

## **REFERENCES**

1. Akita, K. and F. Yoshida, "Gas holdup and Volumetric Mass Transfer Coefficient in Bubble Columns", Ind. Eng. Chem. Proc. Des. Dev., 12, 76-80 (1973)
2. Alfano, O.M., L.R. Romero, and A.E. Cassano, "Radiation Field Modeling in Photoreactors – I. Homogeneous Media", Chem. Eng. Sci, 41, 421-444 (1986a)
3. Alfano, O.M., L.R. Romero, and A.E. Cassano, "Radiation field modeling in photoreactors – II. Heterogeneous media", Chem. Eng. Sci, 41, 1137-1153 (1986b)
4. Alibegic, D., S. Tsuneda and A. Hirata, "Photooxidation of PCE in Gas Phase in UV-Bubble Column Reactor with  $\text{H}_2\text{O}_2$ ", In Proceedings of IWAQ Conference "Critical Technologies to the World in 21<sup>st</sup> Century: Pollution Control and Reclamation in Process Industries", Beijing, September 18-20, 798-806 (2000a) and Water Intelligence Online (IN PRESS)
5. Alibegic, D., S.Tsuneda, and A. Hirata, "Influence of  $\text{H}_2\text{O}_2$  Concentration and Gas Flow Rate on the Photodegradation of Tetrachloroethylene in UV-Bubble Column Reactor", In Proceedings of Advanced Study Institute "Remediation of the Aquatic and Atmospheric Environments by Advanced Oxidation", edited by Yue, P-L., Hong Kong, November 28-December 3, 245-250 (2000b)
6. Alibegic, D., "Photooxidation of PCE in Gas Phase in UV-Bubble Column Reactor with  $\text{H}_2\text{O}_2$ ," M.E. Thesis, Waseda University, Japan (2001)

## *References*

---

7. Alibegic, D., S. Tsuneda and A. Hirata, "Kinetics of Tetrachloroethylene (PCE) Degradation and Byproducts Formation During UV/H<sub>2</sub>O<sub>2</sub> Treatment in UV-Bubble Column Reactor", *Chem. Eng. Sci.* 56(21-22), 6199-6207 (2001)
8. Alibegic, D., S. Tsuneda and A. Hirata, "UV-Bubble Column Reactor (UV-BCR) for Photolytic Removal of Tetrachloroethylene (PCE) From the Vapor Phase. Methodological Approach", *J. Chem. Engng. Jap.* IN PRESS (2002a)
9. Alibegic, D., S. Tsuneda and A. Hirata, "Kinetic Considerations of UV-Bubble Column Reactor for Removal of CVOCs from the Gas Phase", In "Proc. 15th Int. Cong. Chem. Proc. Engng. CHISA 2002" Prague, Czech Republic, Aug. 25-29, CD-ROM, paper A2.4, pp. 1-14 (2002b)
10. Baxendale, J.H. and J.A. Wilson; "The Photolysis of Hydrogen Peroxide at High Light Intensities," *Trans. Faraday Soc.*, 53, 344-356 (1957)
11. Beltrán, F.J., M. Gonzalez, B. Acedo and J. Jaramillo; "Contribution of Free Radical Oxidation to Eliminate Volatile Organochlorine Compounds in Water by Ultraviolet Radiation and Hydrogen Peroxide," *Chemosphere*, 32, 1949-1961 (1996)
12. Beltrán, F.J., G. Ovejero and J. Rivas, "Oxidation of polynuclear aromatic hydrocarbons in water. 3. UV radiation combined with hydrogen peroxide", *Ind. Eng. Chem. Res.*, 35, 883-890 (1996)
13. Beltran-Hereida, J., J. Torregrosa, J.R. Domingues and J.A. Peres, "Comparison of the degradation of p-hydroxybenzoic acid in aqueous solution by several oxidation processes", *Chemosphere* 42, 351-359 (2001)
14. Benitez, F.J., J. Beltran-Hereida, J.L. Acero and F.J. Rubio, "Contribution of the free radicals to chlorophenols decomposition by several advanced oxidation processes", *Chemosphere* 41, 1271-1277 (2000)
15. Bhowmick, M. and M.J. Semmens; "Ultraviolet Photooxidation for the Destruction of VOCs in Air", *Water Res.*, 28, 2407-2415 (1994)
16. Bielefeldt A.R. and H.D. Stensel, "Treating VOC-contaminated gases in activated sludge: Mechanistic model to evaluate design performance", *Environ. Sci. Technol.*, 33, 3234-3240 (1994).
17. Bolton, J.R., K.G. Bircher, W. Thomas and C.A. Tolman, "Figures of Merit for the Technical Development and Application of Advanced Oxidation Processes", *J. Adv. Oxid. Technol.* 1, 13 (1996)

18. Bouaifi, M., G. Hebrard, D. Bastoul, and M. Roustan, "A Comparative Study of Gas Hold-up, Bubble Size, Interfacial Area and Mass Transfer Coefficients in Stirred Gas-liquid Reactors and Bubble Columns", *Chem. Eng. Proc.*, 40, 97-111 (2001)
19. Box, G.E.P., W.G. Hunter and J.S. Hunter, "Statistics for Experimenters: An Introduction to Design, Data Analysis and Model Building", Wiley, New York (1978)
20. Braun, A.M., L. Jakob, E. Oliveros and C.A. Oller de Nascimento, "Up-scaling Photochemical Reactions", In *Advances in Photochemistry*, 18, 235-313 (1993)
21. Buxton, G.V., C.L. Greenstock, W.P. Helman and A.B. Ross, "Critical Review of the Rate Constants for Reactions of Hydrated Electrons, Hydrogen Atoms and Hydroxyl Radicals ( $\text{OH}/\text{O}^-$ ) in Aqueous Solutions," *J. Phys. Chem. Ref. Data*, 17, 513-886 (1988)
22. Calderbank, P.H., "Gas Absorption from Bubbles", *The Chem. Engr.*, 45, CE209 (1967)
23. Camarasa, E., C. Vial, S. Poncin, G. Wild, N. Midoux and J. Bouillard, "Influence of Coalescence Behavior of the Liquid and Gas Sparging on Hydrodynamics and Bubble Characteristics in a Bubble Column", *Chem. Eng. Proc.* 38, 329-344 (1999)
24. Cassano, A.E., C.A. Martin, R.J. Brandi and O.M. Alfano, "Photoreactor Analysis and Design: Fundamentals and Applications", *Ind. Eng. Chem Res.*, 34, 2155-2201 (1995)
25. Charpentier, J.C., "Mass-transfer Rates in Gas-liquid Absorbers and Reactors". In *Advances in Chemical Engineering*, Vol. 11, Academic Press, New York, USA, pp. 3-133 (1981)
26. Crittenden, J.C., S. Hu, D.W. Hand and S.A. Green, "A Kinetic Model for  $\text{H}_2\text{O}_2/\text{UV}$  Process in a Completely Mixed Batch Reactor", *Water Res.*, 33, 2315-2328 (1999)
27. Deckwer, W.D. and A. Schumpe, "Improved Tools for Bubble Column Reactor Design and Scale-up", *Chem Eng.Sci.* 48, 889-911 (1993)
28. Deckwer, W.D., R. Burckhart and G. Zoll, "Mass Transfer in Tall Bubble Column", *Chem. Eng. Sci.*, 29, 2177-2188 (1974)
29. Elk, van, E.P., P.C. Borman, J.A.M. Kuipers and G.F. Versteeg, "Modeling of Gas-liquid Reactors – Implementation of the Penetration Model in Dynamic Modeling of Gas-liquid Processes With the Presence of a Liquid Bulk," *Chem. Eng. Journal*, 76, 223-237 (2000)

## *References*

---

30. Feiyan, C., S.O. Pehkonen and M.B. Ray, "Kinetics and Mechanism of UV-Photodegradation of Chlorinated Organics in the Gas Phase", *Water Res.*, 36, 4203-4214 (2002)
31. Fukami, N., M. Yoshida, B-D. Lee, K. Taku and M. Hosomi, "Photocatalytic Degradation of Gaseous Perchloroethylene: Products and Pathway", *Chemosphere*, 42, 345-350 (2001)
32. Gaddis, E.S., "Mass Transfer in Gas-Liquid Contractors", *Chem. Eng. Proc.* 38, 503-510 (1999)
33. Garcia Einschlag, F.S., J. Lopez, L. Carlos, A.L. Capparelli, A.M. Braun and E. Oliveros, "Evaluation of Efficiency of Photodegradation of Nitroaromatics Applying the UV/H<sub>2</sub>O<sub>2</sub> Technique", *Environ. Sci. Technol.*, 36, 3936-3944 (2002)
34. Glaze, W.H. and J-W. Kang, "AOP for Treating Groundwater Contaminated with TCE and PCE: Laboratory Studies", *J. AWWA*, 78, 57-63 (1988)
35. Glaze, W.H. and J-W. Kang, "Advanced Oxidation Processes. Description of a Kinetic Model for the Oxidation of Hazardous Materials in Aqueous Media with Ozone and Hydrogen Peroxide in a Semibatch Reactor", *Ind. Eng. Chem. Res.*, 28, 1573-1580 (1989a)
36. Glaze, W.H. and J-W. Kang, "Advanced Oxidation Processes. Test of a Kinetic Model for the Oxidation of Organic Compounds with Ozone and Hydrogen Peroxide in a Semibatch Reactor", *Ind. Eng. Chem. Res.*, 28, 1580-1587 (1989b)
37. Glaze, W.H., J.F. Kenneke and J.L. Ferry, "Chlorinated Byproducts from the TiO<sub>2</sub> Mediated Photodegradation of Trichloroethylene and Tetrachloroethylene in Water", *Environ. Sci. Technol.* 27, 177-184 (1993)
38. Glaze, W.H., Y. Lay and J-W. Kang; "Advanced Oxidation Processes. Kinetic Model for the Oxidation of 1,2-dibromo-3-chloropropane in Water by the Combination of Hydrogen Peroxide and UV Radiation," *Ind. Eng. Chem. Res.*, 34, 2314-2323 (1995)
39. Gurol, M.D., and S. Nekouinaini, "Effect of Organic Substances on Mass Transfer in Bubble Aeration", *J.WPCF*, Vol.57, No.3, 235-240 (1985)
40. Görtler, R., U. Möller, S. Sommer, H. Müller and K. Kleinersmanns, "Photooxidation of Exhaust Pollutants; III. Photooxidation of Chloroethenes: Degradation Efficiencies, Quantum Yields and Products", *Chemosphere*, Vol.29, No.8, 1671-1682 (1994)

41. Hatta, S., "On the Absorption Velocity of Gasses by Liquids", Tech. Rep. Tohoku Imp. Univ., 10, 119-135 (1932)
42. Higbie, R., "The Rate of Absorption of Pure Gas into a Still Liquid During Short Periods of Exposure", Trans. AIChE J. 35, 365-389 (1935)
43. Hikita, H., S. Asai, K. Tanigawa, K. Segawa and M. Kitao, " The Volumetric Liquid-Phase Mass Transfer Coefficient in Bubble Columns", Chem. Eng. J., 22, 61-67 (1981)
44. Hunt, J.P., and H. Taube, "The Photochemical Decomposition of Hydrogen Peroxide. Quantum Yields, Tracers and Fractional Effects", J. Am. Chem. Soc. 74, 599-6002 (1952)
45. Hatchard C.G., and C.A.A. Parker, "A New Sensitive Chemical Actinometer II. Potassium Ferrioxalate as a Standard Chemical Actinometer", Proc. R. Soc. London, A, 518-536 (1956)
46. Jacob, S.M. and J.S. Dranoff, "Light Intensity Profiles in a Perfectly Mixed Photoreactor", AIChE J. 16, 359-363 (1970)
47. Jayson, G.G, B.J. Parsons and A.J. Swallow, "Some Simple, Highly Reactive, Inorganic Chlorine Derivates in Aqueous Solution", J. Chem. Soc. Faraday Trans. I 69, 1597-1607 (1973)
48. Khuri, A.I. and J.A. Cornel; Response Surfaces, Designs and Analyses; Marcel Dekker, ASQC Quality Press, New York, USA (1987)
49. Klassen, N.V., D. Marchington and H.C.E. McGowan, "H<sub>2</sub>O<sub>2</sub> Determination by the I<sub>3</sub><sup>-</sup> Method and by KMnO<sub>4</sub> Titration", Anal. Chem., 66, 2921-2925 (1994)
50. Kumar A.T., T. Dagaleesen, G.S. Laggha and H.E. Hoelscher, "Bubble Swarm Characteristics in Bubble Columns", Can. J. Chem. Eng., 54, 503-510 (1976)
51. Laat J., E. Tace and M. Dore, "Degradation of Chloroethanes in Dilute Aqueous Solutions by H<sub>2</sub>O<sub>2</sub>/UV", Wat. Res., 28(12), 2507-2519 (1994)
52. Legrini, O., E. Oliveros and A.M. Braun; "Photochemical Processes for Water Treatment", Chem. Rev., 93, 671-698 (1993)
53. Liao, C.H. and M.D. Gurol, "Chemical Oxidation by Photolytic Decomposition of Hydrogen Peroxide", Environ. Sci. Technol., 29, 3007-3014 (1995)
54. Liao, C.H., S.-F. Kang and F.-A. Wu, "Hydroxyl Radical Scavenging Role of Chloride and Bicarbonate Ions in the H<sub>2</sub>O<sub>2</sub>/UV Process", Chemosphere 44, 1193-1200 (2001)

## *References*

---

55. Martens, R. and C. von Sonntag, "Photolysis ( $\lambda=254$  nm) of Tetrachloroethene in Aqueous Solutions", *J. Photochem. Photobiol. A: Chem.*, 85, 1-9 (1995)
56. Matsutani, H., M. Hashimoto and M. Hashimoto; "Pilot Scale Evaluation on Photooxidation Treatment of TCE in Gas Phase," *Journal of Jap. Soc. Wat. Environment*, 22, 403-408 (1999) (in Japanese)
57. Munz, C. and P.V. Roberts, "Gas- and Liquid-phase Mass Transfer Resistance of Organic Compounds During Mechanical Surface Aeration", *Water Res.*, 23(5), 589-601 (1989)
58. Nicole, I., J. de Laat, M. Dore, J.P. Duget and C. Bonnel, "Use of U.V. Radiation in Water Treatment: Measurement of Photonic Flux by Hydrogen Peroxide actinometry", *Water Res.* 24(2), 157-168 (1990)
59. Nimlos, M.R., W.A. Jacoby, D.M. Blake and A. Milne, "Direct Mass Spectrometric Studies of the Destruction of Hazardous Wastes. 2. Gas-phase Photocatalytic Oxidation of Trichloroethylene Over TiO<sub>2</sub>: Products and Mechanisms", *Environ. Sci. Technol.* 27, 732-740 (1993)
60. Otake, T. S.Tone, K. Higuchi, K. Nakao, "Light Intensity Profile in Gas-Liquid Dispersion. Applicability of the Effective Absorption Coefficient", *Int. Chem. Eng.* 23(2), 288-297 (1983)
61. Öztürk, S.S., A. Shumpe and W-D. Deckwer, "Organic Liquids in a Bubble Column: Hold-ups and Mass Transfer Coefficients", *AIChE J.*, 33, 1473-1480 (1987)
62. Rizzuti, L. In M. Schiavello (Ed.), *Photoelectrochemistry, Photocatalysis and Photoreactors*. 1985, 587-604.
63. Roberts, P.V., C. Munz, and P. Dändliker, "Modeling Volatile Organic Solute Removal by Surface and Bubble Aeration", *J.WPCF*, Vol.56, No.2, 157-163 (1984)
64. Roizard, C. and G. Wild, "Mass Transfer with Chemical Reaction: the Slow Reaction Regime Revisited", *Chem. Eng. Sci.* 57, 3479-3484 (2002)
65. Shah, Y.T., B.G. Kelkar, S.R. Godbole and W.D. Deckwer, "Design Parameters Estimations for Bubble Column Reactors", *AIChE J.*, 28(3), 353-379 (1982)
66. Shen, Y-S. and Y. Ku; "Decomposition of Gas-phase Chloroethenes by UV/O<sub>3</sub> Process", *Water Res.*, 32, 2669-2679 (1998)
67. Stefan, M.I., A.R. Hoy and J.R. Bolton, "Kinetics and Mechanism of the Degradation and Mineralization of Acetone in Dilute Aqueous Solutions Sensitized by the UV Photolysis of Hydrogen Peroxide", *Environ. Sci. Technol.* 30, 2382-2390 (1996)

68. Stefan, M.I., J. Mack and J.R. Bolton, "Degradation Pathways of Methyl tert-Butyl Ether by the H<sub>2</sub>O<sub>2</sub>/U Process", *Environ. Sci. Technol.* 34, 650-658 (2000)
69. van Swaaij, W.P.M., and G.F. Versteeg, "Mass Transfer With Complex Reversible Chemical Reaction in Gas-Liquid Systems: An Overview", *Chem. Eng. Sci.* 47, 3181-3195 (1992)
70. Volman, D.H., and J.C. Chen, "The Photochemical Decomposition in Aqueous Solutions of Allyl Alcohol at 253.7 Å", *J. Am. Chem. Soc.* 18, 4141-4144 (1959)
71. Weir, B.A., and D.W. Sundstrom, "Destruction of Trichloroethylene by UV Light-Catalyzed Oxidation with Hydrogen Peroxide", *Chemosphere*, Vol.27, No.7, 1279-1291 (1993)
72. Whitman, W.G., "Preliminary Experimental Confirmation of the Two-Film Theory of Gas Absorption", *Chem. Metall. Eng.* 29, 146-148 (1923)
73. Yamazaki, S., H. Tsukamoto, K. Araki, T. Tanimura, I. Tejedor-Tejedor and M.A. Anderson, "Photocatalytic Degradation of Gaseous Tetrachloroethylene on Porous TiO<sub>2</sub> Pellets", *App. Cat. B: Environ.* 33, 109-117 (2001a)
74. Yamazaki, S., S. Matsunaga and K. Hori, "Photocatalytic Degradation of Trichloroethylene in Water Using TiO<sub>2</sub> Pellets", *Water Res.* 35, 1022-1028 (2001b)
75. Yamazaki-Nishida S., K.J. Nagano, L.A. Phillips, S. Cervera-March and M.A. Anderson, "Photocatalytic Degradation of Trichloroethylene in the Gas Phase Using Titanium Dioxide Pellets", *J.Photochem. Photobiol. A: Chem.*, 70, 95-99 (1993)
76. Yamazaki-Nishida, S., X. Fu, M.A. Anderson and K. Hori, "Chlorinated Byproducts from the Photoassisted Catalytic Oxidation of Trichloroethylene and Tetrachloroethylene in Gas Phase Using Porous TiO<sub>2</sub> Pellets", *J.Photochem. Photobiol. A: Chem.*, 97, 175-179 (1996)
77. Yokota, T., T. Iwano, H. Deguchi and T. Tadaki, "Light Absorption Rate in a Bubble Column Photochemical Reactor", *Kagaku Kogaku Ronbunshu*, 7, 157-163 (1981) (in Japanese)
78. Yue, P.L., "Modeling of Kinetics and Reactors for Water Purification by Photo-oxidation", *Chem. Eng. Sci.* 48, 1-11 (1993)
79. Zepp, R.G., "Quantum Yields for Reactions of Pollutants in Dilute Aqueous Solutions", *Environ. Sci. Technol.* 12, 327-329 (1978)