JEP> Vol.3 No.7, July 2012

OPEN ACCESS

# Defluoridation of Water by a Biomass: *Tinospora cordifolia*

PDF (Size:432KB) PP. 610-616 DOI: 10.4236/jep.2012.37074

## Author(s)

Piyush Kant Pandey, Madhurima Pandey, Rekha Sharma

## ABSTRACT

This research is focused on the search of a biomass for the sequestration of fluoride from drinking water. Defluoridation of water was studied by batch experiments in biosorption process. The biomass was found to reduce fluoride to permissible limit 1.5 mg/L as prescribed by WHO. The efficiency of the sorption process was investigated under different experimental parameters such as pH 7, standing time 120 min and biomass doses 7.0 g with 5 mg/L concentration of fluoride. Neutral pH was identified as the optimum condition of the medium and 120 minutes was the best contact time for maximum fluoride adsorption. The experimental data was found good fitting to Langmuir and Freundlich isotherm models. In interference study tolerable effect was found with 50 mg/L concentration of co-ions, whereas increasing the concentration of co-ions retarded the fluoride removal capacity in some extent. FT-IR spectrum analysis showed fluoride binding in the different frequency ranges of the biomass. Eventually, this plant biomass is recommended as a suitable and low cost adsorbent to reduce fluoride into standard permissible limit.

## KEYWORDS

Sequestration; Defluoridation; Biosorption; FT-IR Spectrum; Permissible

## Cite this paper

P. Kant Pandey, M. Pandey and R. Sharma, "Defluoridation of Water by a Biomass: *Tinospora cordifolia*," *Journal of Environmental Protection*, Vol. 3 No. 7, 2012, pp. 610-616. doi: 10.4236/jep.2012.37074.

## References

[1] J. Cao, Y. Zhao, J. W. Lin, R. D. Xirao and S. B. Danzeng, "Environmental Fluoride in Tibet," Environmental Research, Vol. 83, Vol. 83, No. 3, 2000, pp. 333-337. doi:10.1006/enrs.2000.4066

[2] V. K. Gupta, A. Lmran and V. K. Sain, "Defluoridation of Wastewaters Using Waste Carbon Slurry," Water Research, Vol. 41, No. 15, 2007, pp. 3307-3316. doi:10.1016/j.watres.2007.04.029

[3] G. Zhang, Y. Gao, Y. Zhang and P. Gu, "Removal of Fluoride from Drinking Water by a Membrane Coagulation Reactor (MCR)," Desalination, Vol. 177, No. 1-3, 2005, pp. 143-155. doi:10.1016/j.desal.2004.12.005

[4] BIS, "Indian Standards for Drinking Water-Specification," Bureau of Indian Standards, New Delhi, 1991.

[5] S. Venkata Mohan, P. Nikhila and S. J. Reddy, "Determination of Fluoride Content in Drinking Water and Development of a Model in Relation to Some Water Quality Parameters," Fresenius Environmental Bulletin, Vol. 4, 1995, pp. 297-302.

[6] R. C. Maheshwari and Meenakshi, "Fluoride in Drinking Water and Its Removal," Journal of Hazardous Materials, Vol. 137, No. 1, 2006, pp. 456-463. doi:10.1016/j.jhazmat.2006.02.024

[7] D. Jackson, J. J. Murray and C. G. Fairpo, "Lifelong Benefits of Fluoride in Drinking Water," British Dental Journal, Vol. 134, No. 10, 1973, pp. 419-422. doi:10.1038/sj.bdj.4803012

[8] G. Karthikeyan, A. Pius and G. Alagumuthu, "Fluoride Adsorption Studies of Montmorillonite Clay," Indian Journal of Chemical Technology, Vol. 12, 2005, pp. 263-273.

- Open Special Issues
- Published Special Issues
- Special Issues Guideline

JEP Subscription

Most popular papers in JEP

About JEP News

Frequently Asked Questions

Recommend to Peers

Recommend to Library

Contact Us

[9] N. Subba Rao and D. J. Devdas, "Fluoride Incidence in Groundwater in an Area of Peninsula India," Environmental Geology, Vol. 45, No. 2, 2003, pp. 243-251. doi:10.1007/s00254-003-0873-3

[10] A. K. Chaturvedi, K. P. Yadva, K. C. Yadava, K. C. Pathak and V. N. Singh, "Deflouridation of Water by Adsorption on Fly Ash," Water, Air, Soil Pollution, Vol. 49, No. 1-2, 1990, pp. 51-61. doi:10.1007/BF00279509

[11] M. Emamjomeh and M. Sivakumar, "Fluoride Removal by a Continuous Flow Ectrocoagulation Reactor," Journal of Environmental Management, Vol. 90, No. 2, 2009, pp. 1204-1212. doi:10.1016/j.jenvman.2008.06.001

[12] A. V. Jamode, V. S. Sapkal and V. S. Jamode, "Defluoridation of Water Using Inexpensive Adsorbents," Journal of the Indian Institute of Science, Vol. 84, 2004, pp. 163-171.

[13] K. Sarala and P. R. Rao, "Endemic Fluorosis in the Village Ralla, Anantapuram in Andhra Pradesh an Epidemiological Study," Fluoride, Vol. 26, 1993, pp. 177-180.

[14] H. E. Short, G. R. Mc Robert, T. W. Bernardand and A. S. Mannadiyar, "Endemic Fluorosis in the Madras Presidency," Indian Journal of Medical Research, Vol. 25, 1937, pp. 553-561.

[15] K. Shushila, "Fluorosis Management Programme in India: The Impact Due to Networking between Health and Rural Drinking Water Supply," International Association of Hydrological Sciences, Vol. 260, 2000, pp. 159-165.

[16] S. Chidambaram, A. L. Ramnathan and S. Vasudevan, "Fluoride Removal Studies in Water Using Natural Materials," Water SA, Vol. 29, No. 3, 2003, pp. 339-343.

[17] A. M. Raichur and M. Jyoti Basu, "Adsorption of Fluoride onto Mixed Rare Earth Oxides," Separation and Purification Technology, Vol. 24, No. 1-2, 2001, pp. 121-127. doi:10.1016/S1383-5866(00) 00219-7

[18] E. J. Reardon and Y. Wang, "Limestone Reactor for Fluoride Removal from Waste Waters," Environmental Science & Technology, Vol. 34, No. 15, 2000, pp. 3247-3253. doi:10.1021/es990542k

[19] B. Singh, P. K. Kumar Sen and J. Maunder, "Removal of Fluoride from Spent Pot Liner Leachate Using Ion Exchange," Water Environment Research, Vol. 71, No. 1, 1999, pp. 36-42. doi:10.2175/106143099X121571

[20] A. Dieye, C. Larchet, B. Auclair and C. Mar-Diop, "Elimination des Fluorures Parla Dialyse Ionicque Croisee," European Polymer Journal, Vol. 34, No. 1, 1998, pp. 67-75. doi:10.1016/S0014-3057(97) 00079-7

[21] N. Mameri, H. Lounici, D. Belhocine, H. Grib, G. F. Prion and Y. Yahiat, "Defluoridation of Sahara Water by Small Electro Coagulation Using Bipolar Aluminium Electrodes," Separation and Purification Technology, Vol. 24, No. 1-2, 2001, pp. 13-119. doi:10.1016/S1383-5866(00)00218-5

[22] M. Hichour, F. Persin, J. Sandeaux and C. Gavach, "Water Defluoridation by Donann Dialysis and Electro Dialysis," Separation and Purification Technology, Vol. 18, No. 1, 2000, pp. 1-11. doi:10.1016/S1383-5866(99)00042-8

[23] S. Venkata Mohan, S. Ramanaiah, B. Rajkumar and P. Sarma, "Biosorption of Fluoride from Aqueous Phase onto Algal Spirogyra IO1 and Evaluation of Adsorption Kinetics," Bioresource Technology, Vol. 98, No. 5, 2007, pp. 1006-1016. doi:10.1016/j.biortech.2006.04.009

[24] B. Volesky, "Biosorption and Me.," Water Research, Vol. 41, No. 18, 2007, pp. 4017-4029. doi:10.1016/j.watres.2007.05.062

[25] B. Volesky and Z. R. Holan, "Biosorption of Heavy Metals," Biotechnology Progress, Vol. 11, No. 3, 1995, pp. 235-250. doi:10.1021/bp00033a001

[26] J. Crittenden, R. Trussell, D. Hand, K. Howe and G. Tchobanoglous, "Water Treatment: Principles and Design," John Wiley and Sons, New York, 2005.

[27] M. Malakootian, A. Almasi and H. Hossaini, "Pb and Co Removal from Paint Industries Effluent Using Wood Ash," International journal of Environmental Science and Technology, Vol. 5, No. 2, 2008, pp. 217-222.

[28] D. Kratochvil and B. Volesky, "Advances in the Biosorption of Heavy Metals," Trends in Biotechnology, Vol. 16, No. 7, 1998, pp. 291-300.

[29] S. Ghorai and K. Pant, "Investigations on the Column Performance of Fluoride Adsorption by Activated Alumina in a Fixed-Bed," Chemical Engineering Journal, Vol. 98, No. 1-2, 2004, pp. 165-173. doi:10.1016/j.cej.2003.07.003

[30] N. Das, P. Pattanaik and R. Das, "Defluoridation of Drinking Water Using Activated Titanium-Rich Bauxite," Journal of Colloid and Interface Science, Vol. 292, 2005, pp. 6-45.

[31] S. Meenakshi and N. Viswanathan, "Identification of Selective Ionexchange Resin for Fluoride Sorption," Journal of Colloid and Interface Science, Vol. 308, No. 2, 2006, pp. 438-450.

[32] S. Maliyekkal, A. Sharma and L. Philip, "Manganese-Oxide-Coated Alumina: A Promising Sorbent for Defluoridation of Water," Water Research, Vol. 40, No. 19, 2006, pp. 3497-3506.

[33] Y. H. Li, S. Wang, X. Zhang, J. Wei, C. Xu, Z. Luan and D. Wu, "Adsorption of Fluoride from Water by Aligned Carbon Nanotubes," Materials Research Bulletin, Vol. 38, No. 3, 2003, pp. 469-476. doi:10.1016/S0025-5408(02)01063-2

[34] D. J. Killedar and D. S. Bhargava, "Effects of Stirring Rate and Temperature on Fluoride Removal by Fishbone Charcoal," Indian Journal of Environmental Health, Vol. 35, No. 2, 1993, pp. 81-87.

[35] N. Prabavathi, T. Ramachandramoorthy, R EdisonRaja, B. Kavitha, C. Sivajiand and R. Srinivasan, "Drinking Water of Salem District Estimation of Fluoride and Its Defluoridation Using Lignite Rice Husk and Rice-Husk Powder," International Journal of Environment and Pollution, Vol. 23, No. 3, 2003, pp. 304-308.

[36] S. Ayoob and A. K. Gupta, "Insights into Isotherm Making in the Sorptive Removal of Fluoride from Drinking Water," Journal of Hazardous Materials, Vol. 152, No. 3, 2007, pp. 976-985.

[37] Z. C. Di, Y. H. Li, X. J. Peng, Z. K. Luan and J. Liang, "Adsorption of Fluoride by Aligned Carbon Nanotubes Supported Ceria Nanoparticles," Solid State Phenomena, Vol. 121-123, 2007, pp. 1221-1224.

[38] S. Dey, S. Goswami and U. C. Ghosh, "Hydrous Ferric Oxide (HFO)—A Scavenger for Fluoride from Contaminated Water," Water, Air and Soil Pollution, Vol. 158, No. 1, 2004, pp. 311-323. doi:10.1023/B:WATE.0000044854.71497.b6

[39] M. Bhatnagar, A. Bhatnagar and S. Jha, "Interactive Biosorption by Microalgal Biomass as a Tool for Fluoride Removal," Biotechnology Letters, Vol. 24, No. 13, 1991, pp. 1079-1081. doi:10.1023/A:1016086631017

[40] V. K. Gupta, L. Ali and V. K. Saini, "Defluoridation of Waste Waters Using Waste Carbon Slurry," Water Research, Vol. 41, No. 15, 2007, pp. 3307-3316. doi:10.1016/j.watres.2007.04.029

[41] S. Sinha, Pandey, K. P. Mohan and K. P. Singh, "Removal of Fluoride From Aqueous Solutions by Eichhornia Crassipes Biomass and Its Carbonizsed Form," Industrial & Engineering Chemistry