SUPPLEMENTARY MATERIAL TO: Moloi et al. S Afr J Sci. 2024;120(1/2), Art. #12879

HOW TO CITE:
Moloi SP, Okonkwo JO, Jansen R. Defluoridation of water through the application of carbonised bone as a green adsorbent: A review [supplementary material]. S Afr J Sci. 2024;120(1/2), Art. #12879. https://doi.org/10.17159/sajs.2024/12879/suppl

---

Supplementary table 1: Maximum fluoride levels in drinking water sources throughout the world

Region / Country	Maximum fluoride level (mg/L)	Source
India	69.7	Jha et al.[1]
Ngarenanyuki, Tanzania	37.2	Idini et al.[2]
Pilanesberg and Western Bushveld, South Africa	30	Coetzee et al.[3]
Sanddrif, Kuboes and Leeu Gamka, South Africa	30	Grobler et al.[4]; Mothusi[5]
Kuytun, China	21.5	Fawell et al.[6]; Wang et al.[7]
Ngurdoto village, Tanzania	20.9	Idini et al.[8]
Lake Elmentaita and Lake Nukuru, Kenya	20	Kaimenyi[9]
Abidjan, Ivory Coast	16.78	Osemwegie et al.[10]
Middle and eastern part of Turkey	13.7	WHO[11]
Pakistan	13.52	Shah and Danishwar[12]
Tanzania	12.7	Mjengera and Mkongo[13]
North Central Province, Sri Lanka	10	Dissanayake[14]
Hordaland, Norway	9.48	Bardsen et al.[15]
Munster, Germany	8.8	Queste et al.[16]
Uwiro village, Tanzania	8.4	Idini et al.[17]
Senegal	7.4	Brouwer et al.[18]
Tibiri, Nigeria	6.6	Wongdem et al.[19]
Pohang and Gyeongju, Korea	>5	Kim and Jeong[20]
Bongo, Ghana	4.6	Apambire et al.[21]
Tenerife, Spain	4.59	Hardisson et al.[22]
Alberta, Canada	4.3	WHO[11]
Texas, USA	4.3	Reardon and Wang[23]
Indonesia	4.2	Fawell et al.[6]
Illinois, USA	4.07	Cohen and Conrad[24]
Sudan	3.55	Ibrahim et al.[25]
Wonji–Shoa Sugar Estate, Ethiopia	>3	Tekle-Haimanot et al.[26]
Czech Republic	>3	Heikens et al.[27]
Northern and Central Poland	>3	Czarnowski et al.[28]
Finland	>3	Azbar and Türkman[29]
Hail, Saudi Arabia	2.8	Al-Khateeb et al.[30]
Hermosillo and Abasolo, Mexico	2.8	Díaz-Barriga et al.[31]
Mecca, Saudi Arabia	2.5	Akpata et al.[32]
Rift Valley, Uganda	2.5	Rwenyonyi et al.[33]
Olho D'Agua, Brazil	2–3	Cortes et al.[34]
Japan	1.4	Tsutsui et al.[35]
Coronel Dorrego, Argentina	0.9–18.2	Paoloni et al.[36]
Thailand	>0.9	McGrady et al.[37]

Supplementary table 2: Summary of the comparative efficacies of different defluoridation techniques

Defluoridation technique	Method	Testing environment	Fluoride removal	Source
Adsorption	Fine coffee grounds	Groundwater	56.67%	Siaurusevičiūtė and Albrektienė[38]
Adsorption	Iron sludge	Groundwater	62.92%	Siaurusevičiūtė and Albrektienė[38]
Adsorption	Zirconium onto porous starch	Drinking water	25.41 mg/g	Xu et al.[39]
Adsorption	Nepheline (alkali-hydro-thermal process)	Aqueous solutions	183 mg/g	Wang et al.[40]
Nanofiltration		Groundwater	Fluoride rejection: 90%	Brião et al.[41]
Reverse osmosis		Groundwater	Fluoride rejection: 98%	Brião et al.[41]
Ion exchange		Aqueous solutions	90–95%	Kumar et al.[42]
Membrane filtration		Aqueous solutions	99%	Kumar et al.[42]
Electrocoagulation		Aqueous solutions	85.5%	Kumar et al.[42]
Electrocoagulation	Aluminium electrode	Drinking water	97.86%	Takdastan et al.[43]
Adsorption	Purolite A520E resin	Aqueous environments	64.6%	Nasr et al.[44]
Adsorption	Cupric oxide nanoparticles	Aqueous solutions	97%	Bazrafshan et al.[45]
Adsorption	Earth-modified alumina	Aqueous solutions	26.45 mg/g	He et al.[46]
Adsorption	Alumina supported with fungus hyphae	Aqueous solutions	≈90%	Yang et al.[47]
Adsorption	Aluminium hydroxide modified diatomite	Aqueous solution and natural groundwater	89%	Akafu et al.[48]
Adsorption	Zirconium onto tea powder	Drinking water	12.43 mg/g	Cai et al.[49]
Adsorption	Activated carbon: banana peel and coffee husk	Aqueous solution	80–84%	Getachew et al.[50]
Adsorption	Single-walled carbon nanotubes	Aqueous solution	87%–100%	Balarak et al.[51]
Adsorption	Diatomaceous earth modified with Mg/Ce/Mn oxide	Aqueous solution	>93%	Gitari et al.[52]
Adsorption	Activated carbon: Indian bael shell	Aqueous solution	52%	Singh et al.[53]
Metal organic frameworks		Aqueous solution	41.36 mg/g	Zhao et al.[54]
Adsorption	Activated carbon: cow bone	Aqueous solution	93.6%	Alasmari et al.[55]

Supplementary table 3: Previous studies with bones obtained from domestic animals

Bone origin	Source
Bovine	55–63
Porcine	64,65
Ovine	66
Caprine	66,67
Chicken	68,71
Fish	72,73
Camel	74,75
Undeclared	74,79

References

1. Jha S, Nayak A, Sharma Y. Potential fluoride contamination in the drinking water of Marks Nagar, Unnao district, Uttar Pradesh, India. Environ Geochem Health. 2010;32(3):217—226. https://doi.org/10.1007/s10653-009-9277-y
2. Idini A, Frau F, Gutierrez L, Dore E, Nocella G, Ghiglieri G. Application of octacalcium phosphate with an innovative household-scale defluoridator prototype and behavioral determinants of its adoption in rural communities of the East African Rift Valley. Integr Environ Assess Manag. 2020;16(6):856—870.
3. Coetzee P, Coetzee L, Puka R, Mubenga S. Characterisation of selected South African clays for defluoridation of natural waters. Water SA. 2003;29(3):331—338. https://doi.org/10.4314/wsa.v29i3.4935
4. Grobler S, Dreyer A, Blignaut R. Drinking water in South Africa: Implications for fluoride supplementation. SADJ Vereniging. 2001;56(11):557—559. https://doi.org/10.1046/j.0960-7439.2001.00293.x
5. Mothusi B. Psychological effects of dental fluorosis. Department of Health, North-West Province, South Africa; 1995.
6. Fawell J, Bailey K, Chilton J, Dahi E, Magara Y. Fluoride in drinking-water. London: IWA Publishing; 2006.
7. Wang LF, Wang SL, Lin Q, Sun XZ. The quantificational epidemiological meaning of palm and sole eratosis for endemic arsenicosis. Inner Mongolia Res Endem Dis Contr. 1997;22(3):97—101.
8. Idini A, Frau F, Gutierrez L, Dore E, Nocella G, Ghiglieri G. Application of octacalcium phosphate with an innovative household-scale defluoridator prototype and behavioral determinants of its adoption in rural communities of the East African Rift Valley. Integr Environ Assess Manag. 2020;16(6):856—870. https://doi.org/10.1002/ieam.4262
9. Kaimenyi JT. Oral health in Kenya. Int Dent J. 2004;54:378—382. https://doi.org/10.1111/j.1875595x.2004.tb00015.x
10. Osemwegie I, Oga YM-S, Ahoussi KE, Koffi YB, Kouassi AM, Biémi J. Influence of anthropogenic activities of groundwater from hand dug wells within the precarious settlements of Southern Abidjan, Côte d'Ivoire: Case of the slums of Anoumabo (Marcory) and Adjouffou (Port-Bouët). J Water Resource Prot. 2013;5(4):427—439. https://doi.org/10.4236/jwarp.2013.54042
11. World Health Organization (WHO). The world health report 2002: Reducing risks, promoting healthy life. Geneva: WHO; 2002. https://doi.org/10.1080/1357628031000116808
12. Shah MT, Danishwar S. Potential fluoride contamination in the drinking water of Naranji area, northwest frontier province, Pakistan. Environ Geochem Health. 2003;25(4):475—481. https://doi.org/10.1023/B:EGAH.0000004579.54947.e7
13. Mjengera H, Mkongo G. Appropriate deflouridation technology for use in flourotic areas in Tanzania. Phys Chem Earth. 2003;28(20—27):1097—1104. https://doi.org/10.1016/j.pce.2003.08.030

14. Dissanayake C. Water quality and dental health in the Dry Zone of Sri Lanka. Geological Society, London, Special Publications. 1996;113(1):131—140. https://doi.org/10.1144/GSL.SP.1996.113.01.10
15. Bardsen A, Klock KS, Bjorvatn K. Dental fluorosis among persons exposed to high- and low-fluoride drinking water in western Norway. Community Dent Oral Epidemiol. 1999;27(4):259—267. https://doi.org/10.1111/j.1600-0528.1999.tb02019.x
16. Queste A, Lacombe M, Hellmeier W, Hillermann F, Bortulussi B, Kaup M, et al. High concentrations of fluoride and boron in drinking water wells in the Muenster region — results of a preliminary investigation. Int J Hyg Environ Health. 2001;203(3):221—224. https://doi.org/10.1078/S1438-4639(04)70032-2
17. Idini A, Frau F, Gutierrez L, Dore E, Nocella G, Ghiglieri G. Application of octacalcium phosphate with an innovative household-scale defluoridator prototype and behavioral determinants of its adoption in rural communities of the East African Rift Valley. Integr Environ Assess Manag. 2020;16(6):856—870. https://doi.org/10.1002/ieam.4262
18. Brouwer I, De Bruin A, Dirks OB, Hautvast J. Unsuitability of World Health Organization guidelines for fluoride concentrations in drinking water in Senegal. Lancet. 1988;331(8579):223—225. https://doi.org/10.1016/s0140-6736(88)91073-2
19. Wongdem JG, Aderinokun GA, Sridhar MK, Selkur S. Prevalence and distribution pattern of enamel fluorosis in Langtang town, Nigeria. Afr J Med Med Sci. 2000;29(3—4):243—246.
20. Kim K, Jeong GY. Factors influencing natural occurrence of fluoride-rich groundwaters: A case study in the southeastern part of the Korean Peninsula. Chemosphere. 2005;58(10):1399—1408. https://doi.org/10.1016/j.chemosphere.2004.10.002
21. Apambire W, Boyle D, Michel F. Geochemistry, genesis, and health implications of fluoriferous groundwaters in the upper regions of Ghana. Environ Geol. 1997;33(1):13—24. https://doi.org/10.1007/s002540050221
22. Hardisson A, Rodríguez MI, Burgos A, Flores LD, Gutiérrez R, Várela H. Fluoride levels in publicly supplied and bottled drinking water in the island of Tenerife, Spain. Bull Environ Contam Toxicol. 2001;67:163—170. https://doi.org/10.1007/s001280106
23. Reardon EJ, Wang Y. A limestone reactor for fluoride removal from wastewaters. Environ Sci Tech. 2000;34(15):3247—3253. https://doi.org/10.1021/es990542k
24. Cohen D, Conrad HM. 65,000 GPD fluoride removal membrane system in Lakeland, California, USA. Desalination. 1998;117(1—3):19—35. https://doi.org/10.1016/S0011-9164(98)00063-0
25. Ibrahim Y, Abuaffan A, Bjorvatn K. Prevalence of dental fluorosis in Sudanese children from two villages with 0.25 and 2.56 ppm fluoride in the drinking water. Int J Paediatr Dent. 1995;5(4):223—229. https://doi.org/10.1111/j.1365-263x.1995.tb00183.x
26. Tekle-Haimanot R, Melaku Z, Kloos H, Reimann C, Fantaye W, Zerihun L, Bjorvatn K. The geographic distribution of fluoride in surface and groundwater in Ethiopia with an emphasis on the Rift Valley. Sci Total Environ. 2006;367(1):182—190. https://doi.org/10.1016/j.scitotenv.2005.11.003
27. Heikens A, Sumarti S, Van Bergen M, Widianarko B, Fokkert L, Van Leeuwen K, Seinen W. The impact of the hyperacid Ijen Crater Lake: Risks of excess fluoride to human health. Sci Total Environ. 2005;346(1—3):56—69. https://doi.org/10.1016/j.scitotenv.2004.12.007
28. Czarnowski W, Wrześniowska K, Krechniak J. Fluoride in drinking water and human urine in Northern and Central Poland. Sci Total Environ. 1996;191(1—2):177—184. https://doi.org/10.1016/0048-9697(96)05259-X
29. Azbar N, Türkman A. Defluoridation in drinking waters. Water Sci Technol. 2000;42(1—2):403—407. https://doi.org/10.2166/wst.2000.0346
30. Al-Khateeb TL, Al-Marsafi AI, O'Mullane DM. Caries prevalence and treatment need amongst children in an Arabian community. Community Dent Oral Epidemiol. 1991;19(5):277—280. https://doi.org/10.1111/j.1600-0528.1991.tb00167.x
31. Díaz-Barriga F, Navarro-Quezada A, Grijalva MI, Grimaldo M, Loyola-Rodríguez JP, Deogracias Ortiz M. Endemic fluorosis in Mexico. Fluoride. 1997;30(4):233—239.

32. Akpata E, Fakiha Z, Khan N. Dental fluorosis in 12-15-year-old rural children exposed to fluorides from well drinking water in the Hail region of Saudi Arabia. Community Dent Oral Epidemiol. 1997;25(4):324—327. https://doi.org/10.1111/j.1600-0528.1997.tb00947.x
33. Rwenyonyi C, Birkeland J, Haugejorden O, Bjorvatn K. Age as a determinant of severity of dental fluorosis in children residing in areas with 0.5 and 2.5 mg fluoride per liter in drinking water. Clin Oral Investig. 2000;4(3):157—161. https://doi.org/10.1007/pl00010677
34. Cortes DF, Ellwood RP, O'Mullane DM, de Magalhaes Bastos JR. Drinking water fluoride levels, dental fluorosis, and caries experience in Brazil. J Public Health Dent. 1996;56(4):226—228. https://doi.org/10.1111/j.1752-7325.1996.tb02441.x
35. Tsutsui A, Yagi M, Horowitz AM. The prevalence of dental caries and fluorosis in Japanese communities with up to 1.4 ppm of naturally occurring fluoride. J Public Health Dent. 2000;60(3):147—153. https://doi.org/10.1111/j.1752-7325.2000.tb03320.x
36. Paoloni J, Fiorentino C, Sequeira M. Fluoride contamination of aquifers in the southeast subhumid pampa, Argentina. Environ Toxicol. 2003;18(5):317—320. https://doi.org/10.1002/tox.10131
37. McGrady MG, Ellwood RP, Srisilapanan P, Korwanich N, Worthington HV, Pretty IA. Dental fluorosis in populations from Chiang Mai, Thailand with different fluoride exposures — Paper 1: Assessing fluorosis risk, predictors of fluorosis and the potential role of food preparation. BMC Oral Health. 2012;12(1):1—12. https://doi.org/10.1186/1472-6831-12-16
38. Siaurusevičiūtė I, Albrektienė R. Removal of fluorides from aqueous solutions using exhausted coffee grounds and iron sludge. Water. 2021;13(11):1512. https://doi.org/10.3390/w13111512
39. Xu L, Chen G, Peng C, Qiao H, Ke F, Hou R, et al. Adsorptive removal of fluoride from drinking water using porous starch loaded with common metal ions. Carbohydr Polym. 2017;160:82—89. https://doi.org/10.1016/j.ijbiomac.2020.02.055
40. Wang H, Feng Q, Liu K, Li Z, Tang X, Li G. Highly efficient fluoride adsorption from aqueous solution by nepheline prepared from kaolinite through alkali-hydrothermal process. J Environ Manage. 2017;196:72—79. https://doi.org/10.1016/j.jenvman.2017.03.015
41. Brião VB, Cuenca F, Pandolfo A, Favaretto DP. Is nanofiltration better than reverse osmosis for removal of fluoride from brackish waters to produce drinking water? Desalination Water Treat. 2019;158:20—32. https://doi.org/10.5004/dwt.2019.24237
42. Kumar P, Saraswat C, Mishra BK, Avtar R, Patel H, Patel A, et al. Batch technique to evaluate the efficiency of different natural adsorbents for defluoridation from groundwater. Appl Water Sci. 2017;7(5):2597—2606. https://doi.org/10.1007/s13201-016-0473-5
43. Takdastan A, Tabar SE, Neisi A, Eslami A. Fluoride removal from drinking water by electrocoagulation using iron and aluminum electrodes. Jundishapur J Health Sci. 2014;6(3). https://doi.org/10.5812/jjhs.21718
44. Nasr AB, Charcosset C, Amar RB, Walha K. Fluoride removal from aqueous solution by Purolite A520E resin: Kinetic and thermodynamics study. Desalin Water Treat. 2015;54(6):1604—1611. https://doi.org/10.1080/19443994.2014.892836
45. Bazrafshan E, Balarak D, Panahi AH, Kamani H, Mahvi AH. Fluoride removal from aqueous solutions by cupricoxide nanoparticles. Fluoride. 2016;49(3):233.
46. He Y, Zhang L, An X, Wan G, Zhu W, Luo Y. Enhanced fluoride removal from water by rare earth (La and Ce) modified alumina: Adsorption isotherms, kinetics, thermodynamics and mechanism. Sci Total Environ. 2019;688:184—198. https://doi.org/10.1016/j.scitotenv.2019.06.175
47. Yang W, Tian S, Tang Q, Chai L, Wang H. Fungus hyphae-supported alumina: An efficient and reclaimable adsorbent for fluoride removal from water. J Colloid Interface Sci. 2017;496:496—504. https://doi.org/10.1016/j.jcis.2017.02.015
48. Akafu T, Chimdi A, Gomoro K. Removal of fluoride from drinking water by sorption using diatomite modified with aluminum hydroxide. J Anal Methods Chem. 2019;2019. https://doi.org/10.1155/2019/4831926

49. Cai J, Zhang Y, Qian Y, Shan C, Pan B. Enhanced defluoridation using novel millisphere nanocomposite of La-doped Li-Al layered double hydroxides supported by polymeric anion exchanger. Scientific Rep. 2018;8(1):1—10. https://doi.org/10.1038/s41598-018-29497-1

50. Getachew T, Hussen A, Rao VM. Defluoridation of water by activated carbon prepared from banana (*Musa paradisiaca*) peel and coffee (*Coffea arabica*) husk. Int J Environ Sci Technol. 2015;12:1857—1866. https://doi.org/10.1007/s13762-014-0545-8

51. Balarak D, Mahdavi Y, Bazrafshan E, Mahvi AH, Esfandyari Y. Adsorption of fluoride from aqueous solutions by carbon nanotubes: Determination of equilibrium, kinetic, and thermodynamic parameters. Fluoride. 2016;49(1):71.

52. Gitari WM, Izuagie AA, Gumbo JR. Synthesis, characterization and batch assessment of groundwater fluoride removal capacity of trimetal Mg/Ce/Mn oxide-modified diatomaceous earth. Arab J Chem. 2020;13(1):1—16. https://doi.org/10.1016/j.arabjc.2017.01.002

53. Singh K, Lataye DH, Wasewar KL. Removal of fluoride from aqueous solution by using bael (*Aegle marmelos*) shell activated carbon: Kinetic, equilibrium and thermodynamic study. J Fluor Chem. 2017 Feb 1;194:23—32. https://doi.org/10.1016/j.jfluchem.2016.12.009

54. Zhao X, Liu D, Huang H, Zhang W, Yang Q, Zhong C. The stability and defluoridation performance of MOFs in fluoride solutions. Microporous Mesoporous Mater. 2014;185:72—78. https://doi.org/10.1016/j.micromeso.2013.11.002

55. Alasmari EM, Alsharif SH, Khayyat MM. Bio-filtration as a solution for the detrimental health effect of excess fluoride in drinking water. Biomed J Sci Tech Res. 2021;39(5):31596—31601. https://doi.org/10.26717/BJSTR.2021.39.006350

56. Rojas-Mayorga C, Bonilla-Petriciolet A, Aguayo-Villarreal IA, Hernandez-Montoya V, Moreno-Virgen M, Tovar-Gómez R, et al. Optimization of pyrolysis conditions and adsorption properties of bone char for fluoride removal from water. J Anal Appl Pyrolysis. 2013;104:10—18. https://doi.org/10.1016/j.jaap.2013.09.018

57. Gumus R, Wauton I, Aliu A. Investigation of the effect of chemical activation and characterization of bone char: Cow bone. J Eng Appl Sci. 2012;4:34—45.

58. Sorlini S, Palazzini D. Experimentation on bone char-based treatment for fluoride removal from drinking water in Senegal. In: Shaw RJ, editor. 35th WEDC International Conference. Loughborough, UK: WEDC, Loughborough University; 2011. p. 9.

59. Moreno-Piraján JC, Giraldo L, García-Cuello VS. Study of the textural properties of bovine bones char under different conditions. J Water Resource Prot. 2011;3(3):176—181. http://dx.doi.org/10.4236/jwarp.2011.33022

60. Zhu H, Wang H, Wang G, Shi L. Removal of fluorine from water by the aluminum-modified montmorillonite. In: 2011 International Conference on Electric Technology and Civil Engineering (ICETCE); 2011 Apr 22. IEEE; 2011. p. 6103—6105. https://doi.org/10.1109/ICETCE.2011.5774229

61. Nigri EM, Santos AL, Bhatnagar A, Rocha SD. Chemical regeneration of bone char associated with a continuous system for defluoridation of water. Braz J Chem Eng. 2019;36(4):1631—1643. https://doi.org/10.1590/0104-6632.20190364s20180258

62. Fantong WY, Ngappe C, Banseka HS, Fonteh MF, Onibon H, Fru EC, et al. Defluoridation of fluoride-rich groundwater in Mayo Tsanaga River Basin-Cameroon using locally produced bone char. J Cameroon Acad Sci. 2019;15(1):11—24. http://dx.doi.org/10.4314/jcas.v15i1.2

63. Shahid MK, Kim JY, Choi Y-G. Synthesis of bone char from cattle bones and its application for fluoride removal from the contaminated water. Groundw Sustain Dev. 2019;8:324—331. https://doi.org/10.1016/j.gsd.2018.12.003

64. Sawangjang B, Induvesa P, Wongrueng A, Pumas C, Wattanachira S, Rakruam P, et al. Evaluation of fluoride adsorption mechanism and capacity of different types of bone char. Int J Environ Res Public Health. 2021;18(13):6878. https://doi.org/10.3390/ijerph18136878

65. Terasaka S, Kamitakahara M, Yokoi T, Ioku K. Effect of preparation temperature on the ability of bone char to remove fluoride ion and organic contaminants. J Ceram Soc JAPAN. 2014;122(1432):995—999. http://dx.doi.org/10.2109/jcersj2.122.995
66. Jacobsen P, Muller K. CDN's experiences in producing bone char. Technical Report. 2007.
67. Dagde KK, Akpa JG, Ekine AA. Production of adsorbent from local raw materials for the removal of fluoride from water. EJET. 2019;7(2).
68. Kikuchi M, Arioka Y, Tafu M, Irie M. Changes in fluoride removal ability of chicken bone char with changes in calcination time. Int J Ceram Eng Sci. 2020;2(2):83—91. https://doi.org/10.1002/ces2.10034
69. Herath H, Kawakami T, Tafu M. The extremely high adsorption capacity of fluoride by chicken bone char (CBC) in defluoridation of drinking water in relation to its finer particle size for better human health. Healthcare (Basel). 2018;6(4):123. https://doi.org/10.3390/healthcare6040123
70. Rugayah N, Muladno, Nuraini H, Salundik. Chicken bone charcoal for defluoridation of groundwater in Indonesia. Int J Poult Sci. 2014;13:591—596. https://dx.doi.org/10.3923/ijps.2014.591.596
71. Kawakami T, Motoyama A, Serikawa Y, Tafu M. Defluoridation of drinking water by chicken bone char. J Ecotechnol Res. 2011;16(2):71—74. https://doi.org/10.11190/jer.16.71
72. Kawasaki N, Ogata F, Tominaga H, Yamaguchi I. Removal of fluoride ion by bone char produced from animal biomass. J Oleo Sci. 2009;58(10):529—535. https://doi.org/10.5650/jos.58.529
73. Nemade PD, Vasudeva Rao A, Alappat BJ. Removal of fluorides from water using low cost adsorbents. Water Supply. 2002;2(1):311—317. https://doi.org/10.2166/ws.2002.0037
74. Alkurdi SSA, Al-Juboori RA, Bundschuh J, Hamawand I. Bone char as a green sorbent for removing health threatening fluoride from drinking water. Environ Int. 2019;127:704—719. https://doi.org/10.1016/j.envint.2019.03.065
75. Kariuki S, Ngari M, Mavura W, Ollengo M, Ongoma P. Effect of essential mineral ions from aqueous media on adsorption of fluoride by bone char. J Environ Sci Toxicol Food Technol. 2015;9:9—17. https://doi.org/10.9790/2402-09520917
76. Abe I, Iwasaki S, Tokimoto T, Kawasaki N, Nakamura T, Tanada S. Adsorption of fluoride ions onto carbonaceous materials. J Colloid Interface Sci. 2004;275(1):35—39. https://doi.org/10.1016/j.jcis.2003.12.031
77. He G, Cao S. Assessment of fluoride removal from drinking water by calcium phosphate systems. Fluoride. 1996;29(4):212—216.
78. Li G, Zhang J, Liu J, editors. Adsorption characteristics of Pb (II) onto red clay, bentonite and bone char. IOP Conference Series: Earth and Environmental Science. IOP Publishing; 2020. https://doi.org/10.1088/1755-1315/526/1/012018
79. Minja RJ. Practical approach for removal of natural organic matter and defluoridation of Maji ya Chai River Water: Use of acid pre-treated bone char and coagulants. Tanz J Engrg Technol. 2020;38(2). https://doi.org/10.52339/tjet.v38i2.505