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Adsorption of Methyl Orange onto Chitosan from Aqueous Solution

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ABSTRACT

Chitosan was utilized as adsorbent to remove methyl orange (MO) from aqueous solution by adsorption. Batch experiments were conducted to study the effects of pH, initial concentration of adsorbate and temperature on dye adsorption. The kinetic data obtained from different batch experiments were analyzed using both pseudo first-order and pseudo second-order equations. The equilibrium adsorption data were analyzed by using the Freundlich and Langmuir models. The best results were achieved with the pseudo second-order kinetic model and with the Langmuir isotherm equilibrium model. The equilibrium adsorption capacity (q_e) increases with increasing the initial concentration of dye and with decreasing pH. The values of q_e were found to be slightly increased with increasing solution temperatures. The activation energy (E_a) of sorption kinetics was found to be 10.41 kJ/mol. Thermodynamic parameters such as change in free energy (ΔG), enthalpy (ΔH) and entropy (ΔS) were also discussed.

KEYWORDS

Adsorption, Kinetics, Chitosan, Anionic dyes, Wastewater

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References

- [1] M. S. Tsuboy, J. P. F. Angeli, M. S. Mantovani, S. Knasmueller, G. A. Umbuzeiro, L. R. Ribeiro, "Genotoxic, Mutagenic and Cytotoxic Effects of the Commercial Dye CI Disperse Blue 291 in the Human Hepatic Cell Line HepG2," *Toxicol. in Vitro*, Vol. 21, No. 8, 2007, pp. 1650-1655.
- [2] S. Vinitnantharat, W. Chartthe, A. Pinisakul, "Toxicity of Reactive Red 141 and Basic Red 14 to Algae and Waterfleas," *Water Sci. Technol.*, Vol. 58, No. 6, 2008, pp. 1193-1198.
- [3] Z. Ra?s, L. El Hassani, J. Maghnoije, M. Hadji, R. Ibelkhat, R. Nejjar, A. Kherbeche, A. Chaqroune, "Dyes' Removal from Textile Wastewater by Phosphogypsum using Coagulation and Precipitation Method," *Phys. Chem. News*, Vol. 7, 2002, pp. 100-109.
- [4] A. Rezaee, M. T. Ghaneian, S. J. Hashemian, G. Moussavi, A. Khavanin, G. Ghanizadeh, "Decolorization of Reactive Blue 19 Dye from Textile Wastewater by the UV/H₂O₂ Process," *J. Applied Sci.*, Vol. 8, No. 6, 2008, pp. 1108-1112.
- [5] J. Racyte, M. Rimeika, H. Bruning, "pH Effect on Decolorization of Raw Textile Wastewater Polluted with Reactive Dyes by Advanced Oxidation with UV/H₂O₂," *Environ. Prot. Eng.*, Vol. 35, No. 3, pp. 167-178.
- [6] R. Saraswathi, M. K. Saseetharan, "Investigation on Microorganisms and their Degradation Efficiency in Paper and Pulp Mill Effluent," *J. Water Resource and Protection*, Vol. 2, No. 7, 2010, pp. 660-664.
- [7] C. Varlikli, V. Bekiari, M. Kus, N. Boduroglu, I. Oner, P. Lianos, G. Lyberatos, S. Icli, "Adsorption of Dyes on Sahara Desert Sand," *J. Hazard. Mater.*, Vol. 170, No. 1, 2009, pp. 27-34.
- [8] A. Rodriguez, J. Garcia, G. Ovejero, M. Mestanza, "Adsorption of Anionic and Cationic Dyes on Activated Carbon from Aqueous Solutions: Equilibrium and Kinetics," *J. Hazard. Mater.*, Vol. 172, No.

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- [9] G. McKay, "The Adsorption of Dyestuffs from Aqueous Solution using Activated Carbon: Analytical Solution for Batch Adsorption Based on External Mass Transfer and Pore Diffusion," *Chem. Eng. J.*, Vol. 27, 1983, pp. 187 - 196.
- [10] K. C. L. N. Rao, K. K. Ashutosh, "Color Removal from a Dyestuff Industry Effluent using Activated Carbon," *Indian J. Chem. Tech.*, Vol. 1, No. 1, 1994, pp. 13 - 19.
- [11] A. N. Fernandes, C. A. P. Almeida, C. T. B. Menezes, N. A. Debacher, M. M. D. Sierra, "Removal of Methylene Blue from Aqueous Solution by Peat," *J. Hazard. Mater.*, Vol. 144, No. (1-2), 2007, pp. 412-419.
- [12] K. R. Ramakrishna, T. Viraraghavan, "Dye Removal using Low Cost Adsorbents," *Water Sci. Tech.*, Vol. 36, No. (2-3), 1997, pp. 189 - 196.
- [13] R. Dolphen, N. Sakkayawong, P. Thiravetyan, W. Nakbanpote, "Adsorption of Reactive Red 141 from Wastewater onto Modified Chitin," *J. Hazard. Mater.*, Vol. 145, No. (1-2), 2007, pp. 250-255.
- [14] G. McKay, H. S. Blair, J. R. Gardner, "Adsorption of Dyes on Chitin. I. Equilibrium Studies," *J. Appl. Polym. Sci.*, Vol. 27, No. 8, 1982, pp. 3043-3057.
- [15] G. Annadurai, M. R. V. Krishnan, "Adsorption of Acid Dye from Aqueous Solution by Chitin: Batch Kinetic Studies," *Indian J. Chem. Technol.* Vol. 4, 1997, pp. 213-222.
- [16] E. Longhinetti, F. Pozza, L. Furlan, M. D. N. D. Sanchez, M. Klug, M. C. M. Laranjeira, V. T. Favere, "Adsorption of Anionic Dyes on the Biopolymer Chitin," *J. Braz. Chem. Soc.*, Vol. 9, No. 5, 1998, pp. 435-440.
- [17] A. K. Chowdhury, A. D. Sarkar, A. Bandyopadhyay, "Rice Husk Ash as a Low Cost Adsorbent for the Removal of Methylene Blue and Congo Red in Aqueous Phases," *Clean*, Vol. 37, No. 7, 2009, pp. 581-591.
- [18] M. Arami, N. Y. Limaee, N. M. Mahmoodi, N. S. Tabrizi, "Equilibrium and Kinetics Studies for the Adsorption of Direct and Acid Dyes from Aqueous Solution by Soy Meal Hull," *J. Hazard. Mater.*, Vol. 135, No. (1-3), 2006, pp. 171-179.
- [19] K. S. Mundhe, A. A. Bhave, R. C. Torane, N. R. Deshpande, R. V. Kashalkar, "Removal of Cationic Dye from Aqueous Solution using Raw Agro Wastes as Non - Conventional Low - Cost Adsorbent, *Orient. J. Chem.*, Vol. 25, No. 4, 2009, pp. 953-959.
- [20] Z. Aksu, S. Tezer, "Equilibrium and Kinetic Modeling of Biosorption of Remazol Black B by *Rhizopus Arrhizus* in a Batch System: Effect of Temperature," *Process Biochem.*, Vol. 36, No. 5, 2000, pp. 431-439.
- [21] Z. Aksu, "Biosorption of Reactive Dyes by Dried Activated Sludge: Equilibrium and Kinetic Modeling," *Biochem. Eng. J.*, Vol. 7, No. 1, 2001, pp. 79-84.
- [22] T. K. Saha, H. Ichikawa, Y. Fukumori, "Gadolinium Diethylenetriaminopetaacetic Acid-Loaded Chitosan Microspheres for Gadolinium Neutron-Capture Therapy," *Carbohydr. Res.*, Vol. 341, No. 17, 2006, pp. 2835-2841.
- [23] N. Bhattarai, J. Gunn, M. Zhang, "Chitosan-Based Hydrogels for Controlled, Localized Drug Delivery," *Adv. Drug Delivery Rev.*, Vol. 62, No. 1, 2010, pp. 83-99.
- [24] M. Manconi, S. Mura, M. L. Manca, A. M. Fadda, M. Dolz, M. J. Hernandez, A. Casanovas, O. Díez-Sales, "Chitosomes as Drug Delivery Systems for C-Phycocyanin: Preparation and Characterization," *Int. J. Pharm.*, Vol. 392, No. (1-2), 2010, pp. 92-100.
- [25] K. H. Chu, "Removal of Copper from Aqueous Solution by Chitosan in Prawn Shell: Adsorption Equilibrium and Kinetics," *J. Hazard. Mater.*, Vol. 90, No. 1, 2002, pp. 77-95.
- [26] P. Miretzky, A. Fernandez Cirelli, "Hg(II) Removal from Water by Chitosan and Chitosan Derivatives: A Review," *J. Hazard. Mater.*, Vol. 167, No. (1-3), 2009, pp. 10-23.
- [27] J. R. Rangel-Mendez, R. Monroy-Zepeda, E. Leyva-Ramos, P. E. Diaz-Flores, K. Shirai, "Chitosan Selectivity for Removing Cadmium(II), Copper(II), and Lead(II) from Aqueous Phase: pH and Organic Matter Effect," *J. Hazard. Mater.*, Vol. 162, No. 1, 2009, pp. 503-511.
- [28] T. K. Saha, S. Karmaker, H. Ichikawa, Y. Fukumori, "Mechanisms and Kinetics of Trisodium 2-hydroxy-

1,17-azonaphthalene-3,4,6-trisulfonate Adsorption onto Chitosan," J. Colloid Interface Sci., Vol. 286, No. 2, 2005, pp. 433-439.

- [29] P. R. Modak, K. S. Singh, D. A. Connor, "Experimental Study on the Elimination of Colour and Organic Matter from Wastewater using an Inexpensive Biomaterial, Chitosan," Water Qual. Res. J. Can., Vol. 44, No. 3, 2009, pp. 295-306.
- [30] A. H. Chen, Y. Y. Huang, "Adsorption of Remazol Black 5 from Aqueous Solution by the Templated Crosslinked-Chitosans," J. Hazard. Mater., Vol. 177, No. (1-3), 2010, pp. 668-675.
- [31] N. K. Lazaridis, G. Z. Kyzas, A. A. Vassiliou, D. N. Bikiaris, "Chitosan Derivatives as Biosorbents for Basic Dyes," Langmuir, Vol. 23, No. 14, 2007, pp. 7634-7643.
- [32] M.-S. Chiou, H.-Y. Li, "Equilibrium and Kinetic Modeling of Adsorption of Reactive Dye on Cross-Linked Chitosan Beads," J. Hazard. Mater., Vol. 93, No. 2, 2002, pp. 233-248.
- [33] H. Yoshida, A. Okamoto, T. Kataoka, "Adsorption of Acid Dye on Cross-Linked Chitosan Fibers: Equilibria," Chem. Eng. Sci., Vol. 48, No. 12, 1993, pp. 2267-2272.
- [34] M. N. V. R. Kumar, "A Review of Chitin and Chitosan Applications," React. Funct. Polym., Vol. 46, No. 1, 2000, pp. 1-27.