

REFERENCES

- [1] K. Hunger, (2003) *Industrial Dyes: Chemistry, Properties, Applications*. Wiley-VCH, Weinheim, Cambridge.
- [2] R.M. Christie, (2007) *Environmental Aspects of Textile Dyeing*. Woodhead, Boca Raton, Cambridge.
- [3] Q. Husain, Potential applications of the oxidoreductive enzymes in the decolorization and detoxification of textile and other synthetic dyes from polluted water: a review. *Crit. Rev. Biotechnol.* 26 (2006) 201–221.
- [4] H. Zollinger, (1987) *Colour Chemistry – Synthesis, Properties of Organic Dyes and Pigments*. VCH Publishers, New York.
- [5] S. Mondal, Methods of dye removal from dye house effluent—an overview, *Environ. Eng. Sci.* 25 (2008) 383–396.
- [6] J. Garcia-Montano, F. Torrades, L.A. Perez-Estrada, I. Oller, S. Malato, M.I. Maldonado, J. Peral, Degradation pathways of the commercial reactive azo dye Procion Red H-E7B under solar-assisted photo-Fenton reaction, *Environ. Sci. Technol.* 42 (2008) 6663–6670.
- [7] G. Crini, Non-conventional low-cost adsorbents for dye removal: A review, *Biores. Technol.* 97 (2006) 1061–1085.
- [8] A. Kar, Y.R. Smith, V. Subramanian, Improved photocatalytic degradation of textile dye using titanium dioxide nanotubes formed over titanium wires, *Environ. Sci. Technol.* 43 (2009) 3260–3265.
- [9] G. McMullan, C. Meehan, A. Conneely, N. Kirby, T. Robinson, P. Nigam, I.M. Banat, R. Marchant, W.F. Smyth, Microbial decolourisation and degradation of textile dyes. *Appl. Microbiol. Biotechnol.* 56 (2001) 81-87.
- [10] J.-S. Bae, H.S. Freeman, Aquatic toxicity evaluation of new direct dyes to the *Daphnia magna*. *Dyes Pigm.* 73 (2007) 81–85.

- [11] K.L. Hatch, H.I. Maibach, Dyes as contact allergens: a comprehensive record. *Text. Chem. Color.* 1 (1999) 53–59.
- [12] H.S. Rai, M.S. Bhattacharyya, J. Singh, T.K. Bansal, P. Vats, U.C. Banerjee, Removal of dyes from the effluent of textile and dyestuff manufacturing industry: a review of emerging techniques with reference to biological treatment. *Crit. Rev. Env. Sci. Technol.* 35 (2005) 219–238.
- [13] W.G. Kuo, Decolorizing dye waste-water with fenton reagent. *Water Res.* 26 (1992) 881–886.
- [14] G.E. Walsh, L.H. Bahner, W.B. Horning, Toxicity of textile mill effluents to freshwater and estuarine algae, crustaceans and fishes. *Environ. Pollut. A* 21 (1980) 169–179.
- [15] P. Nigam, G. Armour, I.M. Banat, D. Singh, R. Marchant, Physical removal of textile dyes and solid state fermentation of dye-adsorbed agricultural residues. *Bioresour. Technol.*, 72 (2000) 219–226.
- [16] E. Weber, N.L. Wolfe, Kinetics studies of reduction of aromatic azo compounds in anerobic sediment/water systems. *Environ. Toxicol. Chem.* 6 (1987) 911 – 920.
- [17] E. Forgacs, T. Cserhati, G. Oros, Removal of synthetic dyes from wastewaters: a review, *Environ. Int.* 30 (2004) 953– 971.
- [18] M.H. Zonoozi, M.R.A. Moghaddam, M. Arami, Coagulation /flocculation of dyecontaining solutions using polyaluminium chloride and alum, *Water Sci. Technol.* 59 (2009) 1343–1351.
- [19] S. Sachdeva, A. Kumar, Preparation of nanoporous composite carbonmembrane for separation of Rhodamine B dye, *J. Membr. Sci.* 329 (2009) 2–10.
- [20] I.A.W. Tan, A.L. Ahmad, B.H. Hameed, Adsorption of basic dye on high-surfacearea activated carbon prepared from coconut husk:

equilibrium, kinetic and thermodynamic studies, *J. Hazard. Mater.* 154 (2008) 337–346.

[21] V.K. Gupta, R. Jain, S. Varshney, Electrochemical removal of hazardous dye Reactofix Red 3 BFN from industrial effluents, *J. Colloid Interface Sci.* 312 (2007) 292–296.

[22] M.A. Rauf, S.S. Ashraf, Radiation induced degradation of dyes – An overview, *J. Hazard. Mater.* 166 (2009) 6–16.

[23] K.C. Chen, J.Y. Wu, W.B. Yang, S.C.J. Hwang, Evaluation of effective diffusion coefficient and intrinsic kinetic parameters on azo dye biodegradation using PVA-immobilized cell beads, *Biotechnol. Bioeng.* 83 (2003) 821–832.

[24] V.K. Gupta, A. Mittal, R. Jain, M. Mathur, S. Sikarwar, Photochemical degradation of hazardous dye—safaranin-T using TiO₂ catalyst, *J. Colloid Interface Sci.* 309 (2007) 460–465.

[25] D. Kavitha, C. Namasivayam, Experimental and kinetic studies on methylene blue adsorption by coir pith carbon, *Bioresour. Technol.* 98 (2007) 14–21.

[26] V.K. Gupta, Suhas, Application of low cost adsorbents for dye removal—a review, *J. Environ. Manage.* 90 (2009) 2313–2342.

[27] C. Namasivayam, M.V. Sureshkumar, Anionic dye adsorption characteristics of surfactant-modified coir pith, a ‘waste’ lignocellulosic polymer, *J. Appl. Polym. Sci.* 100 (2006) 1538–1546.

[28] W. Cheng, S.G. Wang, L. Lu, W.X. Gong, X.W. Liu, B.Y. Gao, H.Y. Zhang, Removal of malachite green (MG) from aqueous solutions by native and heat-treated anaerobic granular sludge, *Biochem. Eng. J.* 39 (2008) 538–546.

- [29] M. Dogan, H. Abak, M. Alkan, Biosorption of methylene blue from aqueous solutions by hazelnut shells: equilibrium, parameters and isotherms, *Water Air Soil Pollut.* 192 (2008) 141–153.
- [30] V.K. Gupta, A. Mittal, A. Malviya, J. Mittal, Adsorption of carmoisine A from wastewater using waste materials—bottom ash and de-oiled soya, *J. Colloid Interf. Sci.* 355 (2009) 24–33.
- [31] V.K. Gupta, I. Ali, Removal of endosulfan and methoxychlor from water on carbon slurry, *Environ. Sci. Technol.*, 42 (2008) 766–770.
- [32] V.K. Gupta, A. Mittal, L. Kurup, J. Mittal, Adsorption of a hazardous dye—erythrosine over hen feathers, *J. Colloid Interface Sci.*, 304 (2006) 52–57.
- [33] V.K. Gupta, A. Mittal, D. Kaur, A. Malviya, J. Mittal, Adsorption studies on the removal of colouring agent Phenol Red from wastewater using waste materials as adsorbents, *J. Colloid Interface Sci.*, 337 (2009) 345–354.
- [34] A.E. Putun, N. Ozbay, E.P. Onal, E. Putun. Fixed-bed pyrolysis of cotton stalks for liquid and solid products. *Fuel Process Technol.*, 86 (2005) 1207–19.
- [35] H. Haykiri-Acma, S. Yaman, S. Kucukbayrak, (2005) Gasification of biomass chars in steam–nitrogen mixture. *Energy Conversion Management*.
- [36] M. Fan, W. Marshall, D. Daugaard, R.C. Brown, Steam activation of chars produced from oat hulls and corn stover. *Bioresource Technol.*, 93 (2004) 103–7.
- [37] W.T. Tsai, C.Y. Chang, S.L. Lee. Preparation and characterization of activated carbons from corn cob. *Carbon* 35 (1997) 1198–200.
- [38] D. Savova, E. Apak, E. Ekinici, F. Yardim, N. Petrova, T. Budinova,

- M. Razvigorova, V. Minkova, Biomass conversion to carbon adsorbents and gas. *Biomass Bioenergy* 21(2001) 133–42.
- [39] T. Zhang, W.P. Walawender, L.T. Fan, M. Fan, D. Daugaard, R.C. Brown. Preparation of activated carbon from forest and agricultural residues through CO₂ activation. *Chem. Eng. J.* 105 (2004) 53–9.
- [40] W.T. Tsai, C.Y. Chang, S.L. Lee. A low cost adsorbent from agricultural waste corn cob by zinc chloride activation. *Bioresource Technol.* 64 (1998) 211–7.
- [41] O. GH, C.R. Park. Preparation and characteristics of rice-straw-based porous carbons with high adsorption capacity. *Fuel* 81 (2002) 327–36.
- [42] V. Gomez, M.S. Larrechi, M.P. Callao, Kinetic and adsorption study of acid dye removal using activated carbon. *Chemosphere*, 69 (2007) 1151–1158.
- [43] N.K. Amin, Removal of reactive dye from aqueous solutions by adsorption onto activated carbons prepared from sugarcane bagasse pith. *Desalin.* 223 (2008) 152–161.
- [44] N.K. Amin, Removal of direct blue-106 dye from aqueous solution using new activated carbons developed from pomegranate peel: Adsorption equilibrium and kinetics. *J. Hazard. Mater.* 165 (2009) 52–62.
- [45] K. Santhy, P. Selvapathy, Removal of reactive dyes from wastewater by adsorption on coir pith activated carbon. *Biores. Technol.* 97 (2006) 1329–1336.
- [46] P.K. Malik, Dye removal from wastewater using activated carbon developed from sawdust: adsorption equilibrium and kinetics. *J. Hazard. Mater.* B113 (2004) 81–88.
- [47] A.R. Dincer, Y. Gunes, N. Karakaya, E. Gunes, Comparison of activated carbon and bottom ash for removal of reactive dye from aqueous solution. *Biores. Technol.* 98 (2007) 834–839.

- [48] M. Asadullah, M. Asaduzzaman, M.S. Kabir, M.G. Mostofa, T. Miyazawa, Chemical and structural evaluation of activated carbon prepared from jute sticks for Brilliant Green dye removal from aqueous solution. *Journal of Hazardous Materials*, 174 (2010) 437–443.
- [49] A. Khaled, A. El Nemr, A. El-Sikaily, O. Abdelwahab, Removal of Direct N Blue-106 from artificial textile dye effluent using activated carbon from orange peel: Adsorption isotherm and kinetic studies. *Journal of Hazardous Materials*, 165 (2009) 100–110.
- [50] E.N. El Qada, S.J. Allen, G.M. Walker, Adsorption of basic dyes from aqueous solution onto activated carbons. *Chemical Engineering Journal*, 135 (2008) 174–184.
- [51] O. Gercel, H.F. Gercel, A.S. Koparal, U.B. Ogutveren, Removal of disperse dye from aqueous solution by novel adsorbent prepared from biomass plant material. *Journal of Hazardous Materials*, 160 (2008) 668–674.
- [52] T.C. Chandra, M.M. Mirna, Y. Sudaryanto, S. Ismadji, Adsorption of basic dye onto activated carbon prepared from durian shell: Studies of adsorption equilibrium and kinetics. *Chemical Engineering Journal* 127 (2007) 121–129.
- [53] B.H. Hameed, F.B.M. Daud, Adsorption studies of basic dye on activated carbon derived from agricultural waste: *Hevea brasiliensis* seed coat. *Chemical Engineering Journal*, 139 (2008) 48–55.
- [54] S. Senthilkumaar, P. Kalaamani b, K. Porkodi, P.R. Varadarajan, C.V. Subburaam, Adsorption of dissolved Reactive red dye from aqueous phase onto activated carbon prepared from agricultural waste. *Bioresource Technology*, 97 (2006) 1618–1625.

- [55] A.A. Ahmad, B.H. Hameed, A.L. Ahmad, Removal of disperse dye from aqueous solution using waste-derived activated carbon: Optimization study, *Journal of Hazardous Materials* 170 (2009) 612–619.
- [56] Y.S. Al-Degs, M.I. El-Barghouthi, A.H. El-Sheikh, G.M. Walker Effect of solution pH, ionic strength, and temperature on adsorption behavior of reactive dyes on activated carbon, *Dyes Pigm.* 77 (2008) 16-23.
- [57] S. Wang, Z.H. Zhu, Effects of acidic treatment of activated carbons on dye adsorption , *Dyes and Pigments*, 75 (2007) 306-314.
- [58] S. Wang, H. Li, Kinetic modelling and mechanism of dye adsorption on unburned carbon , *Dyes and Pigments*, 72 (2007) 308-314.
- [59] H. Metivier-Pignon, C. Faur, P. Le Cloirec, Adsorption of dyes onto activated carbon cloth: Using QSPRs as tools to approach adsorption mechanisms , *Chemosphere*, 66 (2007) 887-893.
- [60] A.A. Ahmad, B.H. Hameed, Fixed-bed adsorption of reactive azo dye onto granular activated carbon prepared from waste, *Journal of Hazardous Materials*, 175 (2010) 298-303.
- [61] K. Nuithitikul, S. Srikhun, S. Hirunpraditkoon, Kinetics and equilibrium adsorption of Basic Green 4 dye on activated carbon derived from durian peel: Effects of pyrolysis and post-treatment conditions, *Journal of the Taiwan Institute of Chemical Engineers*, 41(2010) 591-598.
- [62] L. Wang, J. Zhang, R. Zhao, C. Li, Y. Li, C. Zhang, Adsorption of basic dyes on activated carbon prepared from *Polygonum orientale* Linn:

Equilibrium, kinetic and thermodynamic studies Original Desalination, 254 (2010) 68-74.

[63] G.O. El-Sayed, M.E. Moustafa, M.F. Mahrous, Removal of disperse 2BLN dye from industrial water onto activated carbon prepared from sugarc stalks, International Journal of Chem Tech Research, 3 (2011) 1604-1611.

[64] P.-J. Lu, H.-C. Lin, W.-T. Yu, J.-M. Chern, Chemical regeneration of activated carbon used for dye adsorption, Journal of the Taiwan Institute of Chemical Engineers, 42 (2011) 305-311.

[65] S. Senthilkumaar, P. Kalaamani, K. Porkodi, P.R. Varadarajan, C.V. Subburaam, Adsorption of dissolved Reactive red dye from aqueous phase onto activated carbon prepared from agricultural waste, Bioresource Technology, 97 (2006) 1618-1625.

[66] N. Hoda, E. Bayram, E. Ayranci, Kinetic and equilibrium studies on the removal of acid dyes from aqueous solutions by adsorption onto activated carbon cloth, Journal of Hazardous Materials, 137 (2006) 344-351.

[67] I.A.W. Tan, A.L. Ahmad, B.H. Hameed, Adsorption of basic dye on high-surface-area activated carbon prepared from coconut husk: Equilibrium, kinetic and thermodynamic studies, Journal of Hazardous Materials, 154 (2008) 337-346.

[68] A. Rodríguez, J. García, G. Ovejero, M. Mestanza, Adsorption of anionic and cationic dyes on activated carbon from aqueous solutions: Equilibrium and kinetics, Journal of Hazardous Materials, 172 (2009) 1311-1320.

- [69] V. Gómez, M.S. Larrechi, M.P. Callao, Kinetic and adsorption study of acid dye removal using activated carbon *Chemosphere*, 69 (2007) 1151-1158.
- [70] S.S. Ashour, Kinetic and equilibrium adsorption of methylene blue and remazol dyes onto steam-activated carbons developed from date pits, *Journal of Saudi Chemical Society*, 14 (2010) 47-53.
- [71] M.P. Elizalde-González, V. Hernández-Montoya, Guava seed as an adsorbent and as a precursor of carbon for the adsorption of acid dyes, *Bioresource Technology*, 100 (2009) 2111-2117.
- [72] S.K. Ling, H.Y. Tian, S. Wang, T. Rufford, Z.H. Zhu, C.E. Buckley, KOH catalysed preparation of activated carbon aerogels for dye adsorption, *Journal of Colloid and Interface Science*, 357 (2011) 57-162.
- [73] L.S. Chan, W.H. Cheung, G. McKay, Adsorption of acid dyes by bamboo derived activated carbon, *Desalination*, 218 (2008) 304-312.
- [74] S. Karaca, A. Gürses, M. Açıkyıldız, M. Ejder (Korucu), Adsorption of cationic dye from aqueous solutions by activated carbon, *Microporous and Mesoporous Materials*, 115 (2008) 376-382.
- [75] A. Derylo-Marczewska, A.W. Marczewski, S. Winter, D. Sternik, Studies of adsorption equilibria and kinetics in the systems: Aqueous solution of dyes–mesoporous carbons, *Applied Surface Science*, 256 (2010) 5164-5170.
- [76] P.K. Malik, Dye removal from wastewater using activated carbon developed from sawdust: adsorption equilibrium and kinetics, *Journal of Hazardous Materials*, 113 (2004) 81-88.

- [77] C. Hung-Lung, L. Kuo-Hsiung, C. Shih-Yu, C. Ching-Guan, P. San-De, Dye adsorption on biosolid adsorbents and commercially activated carbon, *Dyes and Pigments*, 75 (2007) 52-59.
- [78] B.G.P. Kumar, L.R. Miranda, M. Velan, Adsorption of Bismark Brown dye on activated carbons prepared from rubber wood sawdust (*Hevea brasiliensis*) using different activation methods, *Journal of Hazardous Materials*, 126 (2005) 63-70.
- [79] W.-H. Li, Q.-Y. Yue, B.-Y. Gao, Z.-H. Ma, Y.-J. Li, H.-X. Zhao, Preparation and utilization of sludge-based activated carbon for the adsorption of dyes from aqueous solutions, *Chemical Engineering Journal*, 171 (2011) 320-327.
- [80] M. Auta, B.H. Hameed, Preparation of waste tea activated carbon using potassium acetate as an activating agent for adsorption of Acid Blue 25 dye, *Chemical Engineering Journal*, 171 (2011) 502-509.
- [81] W.T. Tsai, C.Y. Chang, M.C. Lin, S. F. Chien, H.F. Sun, M.F. Hsieh, Adsorption of acid dye onto activated carbons prepared from agricultural waste bagasse by ZnCl_2 activation, *Chemosphere*, 45 (2001) 51-58.
- [82] E. Demirbas, M. Koby, M.T. Sulak, Adsorption kinetics of a basic dye from aqueous solutions onto apricot stone activated carbon, *Bioresource Technology*, 99 (2008) 5368-5373.
- [83] R. Baccar, P. Blázquez, J. Bouzid, M. Feki, M. Sarrà, Equilibrium, thermodynamic and kinetic studies on adsorption of commercial dye by activated carbon derived from olive-waste cakes, *Chemical Engineering Journal*, 165 (2010) 457-464.

- [84] C. Kannan, N. Buvaeswari, T. Palvannan, Removal of plant poisoning dyes by adsorption on Tomato Plant Root and green carbon from aqueous solution and its recovery, *Desalination*, 249 (2009) 1132-1138.
- [85] Y. Chun, G. Sheng, C. Chiou, B. Xing, Compositions and sorptive properties of crop residue-derived chars. *Environ. Sci. Technol.*, 38 (2004) 4649-4655.
- [86] Y. Leon, C. Leon, J. Solar, V. Calemme, L. Radovic, Evidence for the protonation of basal plane sites on carbon, *Carbon* 30 (1992) 797-811.
- [87] Mattson J, Mark H. Activated carbon: surface chemistry and adsorption from solution. New York: Marcel Dekker, Inc.; 1971.
- [88] M. Mazet, B. Farkhani, M. Baudu, Influence of heat or chemical treatment of activated carbon onto the adsorption of organic compounds. *Water Res.* 28 (1994) 1609-1617.
- [89] B.M. Babic, S.K. Milonjic, M.J. Polovina, B.V. Kaludierovi'c, Point of zero charge and intrinsic equilibrium constants of activated carbon cloth, *Carbon* 37 (1999) 477-481.
- [90] A. Aziz, M.S. Ouali, E.H.E. Ioussi, L.C. De Menorval, M. Lindheimer, Chemically modified olive stone: A low-cost sorbent for heavy metals and basic dyes removal from aqueous solutions, *J. Hazard. Mater.* 163 (2009) 441-447.
- [91] M.N. Khan, M.F. Wahab, Characterization of chemically modified corncobs and its application in the removal of metal ions from aqueous solution, *J. Hazard. Mater.* 141 (2007) 237-244.
- [92] B.H. Hameed, D.K. Mahmoud, A.L. Ahmad, Sorption equilibrium and kinetics of basic dye from aqueous solution using banana stalk waste. *J. Hazard. Mater.* 158 (2008) 499-506.

- [93] V. Vimonses, S.M. Lei, B. Jin, C.W.K. Chowd, C. Saint, Kinetic study and equilibrium isotherm analysis of Congo Red adsorption by clay materials, *Chem. Eng. J.* 148 (2009) 354–364.
- [94] E. Demirbas, M. Kobya, M.T. Sulak, Adsorption kinetics of a basic dye from aqueous solutions onto apricot stone activated carbon, *Bioresour. Technol.* 99 (2008) 5368–5373.
- [95] N. Azouaou, Z. Sadaoui, A. Djaafri, H. Mokaddem, Adsorption of cadmium from aqueous solution onto untreated coffee grounds: Equilibrium, kinetics and thermodynamics, *J. Hazard. Mater.* 184 (2010) 126–134.
- [96] R. Han, Y.F. Wang, P. Han, J. Shi, J. Yang, Y.S. Lu, Removal of methylene blue from aqueous solution by chaff in batch mode, *J. Hazard. Mater.* B137 (2006) 550–557.
- [97] F.J. Hingston. In: Anderson MA, Rubin AJ, editors. Adsorption of inorganics at solid-liquid interfaces. Ann Arbor, MI: Ann Arbor Science Publishers, Inc.; 1981.
- [98] M. Alkan, S. Celikcapa, O. Demirbasx, M. Dogan, Removal of reactive blue 221 and acid blue 62 anionic dyes from aqueous solutions by sepiolite, *Dyes Pigm.* 65 (2005) 251–259.
- [99] Y.S. Al-Degs, M.I. El-Barghouthi, A.H. El-Sheikh, G.M. Walker, Effect of solution pH, ionic strength, and temperature on adsorption behavior of reactive dyes on activated carbon, *Dyes Pigm.* 77 (2008) 16–23.
- [100] S.D. Khattria, M.K. Singh, Removal of malachite green from dye wastewater using neem sawdust by adsorption, *J. Hazard Mater.* 167 (2009) 1089–1094.

- [101] A. Grimm, R. Zanzi, E. Bjornbom, A.L. Cukierman, Comparison of different types of biomasses for copper biosorption, *Bioresour. Technol.* 99 (2008) 2559–2565.
- [102] W.H. Zou, R.P. Han, Z.Z. Chen, J. Shi, H.M. Liu, Characterization and Properties of manganese oxide coated zeolite (MOCZ) as adsorbent for removal of copper(II) and lead(II) ions from solution, *J. Chem. Eng. Data* 51 (2006) 534–541.
- [103] N. Yeddou Mezenner, A. Bensmaili, Kinetics and thermodynamic study of phosphate adsorption on iron hydroxide- eggshell waste, *Chem. Eng. J.* 147 (2009) 87–96.
- [104] M. Yalvac Can, E. Yildiz, Phosphate removal from water by fly ash: factorial experimental design, *J. Hazard. Mater.* 135 (2006) 165–170.
- [105] A. El Nemr, Potential of pomegranate husk carbon for Cr(VI) removal from wastewater: Kinetic and isotherm studies, *J. Hazard. Mater.* 161 (2009) 132–141.
- [106] I. Langmuir, The constitution and fundamental properties of solids and liquids, *J. Am. Chem. Soc.* 38 (1916) 2221–2295.
- [107] D.G. Kinniburgh, General purpose adsorption isotherms, *Environ. Sci. Technol.* 20 (1986) 895–904.
- [108] B.H. Hameed, R.R. Krishni, S.A. Sata, A novel agricultural waste adsorbent for the removal of cationic dye from aqueous solutions, *J. Hazard. Mater.* 162 (2009) 305–311.
- [109] G. McKay, Adsorption of dyestuffs from aqueous solution with activated carbon. I. Equilibrium and batch contact time studies, *J. Chem. Technol. Biotechnol.* 32 (1982) 759–772.
- [110] H. Freundlich, Uber die adsorption in losungen (adsorption in solution), *Z. Phys.Chem.* 57 (1906) 384–470.

- [111] C. Septhum, S. Rattanaphani, J.B. Bremner, V. Rattanaphani, An adsorption study of Al(III) ions onto chitosan. *J. Hazard. Mater.* 148 (2007) 185–191.
- [112] C. Aharoni, M. Ungarish, Kinetics of activated chemisorption. Part 2. Theoretical models, *J. Chem. Soc. Faraday Trans.* 73 (1977) 456–464.
- [113] G.O. El-Sayed, Removal of methylene blue and crystal violet from aqueous solutions by palm kernel fiber, *Desalin.* 272, (2011) 225–232.
- [114] Z. Aksu, Determination of the equilibrium, kinetic and thermodynamic parameters of the batch biosorption of lead(II) ions onto *Chlorella vulgaris*, *Process Biochem.* 38 (2002) 89–99.
- [115] Srivastava VC, Prasad B, Mall ID, Mahadevswamy M, Mishra IM. Adsorptive removal of phenol by bagasse fly ash and activated carbon: equilibrium, kinetics and thermodynamics. *Colloid Surf A* 272 (2006) 89–104.
- [116] C. Raymon, Chemistry: thermodynamic. Boston: McGraw-Hill; 1998. p. 737.