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Adaptive Neuro-Fuzzy Logic System for Heavy Metal Sorption in Aquatic Environments

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ABSTRACT

In this paper, adaptive neuro-fuzzy inference system ANFIS is used to assess conditions required for aquatic systems to serve as a sink for metal removal; it is used to generate information on the behavior of heavy metals (mercury) in water in relation to its uptake by bio-species (e.g. bacteria, fungi, algae, etc.) and adsorption to sediments. The approach of this research entails training fuzzy inference system by neural networks. The process is useful when there is interrelation between variables and no enough experience about mercury behavior, furthermore it is easy and fast process. Experimental work on mercury removal in wetlands for specific environmental conditions was previously conducted in bench scale at Concordia University laboratories. Fuzzy inference system FIS is constructed comprising knowledge base (*i.e.* premises and conclusions), fuzzy sets, and fuzzy rules. Knowledge base and rules are adapted and trained by neural networks, and then tested. ANFIS simulates and predicts mercury speciation for biological uptake and mercury adsorption to sediments. Modeling of mercury bioavailability for bio-species and adsorption to sediments shows strong correlation of more than 98% between simulation results and experimental data. The fuzzy models obtained are used to simulate and forecast further information on mercury partitioning to species and sediments. The findings of this research give information about metal removal by aquatic systems and their efficiency.

KEYWORDS

Adaptive Neuro-Fuzzy; Simulation, Heavy Metal; Sorption; Aquatic Systems; Forecast

Cite this paper

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References

[1] D. Inthorn, H. Nagase, Y. Isaji, K. Hirata and K. Miyamoto, "Removal of Cadmium from Aqueous Solution by the Filamentous Cyanobacterium Tolypothrix tenuis," Journal of Fermentation and Bioengineering, Vol. 82, No. 6, 1996, pp. 580-584. doi:10.1016/S0922-338X(97)81256-1

[2] L. C. Rai, J. P. Gaur and H. D. Kumar, "Phycology and Heavymetal Pollution," Biological Reviews, Vol. 56, No. 2, 1981, pp. 99-103. doi:10.1111/j.1469-185X.1981.tb00345.x

[3] V. Kuppusamy, J. R. Jegan, K. Palanivelu and M. Velan, "Copper Removal from Aqueous Solution by Marine Green Alga Ulva Reticulate," Electronic Journal of Biotechnology, Vol. 7, No. 1, 2004, pp. 61-71.

[4] M. Horsfall Jr. and A. I. Spiff, "Effects of Temperature on the Sorption of Pb2+ and Cd2+ from Aqueous Solution by Caladium Bicolour (wild Cocoyam) Biomass," Electronic Journal of Biotechnology, Vol. 8, No. 2, 2005.

[5] J. C. Igwe and A. A. Abia, "Maize Cob and Husk as Adsorbents for Removal of Cd, Pb and Zn Ions from Wastewater," The Physical Science, Vol. 2, 2003, pp. 83-94.

[6] L. H. Keith and W. A. Telliard, "Priority Pollutants," Environmental Science & Technology, Vol. 13, No.

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4, 1979, pp. 416-424. doi:10.1021/es60152a601

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

[8] J. L. Wang and C. Chen, "Biosorption of Heavy Metals by Saccharomyces Cerevisiae: A Review," Biotechnology Advances, Vol. 24, No. 5, 2006, pp. 427-451. doi:10.1016/j.biotechadv.2006.03.001

[9] K. Vijayaraghavan and Y. S. Yun, "Bacterial Biosorbents and Biosorption," Biotechnology Advances, Vol. 26, No. 2, 2008, pp. 266-291. doi:10.1016/j.biotechadv.2008.02.002

[10] G. M. Gadd, "Interactions of Fungi with Toxic Metals," New Phytologist, Vol. 124, No. 1, 1993, pp. 25-60. doi:10.1111/j.1469-8137.1993.tb03796.x

[11] V. S. Podgorskii, T. P. Kasatkina and O. G. Lozovaia, "Yeasts—Biosorbents of Heavy Metals," Mikrobiol Z, Vol. 66, 2004, pp. 91-103.

[12] D. Kratochvil and B. Volesky, "Advances in the Biosorption of Heavy Metals," Trends in Biotechnology, Vol. 16, No. 7, 1998, pp. 291-300. doi:10.1016/S0167-7799(98)01218-9

[13] S. Tunali, A. Cabuk and T. Akar, "Removal of Lead and Copper Ions from Aqueous Solutions by Bacterial Strain Isolated from Soil," Chemical Engineering Journal, Vol. 115, No. 3, 2006, pp. 203-211. doi:10.1016/j.cej.2005.09.023

[14] M. X. Loukidou, T. D. Karapantsios, A. I. Zouboulis and K. A. Matis, "Diffusion Kinetic Study of Cadmiurn (II) Biosorption by Aeromonas caviae," Journal of Chemical Technology and Biotechnology, Vol. 79, No. 7, 2004, pp. 711-719. doi:10.1002/jctb.1043

[15] J. A. Davis, B. Volesky and R. H. S. F.Vierra, "Sargassum Seaweed as Biosorbent for Heavy Metals," Water Research, Vol. 34, No. 17, 2000, pp. 4270-4278. doi:10.1016/S0043-1354(00)00177-9

[16] A. Selatnia, A. Boukazoula, N. Kechid, M. Z. Bakhti and A. Chergui, "Biosorption of Fe3+ from Aqueous Solution by a Bacterial Dead Streptomyces Rimosus Biomass," Process Biochemistry, Vol. 39, No. 11, 2004, pp. 1643-1651. doi:10.1016/S0032-9592(03)00305-4

[17] T. Srinath, T. Verma, P. W. Ramteke and S. K. Garg, "Chromium (VI) Biosorption and Bioaccumulation by Chromate Resistant Bacteria," Chemosphere, Vol. 48, No. 4, 2002, pp. 427-435. doi:10.1016/S0045-6535(02)00089-9

[18] K. Vijayaraghavan, J. R. Jegan, K. Palanivelu and M. Velan, "Copper Removal from Aqueous Solution by Marine Green Alga Ulva Reticulate," Electronic Journal of Biotecnology, Vol. 7, No 1, 2004. doi:10.2225/vol7-issue1-fulltext-4

[19] A. Ozturk, "Removal of Nickel from Aqueous Solution by the Bacterium Bacillus Thuringiensis," Journal of Hazardous Materials, Vol. 147, No. 1-2, 2007, pp. 518-523. doi:10.1016/j.jhazmat.2007.01.047

[20] T. R. Muraleadharan, L. Iyengar and C. Venkobachar, "Screening of Tropical Wood-Rotting Mushrooms for Copper Biosoption," Applied and Environmental Microbiology, Vol. 61, No. 9, 1995, pp. 3507-3508.

[21] A. Nakajima and T. Tsuruta, "Competitive biosorption of thorium and uranium by Micrococcus luteus," Journal of Radioanalytical and Nuclear Chemistry, Vol. 260, No. 1, 2004, pp. 13-18. doi:10.1023/B:JRNC.0000027055.16768.1e

[22] S. Gang and S. Weixing, "Sunflower Stalks as Adsorbents for the Removal of Metal Ions from Wastewater," Industrial & Engineering Chemistry Research, Vol. 37, No. 4, 1998, pp. 1324-1328. doi:10.1021/ie970468j

[23] J. Rincon, F. Gonzalez, A. Ballester, M. L. Blazquez and J. A. Munoz, "Biosorption of Heavy Metals by Chemically-Activated Alga Fucus Vesiculosus," Journal of Chemical Technology and Biotechnology, Vol. 80, No. 12, 2005, pp. 1403-1407. doi:10.1002/jctb.1342

[24] N. Kuyicak and B. Volesky, "Biosorption by Fungal Biomass," In: B. Volesky, Ed., Biosorption of Heavy Metals, CRC press, Florida, 1990, pp. 173-198.

[25] E. Romera, F. Gonzalez, A. Ballester, M. L. Blazquez and J. A. Munoz, "Biosorption with Algae: A Statistical Review," Critical Reviews in Biotechnology, Vol. 26, No. 4, 2006, pp. 223-235. doi:10.1080/07388550600972153

[26] J. D. Allison, D. S. Brown and K. J. Novo-Gradac, “ MINTEQA2/PRODEFA2, Geochemical Assessments