragui, J., Arridge, H. and Silva, S.A. (2001). *Development of a New Approach to Waste Stabilization Pond Design*. Research monographs in tropical public health engineering. School of Civil Engineering, University of Leeds. Leeds, U.K.
- Marais, G.v.R. (1966). New factors in the design, operation and performance of waste stabilization ponds. *Bulletin of the World Health Organization*, **34**, 737-763.
- Marais, G.v.R. (1970). Dynamic behaviour of oxidation ponds. In: *Proceedings of the 2nd. International Symposium on Waste Treatment Lagoons*. Kansas city. USA.
- Marais, G.v.R. and Ekama, G.A. (1976). The activated sludge process part I: Steady state behaviour. *Water SA*. 163.
- Marecos do Monte, M.H F. and Mara, D.D. (1987). The hydraulic performance of waste stabilisation ponds in Portugal. *Wat. Sci. Tech.* **19** (12), 219-227.
- Mascareño, C. and Balbi, G. (1995). Municipalities and decentralisation: necessity of information for local governments. CIID. Montevideo, Uruguay. (in Spanish).
- Massey, B. (1998). *Mechanics of fluids*. 7th ed. Stanley Thornes Ltd. Cheltenham, UK.
- McCarty, P.L. (1990). Modelling of anaerobic processes. *Presented at the IAWPRC Workshop on Anaerobic Treatment of Wastewater*. Valladolid, Spain.
- McCarty, P.L. (2001). The development of anaerobic treatment and its future. In: *Anaerobic Digestion for Sustainable Development: papers of the farewell seminar of Professor Gatzke Lettinga*. (ed. J. van Lier and M. Lexmond), Wageningen, NL.
- McInernay, M.J., Bryant, R.B., Hespell, R.B. and Costerton, J.W. (1981). *Syntrophomonas wolfei*, gen. nov. sp. nov., an anaerobic syntrophic, fatty acid-oxidizing bacterium. *Appl. Env. Microbiol.* **41**: 1029-1039.
- Meiring, P.G., Drews, R.J., van Eck, H. and Stander, G.J. (1968). A guide to the use of pond systems in South Africa for the purification of raw and partially treated sewage. CSIR Special Report WAT 34. Pretoria: National Institute for Water Research.

- Meron, A., Rebhun, M. and Sless, B. (1965). Quality changes as a function of detention time in wastewater stabilisation ponds. *JWPCF*. 37 (12): 1657-1670.
- Metcalf and Eddy, Inc. (1991). *Wastewater engineering: Treatment, disposal and reuse*. McGraw Hill. 3rd ed. New York, USA.
- Middlebrooks, E.J., Middlebrooks, C.H., Reynolds, J.H., Walters, G.Z., Reed, S.C. and George, D.B. (1982). *Wastewater stabilisation lagoon design, performance and upgrading*. New York: Macmillan Publishing Co.
- MINAMBIENTE (1998). *Applied Technologies for the Treatment of Domestic Wastewaters in Colombia*. Technical Report. Ministerio del Medio Ambiente, Bogotá, Colombia. (in Spanish).
- MINDESARROLLO (1998). *National Inventory of the Water and Sanitation Sector*. Technical Report. Ministerio de Desarrollo Económico. Bogotá, Colombia. (in Spanish).
- Molina, F. and Alazard, D. (1997). Microbiology of anaerobic digestion and characterisation of anaerobic sludge. ORSTOM, Universidad de Antioquia. Cali, Colombia. (in Spanish).
- Monroy, O., Noyola, A., Ramirez, F. and Guyot, J.P. (1988). Anaerobic digestion and water hyacinth as a highly efficient treatment process for developing countries. In: *Proceedings of the 5th International Symposium on Anaerobic Digestion*. Bologna, Italy.
- Monroy, O., Fama, G., Meraz, M., Montoya, L. and Macarie, H. (2000). Anaerobic digestion for wastewater treatment in Mexico: state of the technology. *Wat. Res.* 34 (6), 1803-1816.
- Montgomery, D.C. (1997). *Design and Analysis of Experiments*. 4th ed. John Wiley & Sons, New York.
- Moreno, M.D. (1990). A tracer study of the hydraulics of facultative stabilisation ponds. *Wat. Res.* 24 (8), 1025-1030.
- Moscoso, J. and León, R. (1995). Reuse of wastewaters in Peru. Bulletin of Sanitary and Environmental Engineering. Buenos Aires, Argentina. (in Spanish).
- Mulder, A. (1984). The effects of high sulphate concentrations on the methane fermentation of wastewater. *Progr. Ind. Microbiol.* 20, 133-143.
- Mulder, R., Vereijken, T.L.F. and Vellinga, S.H.J. (2001). Future perspectives in reactor development. In: *Anaerobic Digestion for Sustainable Development: papers of the farewell seminar of Professor Gatze Lettinga*. (ed. J. van Lier and M. Lexmond), Wageningen, NL.
- Narnoli, S. and Mehrotra, I. (1997). Sludge blanket of UASB reactor: mathematical simulation. *Wat. Res.* 31 (4), 715-726.

- Nelson, K.L. and Jimenez, B.C. (2000). Sludge accumulation, properties and degradation in a waste stabilisation pond in Mexico. *Wat. Sci. Tech.* **42** (10-11), 231-236.
- Nobre, C.A. and Guimaraes, M.O. (1987). Experiments of anaerobic digestion of urban wastes. *Revista DAE*, **47**, 75. (in Portuguese).
- Oldham, W.K. and Nemeth, L. (1973). Anaerobic lagoons for treatment of high-strength organic wastes. *JWPCF*. **45** (11), 2397-2403.
- Oliveira, R., Silva, S., Araujo, A., Soares, J., Mara, D.D., and Pearson, H. (1996). The performance of a pilot-scale series of ten ponds treating municipal sewage in northeast Brazil. *Wat. Sci. Tech.* **33** (7), 57-61.
- Oragui, J.I., Arridge, H., Mara, D.D., Pearson, H.W. and Silva, S.A. (1993). *Vibrio Cholerae* 01 (EI Tor) removal in waste stabilisation ponds in northeast Brazil. *Wat. Res.* **27** (4), 727-728.
- Oragui, J.I., Arridge, H., Mara, D.D., Pearson, H.W. and Silva, S.A. (1995). Rotavirus removal in experimental waste stabilisation pond systems with different geometries and configurations. *Wat. Sci. Tech.* **31** (12), 285-290.
- Owen, W.F., Stuckey, D.C., Healy, J.B., Young, L.Y. and McCarty, P.L. (1979). Bioassay for monitoring biochemical methane potential and anaerobic toxicity. *Wat. Res.* **13** (6), 485-492.
- PAHO (2001). *Health, Potable Water and Sanitation in Sustainable Human Development*. Technical report. 43rd Consejo Directivo, Sesión del Comité Regional. Washington D.C, USA. (in Spanish).
- Paing, J., Picot, B., Sambuco, J.P. and Rambaud, A. (2000). Sludge accumulation and methanogenic activity in an anaerobic lagoon. *Wat. Sci. Tech.* **42** (10-11), 247-255.
- Parkin, C.F., Lynch, N.A., Kuo, W.C., Van Keuren, E.L. and Bhattacharya, S.K. (1990). Interaction between sulphate reducers and methanogens fed acetate and propionate. *JWPCF*. **62**, 780-788.
- Patel, G.B. and Sprott, G.D. (1990). *Methanosaeta concilii* New Genus, New Species (*Methanothrix concilii*) and *Methanosaeta thermoacetophila* New Combination, Revived Name. *Int. Jou. System. Bact.* **40** (1), 79-82.
- Pavlostathis, S.G. and Gossett, J.M. (1986). Kinetics of anaerobic digestion. *Biotech. Bioeng.* **28**, 1519-1525.
- Pavlostathis, S.G. and Giraldo-Gomez, E. (1991). Kinetics of anaerobic treatment. *Wat. Sci. Tech.* **24** (8), 35-59.
- Pearson, H.W. (1996). Expanding the horizons of pond technology and application in an environmentally conscious world. *Wat. Sci. Tech.* **33** (7), 1-9.

- Pearson, H. W., Mara, D.D., Cawley, L.R., Arridge, H.M. and Silva, S.A. (1996). The performance of an innovative tropical experimental waste stabilisation pond system operating at high organic loadings. *Wat. Sci. Tech.* **33** (7), 63-73.
- Peña, M.R. (1995). *Waste Stabilisation Ponds for Small Urban Communities in Colombia*. M.Sc Dissertation in Tropical Public Health Engineering. University of Leeds, U.K.
- Peña, M.R., Mara, D.D. and Sanchez, A. (2000). Dispersion studies in anaerobic ponds: implications for design and operation. *Wat. Sci. Tech.* **42** (10-11), 273-282.
- Peña, M.R., Madera, C.A. and Mara, D.D. (2002). Feasibility of waste stabilization pond technology for small municipalities in Colombia. *Wat. Sci. Tech.* **45** (1), 1-8.
- Pescod, M.B. (1996). The role and limitations of anaerobic pond systems. *Wat. Sci. Tech.* **33** (7), 152-160.
- Peters, J.F., Howington, S.E., Tracy, F.T. and Hollanda, J.P. (1998). *Effects of Subsurface Heterogeneity on Groundwater Subsurface Flows and Transport*. A DoD HPC Challenge Project Report. Technical University of Delft, Delft.
- Pfeffer, J.T. (1974). *Biotech. Bioeng.* **16**, 771-780.
- Polprasert, Ch. and Bhattarai, K.K. (1985). Dispersion model for waste stabilisation ponds. *Jou. Env. Eng. ASCE.* **111** (1), 45-59.
- PROSAB (1999). *Domestic Wastewater Treatment by Anaerobic Processes and Controlled Disposal on Soil*. J. R. Campos (ed.), PROSAB, Rio de Janeiro, Brazil. (in Portuguese).
- Rinzema, A., Paardekooper, A.H., De Vegt, A.L. and Lettinga, G. (1986). Anaerobic treatment of edible oil refinery wastewater in granular sludge UASB reactors. In: *Proceedings of the EWPCA Conference on Anaerobic treatment, a Grown up Technology*. Amsterdam, NL.
- Rinzema, A. and Schultz, C.E. (1987). *Anaerobic Treatment of Acid Water on a Semitechnical Scale*. Final report prepared for the ministry of housing, physical planning and environment. Agricultural University of Wageningen, Department of Water Pollution Control. NL.
- Rinzema, A. (1988). *Anaerobic Treatment of Wastewater with High Concentrations of Lipids and Sulphate*. Ph.D thesis, Wageningen Agricultural University, Wageningen, NL.
- Rodríguez, J.A., Peña, M.R. and Manzi, V. (2001). Application of an innovative methodology to improve the starting-up of UASB reactors treating domestic sewage. *Wat. Sci. Tech.* **44** (4), 295-303.
- Rojas, O. (1994). Relation between alkalinity and volatile fatty acids. In: *Manual del Curso Arranque y Operación de Reactores UASB*. Universidad del Valle-Universidad Agrícola de Wageningen-CVC. Cali, Colombia. (in Spanish).

- Salter, H.E., Ta, C.T., Ouki, S.K. and Williams, S.C. (2000). Three-dimensional computational fluid dynamic modelling of a facultative lagoon. *Wat. Sci. Tech.* **42** (10-11), 335-342.
- Samson, R. and Guiot, S. (1985). Mixing characteristics and performance of the anaerobic upflow blanket filter (UBF) reactor. *J. Chem. Tech. Biotechnol.* **35** (B), 65-74.
- Sanchez, A. (2001). *Dispersion Studies in the Anaerobic Ponds of Ginebra and Toro, Valle del Cauca, Colombia*. M.Sc Dissertation. Universidad del Valle, Instituto Cinara, Cali, Colombia. (in Spanish).
- Saqqar, M.M. and Pescod, M.B. (1995). Modelling the performance of anaerobic wastewater stabilisation ponds. *Wat. Sci. Tech.* **31** (12), 171-183.
- Sawyer, C.N. and McCarty, P.L. (1978). *Chemistry for Environmental Engineers*. 3rd ed. McGraw-Hill Book Co. New York.
- Schellinkhout, A., Lettinga, G., Van Velsen, L., Louwe Kooijmans, J. and Rodrigues, G. (1985). The application of the UASB reactor for direct treatment of domestic wastewater under tropical conditions. In: *Proceedings of the seminar on anaerobic treatment of sewage*. M. S. Schwitzenbaum (ed.), University of Massachusetts, Amherst, MA, USA.
- Schellinkhout, A., Jakma, F.F.G.M. and Forero, G.E. (1988). Sewage treatment: The anaerobic way is advancing in Colombia. In: *Proceedings of the 5th International Symposium on Anaerobic Digestion*. Bologna, Italy.
- Seereeram, S.M. (2001). *The Enhancement of Biomass in an Anaerobic Digester Using Inert Support Media*. Ph.D thesis, School of Civil Engineering, University of Leeds, Leeds, UK.
- Shilton, A. (2000). Potential application of computational fluid dynamics to pond design. *Wat. Sci. Tech.* **42**(10-11), 327-334.
- Shilton, A., Wilks, T., Smyth, J. and Bickers, P. (2000). Tracer studies on a New Zealand waste stabilisation pond and analysis of treatment efficiency. *Wat. Sci. Tech.* **42** (10-11), 343-348.
- Silva, S.A., Oliveira, R., Soares, J., Mara, D.D. and Pearson, H.W. (1995). Nitrogen removal in pond systems with different configurations and geometries. *Wat. Sci. Tech.* **31** (12), 321-330.
- Soares, J., Silva, S.A., Oliveira, R., Araujo, A.L.C., Mara, D.D. and Pearson, H.W. (1996). Ammonia removal in a pilot-scale WSP complex in northeast Brazil. *Wat. Sci. Tech.* **33** (7), 165-171.
- Speece, R.E. (1983). Anaerobic biotechnology for industrial waste treatment. *Environ. Sci. Tech.* **17**, 416A-427A.
- Speece, R.E. (1996). *Anaerobic biotechnology for industrial wastewaters*. 2nd ed. Archae Press. Nashville, USA.

- Standard Methods for the Examination of Water and Wastewater* (1992). American Public Health Association. 18th Edition. Washington D.C, USA.
- Stryer, L. (1988). *Biochemistry*. 3rd ed. W.H. Freeman & Co. New York, USA.
- Stucki, G., Hanselmann, K.W. and Hürzeler, A. (1992). Biological sulphuric acid transformation: reactor design and process optimisation. *Biotech. Bioeng.* **41**, 303-315.
- Surampalli, R.Y., Shankha, K.B., Pycha, C.J. and Lopez, E.R. (1995). Phosphorus removal in ponds. *Wat. Sci. Tech.* **31** (12), 331-339.
- Terzis, E. (1994). Anaerobic treatment of industrial wastewater containing organic solvents. *Wat. Sci. Tech.* **29** (9), 321-329.
- Thirumurthi, D. (1969). Design principles of waste stabilisation ponds. *Jou. San. Eng. Div. ASCE.* **95** (SA2), 311-330.
- Toerien, D.F., Thiele, P.G. and Pretorius, W.A. (1970). Substrate flow in anaerobic digestion. In: *5th International Conference on Water Pollution Research*. San Francisco, CA. USA.
- Toprak, H. (1995a). Removal of soluble chemical oxygen demand from domestic wastewaters in a laboratory-scale anaerobic waste stabilisation pond. *Wat. Res.* **29** (3), 923-932.
- Toprak, H. (1995b). Temperature and organic loading dependency of methane and carbon dioxide emission rates of a full-scale anaerobic waste stabilisation pond. *Wat. Res.* **29** (4), 1111-1119.
- Treybal, R.E. (1981). *Mass-transfer Operations*. 3rd ed. McGraw-Hill International Editions. Chemical engineering series. Singapore.
- Uhlmann, D., Recknagel, F., Sandring, G., Schwarz, S. and Eckelmann, G. (1983). A new design procedure for waste stabilisation ponds. *JWPCF.* **55** (10), 1252-1255.
- UN (2000). "We the peoples". The role of the United Nations in the 21st century. Secretary-General of the United Nations. Department of Public Information, New York.
- UNEP-GPA (2001). *Strategic Action Plan to Address Municipal Wastewater as a Major Land-based Pollutant Affecting Coastal Zones and Marine Ecosystems*. Technical document. UNEP, Washington D.C, USA.
- Van Haandel, A.C. and Lettinga, G. (1994). *Anaerobic Sewage Treatment. A Practical Guide for Regions with a Hot Climate*. John Wiley & Sons. Chichester, U.K.
- Van der Meer, R. and Heertjes, P. (1983). Mathematical description of anaerobic treatment of wastewater in upflow reactors. *Biotech. Bioeng.* **25**, 2557-2566.

- Vavilin, V.A., Vasiliev, V.B., Rytov, S.V. and Ponomarev, A.V. (1995). Modelling ammonia and hydrogen sulphide inhibition in anaerobic digestion. *Wat. Res.* **29** (3), 827-835.
- Veenstra, S., Al-Nozaily, F.A. and Alaerts, G.J. (1995). Purple non-sulphur bacteria and their influence on waste stabilisation ponds performance in the Yemen republic. *Wat. Sci. Tech.* **31** (12), 141-149.
- Vega, G.P. (2001). *Advection and Dispersion in Anaerobic Ponds for Domestic Wastewater Treatment: Implementation of the Mathematical Model MIKE 21*. B.Sc Dissertation. Universidad del Valle, Instituto Cinara-EIDENAR, Cali, Colombia. (in Spanish).
- Vega, G.P., Peña, M.R., Ramirez, C. and Mara, D.D. (2002). Application of CFD modelling to study the hydrodynamics of various anaerobic pond configurations. In: *Proceedings of the 5th International IWA Specialist Group Conference on Waste Stabilisation Ponds: Pond Technology for the New Millennium*. IWA. Auckland, New Zealand.
- Vieira, S.M.M. (1984). Domestic wastewater treatment in upflow anaerobic digesters. *Revista DAE.* **44** (139), 322-328. (in Portuguese).
- Vieira, S.M.M. and Souza, M.E. (1986). Development of technology for the use of the UASB reactor in domestic sewage treatment. *Wat. Sci. Tech.* **18** (12), 109-121.
- Vieira, S.M.M. (1988). Anaerobic treatment of domestic sewage in Brazil, research results and full-scale experience. In: *Anaerobic Digestion 1988: Advances in Water Pollution control*. Brazil.
- Vieira, S.M.M. and Garcia, A.D. (1991). Sewage treatment by UASB reactor: operation results and recommendations for design and utilization. In: *Proceedings of the 6th International IAWPRC Symposium*. São Paulo, Brazil.
- Vieira, S., Carvalho, J., Barijan, F. and Rech, C. (1994). Application of the UASB technology for sewage treatment in a small community at Sumare, Sao Paulo State. *Wat. Sci. Tech.* **30** (12), 203-210.
- Visser, A. (1995). *The Anaerobic Treatment of Sulphate Containing Wastewater*. Ph.D thesis, Wageningen Agricultural University, Wageningen, NL.
- Visser, A., Hulshoff, L. and Lettinga, G. (1996). Competition of methanogenic and sulfidogenic bacteria. *Wat. Sci. Tech.* **33** (3), 99-110.
- Von Sperling, M. (1994). Criteria for the preliminary selection of domestic wastewater treatment systems. *Bio. Engenharia Sanitária e Ambiental.* **3** (1), 7-21. (in Portuguese)
- Von Sperling, M. (1995). Comparison among the most frequently used systems for wastewater treatment in developing countries. In: *International Symposium on Technology Transfer* **1** (1), 107-120.

- Vorkas, C.A. and Lloyd, B.J. (2000). The application of a diagnostic methodology for the identification of hydraulic design deficiencies affecting pathogen removal. *Wat. Sci. Tech.* **42** (10-11), 99-109.
- Warren, P. (1998). *The Design and Control of Anaerobic Ponds with Specific Reference to Western Treatment Plant*. Ph.D thesis, School of Communications and Informatics, Faculty of Engineering and Science, Victoria University of Technology. Melbourne.
- Wehner, J.F. and Wilhelm, R.H. (1956). Boundary conditions of flow reactor. *Chem. Eng. Sci.* **6**, 89-93.
- Wentzel, M.C. and Ekama, G.A. (1997). Principles in the Modelling of Biological Wastewater Treatment Plants: *In Microbial Community Analysis, the Key to the Design of Biological Wastewater Treatment Systems*. IAWQ. Scientific and technical report No 5. London, England.
- Wood, T. (1986). Wastewater stabilization kinetics: A semi-continuous view. *Jour. WPFC.* **58** (9), 937-942.
- Wood, T. (1987). Interpretation of laboratory-scale waste stabilization pond studies. *Wat. Sci. Tech.* **19** (12), 195-203.
- Wood, M., Greenfield, P., Howes, T., Johns, M., and Keller, J. (1995). Computational fluid dynamic modelling of wastewater ponds to improve design. *Wat. Sci. Tech.* **31** (12), 111-118.
- Wood, M.G., Howes, T., Keller, J. and Johns, M.R. (1998). Two-dimensional computational fluid dynamic models for waste stabilisation ponds. *Wat. Res.* **32** (3), 958-963.
- Wu, W.M., Jain, M.K., Conway de Macario, E., Thiele, J.H. and Zeikus, J.G. (1992). Microbial composition and characterization of prevalent methanogens and acetogens isolated from syntrophic methanogenic granules. *Appl. Microbiol. Biotechnol.* **9**, 77-82.
- Zehnder, A.J., Ingvorsen, K. and Marti, T. (1982). Microbiology of methanogen bacteria. In: *Anaerobic Digestion*. Elsevier, Amsterdam, NL.
- Zeikus, J.G. and Bowen, V.G. (1975). Fine structure of *Methanospirillum hungatii*. *J. Bacteriol.* **121** (1), 373-380.
- Zinder, S.H. (1988). Conversion of acetic acid to methane by thermophiles. In: *Anaerobic Digestion 1988. Proceedings of the 5th International Symposium on Anaerobic Digestion*. Bologna, Italy.

URL REFERENCES

URL – 1. UNEP (2001). <http://www.gpa.unep.org/>. Global Programme of Action for the Protection of the Marine Environment from Land-based Activities. Visited 10/04/2002.

URL – 2. PAHO-CEPIS (2001). <http://www.cepis.ops-oms.org/>. Evaluation of potable water and sanitation services 2000 in the Americas. Visited 10/04/2002. (in Spanish).

URL – 3. IGAC (2002). <http://www.igac.gov.co/>. Basic geographic information of the Republic of Colombia. Visited 11/04/2002. (in Spanish).