DAFTAR PUSTAKA

Adeiga, O. I., & Pillay, K. (2024). Rooibos tea waste binary oxide composite: An adsorbent for the removal of nickel ions and an efficient photocatalyst for the degradation of ciprofloxacin. *Journal of Environmental Management*, *355*, 120274. https://doi.org/https://doi.org/10.1016/j.jenvman.2024.120274

Ahmed, R. S., Abuarab, M. E., Baiomy, M. A., & Ibrahim, M. M. (2024). Heavy metals removal from industrial wastewater using bio-adsorbent materials based on agricultural solid wastes through batch and continuous flow mechanisms. *Journal of Water Process Engineering*, *57*, 104665. https://doi.org/https://doi.org/10.1016/j.jwpe.2023.104665

Azmi, A. A., Roslan, N. F. N., Harun, M. H. C., Abuhabib, A. A. M., & Hamzah, S. (2020). *Rice Husk Coated Chitosan Biocomposite as an Adsorbent for Cadmium Removal from Aqueous*.

Bahsaine, K., Benzeid, H., Zari, N., & Bouhfid, R. (2024). Biochar-alginate beads derived from argan nutshells for effective methylene blue removal: A sustainable approach to wastewater treatment. *International Journal of Biological Macromolecules*, 136853.

Birelo, L. M., & Appoloni, C. R. (2024). Materials analysis in three paintings of Thomas Gainsborough (1727–1788) by portable X-ray fluorescence. *Applied Radiation and Isotopes*, *209*, 111324. https://doi.org/https://doi.org/10.1016/j.apradiso.2024.111324

Bishop, J. L. (2018). Chapter 3 - Remote Detection of Phyllosilicates on Mars and Implications for Climate and Habitability. In N. A. Cabrol & E. A. Grin (Eds.), *From Habitability to Life on Mars* (pp. 37–75). Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-12-809935-3.00003-7

Biswas, K., Ahamed, Z., Dutta, T., Mallick, B., Khuda-Bukhsh, A. R., Biswas, J. K., & Mandal, S. K. (2024). Green synthesis of silver nanoparticles from waste leaves of tea (Camellia sinensis) and their catalytic potential for degradation of azo dyes. *Journal of Molecular Structure*, *1318*, 139448. https://doi.org/https://doi.org/10.1016/j.molstruc.2024.139448

Chandra, D., Molla, M. T. H., Bashar, M. A., Islam, M. S., & Ahsan, M. S. (2023). Chitosan-based nano-sorbents: synthesis, surface modification, characterisation and application in Cd (II), Co (II), Cu (II) and Pb (II) ions removal from wastewater. *Scientific Reports*, *13*(1), 6050.

Chen, H., Pan, Y., Zhang, W., Long, A., Chen, M., Xiao, X., Wang, Z., Tang, M., Peng, Y., Sun, S., Zhang, H., & He, Q. (2024). Adsorption-desorption of copper(II) by temperature-sensitive nano-biochar@PNIPAM/alginate double-network composite hydrogel: Enhanced mechanisms and application potentials. *Chemical Engineering Journal*, *495*, 153356. https://doi.org/https://doi.org/10.1016/j.cej.2024.153356

Fatma, U. K., Nizami, G., Ahamad, S., Saquib, M., & Hussain, M. K. (2024). Activated Green Tamarind Pulp (AGTP) as an efficient adsorbent for removal of Pb2+, Cu2+, Zn2+ & Ni2+ from contaminated water. *Journal of Water Process Engineering*, *59*, 105048. https://doi.org/https://doi.org/10.1016/j.jwpe.2024.105048

Feisal, N. A. S., Kamaludin, N. H., Ahmad, M. A., & Tengku Ibrahim, T. N. B. (2024). A comprehensive review of nanomaterials for efficient heavy metal ions removal in water treatment. *Journal of Water Process Engineering*, *64*, 105566. https://doi.org/https://doi.org/10.1016/j.jwpe.2024.105566

Ferreira, D. C. M., dos Santos, T. C., Coimbra, J. S. dos R., & de Oliveira, E. B. (2023). Chitosan/carboxymethylcellulose polyelectrolyte complexes (PECs) are an effective material for dye and heavy metal adsorption from water. *Carbohydrate Polymers*, *315*, 120977. https://doi.org/https://doi.org/10.1016/j.carbpol.2023.120977

Gong, Y., Chen, X., & Wu, W. (2024). Application of fourier transform infrared (FTIR) spectroscopy in sample preparation: Material characterization and mechanism investigation. *Advances in Sample Preparation*, *11*, 100122.

Guerrero, J. D., Arias, E. R., & Gutierrez, L. B. (2024). Enhancing copper and lead adsorption in water by in-situ generation of calcium carbonate on alginate/chitosan biocomposite surfaces. *International Journal of Biological Macromolecules*, *266*, 131110. https://doi.org/https://doi.org/10.1016/j.ijbiomac.2024.131110

Haghighizadeh, A., Rajabi, O., Nezarat, A., Hajyani, Z., Haghmohammadi, M., Hedayatikhah, S., Asl, S. D., & Aghababai Beni, A. (2024). Comprehensive analysis of heavy metal soil contamination in mining Environments: Impacts, monitoring Techniques, and remediation strategies. *Arabian Journal of*

Chemistry, *17*(6), 105777. https://doi.org/https://doi.org/10.1016/j.arabjc.2024.105777

He, D., Zhang, Z., Zhang, W., Zhang, H., & Liu, J. (2024). Municipal sludge biochar skeletal sodium alginate beads for phosphate removal. *International Journal of Biological Macromolecules*, *261*, 129732. https://doi.org/https://doi.org/10.1016/j.ijbiomac.2024.129732

He, R., Sun, J., Bai, X., Lin, Q., Yuan, Y., Zhang, Y., Dai, K., & Xu, Z. (2024). A novel alginate-embedded magnetic biochar-anoxygenic photosynthetic bacteria composite microspheres for multipollutant removal: Mechanisms of photo-bioelectrochemical enhancement and excellent reusability performance. *Environmental Research*, *247*, 118158. https://doi.org/https://doi.org/10.1016/j.envres.2024.118158

He, Y., Jia, X., Zhou, S., Chen, J., Zhang, S., Li, X., Huang, Y., Wågberg, T., & Hu, G. (2022). Separatable MoS2 loaded biochar/CaCO3/Alginate gel beads for selective and efficient removal of Pb(II) from aqueous solution. *Separation and Purification Technology*, *303*, 122212. https://doi.org/https://doi.org/10.1016/j.seppur.2022.122212

Ismail, U. M., Vohra, M. S., & Onaizi, S. A. (2024). Adsorptive removal of heavy metals from aqueous solutions: Progress of adsorbents development and their effectiveness. *Environmental Research*, *251*, 118562. https://doi.org/https://doi.org/10.1016/j.envres.2024.118562

Jawed, A., Sharad, A., Chutani, A., Mehak, & Pandey, L. M. (2024). Amine functionalized Fe(III)-doped-ZnO nanoparticles based alginate beads for the removal of Cu(II) from aqueous solution. *Nano-Structures & Nano-Objects*, *38*, 101199. https://doi.org/https://doi.org/10.1016/j.nanoso.2024.101199

Jha, A., Barsola, B., Pathania, D., Sonu, Raizada, P., Thakur, P., Singh, P., Rustagi, S., Khosla, A., & Chaudhary, V. (2024). Nano-biogenic heavy metals adsorptive remediation for enhanced soil health and sustainable agricultural production. *Environmental Research*, *252*, 118926. https://doi.org/https://doi.org/10.1016/j.envres.2024.118926

Jiangshi, Z., Wang, Y., Jia, H., Fang, L., Wang, K., Tong, L., & Ren, X. (n.d.). Molecular Simulation and Experimental Study on the Wetting and Agglomeration of Bituminous Coal by Oligomeric Surfactant Lae-X. *Available at SSRN 4986834*.

Jusuf, A., Tan, T. L., & Wu, Q. Y. (2023). Fourier transform infrared (FTIR) spectroscopy of formaldoxime isotopologue 12CD2NOH in the 300–3700 cm−1 region and its v12 and v9 bands: Vibrational and rovibrational analyses. *Journal of Molecular Spectroscopy*, *396*, 111812. https://doi.org/https://doi.org/10.1016/j.jms.2023.111812

Karri, R. R., Mubarak, N. M., Bhagat, S. K., Tiyasha, T., Lingamdinne, L. P., Koduru, J. R., Ravindran, G., Tyagi, I., & Dehghani, M. H. (2024). Chapter 1 - Scientometrics and overview of water, environment, and sustainable development goals. In M. H. Dehghani, R. R. Karri, I. Tyagi, & M. Scholz (Eds.), *Water, The Environment, and the Sustainable Development Goals* (pp. 3–33). Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-443-15354-9.00021-9

Kavamura, V. N., Aono, A. H., & Esposito, E. (2019). 6.18 - Biotechnological Strategies Applied to the Decontamination of Soils Polluted With Heavy Metals☆. In M. Moo-Young (Ed.), *Comprehensive Biotechnology (Third Edition)* (pp. 240–252). Pergamon. https://doi.org/https://doi.org/10.1016/B978-0-444-64046-8.00350-5

Khan, H., Yerramilli, A. S., D'Oliveira, A., Alford, T. L., Boffito, D. C., & Patience, G. S. (2020). Experimental methods in chemical engineering: X-ray diffraction spectroscopy—XRD. *The Canadian Journal of Chemical Engineering*, *98*(6), 1255–1266.

Khanzada, A. K., Al-Hazmi, H. E., Kurniawan, T. A., Majtacz, J., Piechota, G., Kumar, G., Ezzati, P., Saeb, M. R., Rabiee, N., Karimi-Maleh, H., Lima, E. C., & Mąkinia, J. (2024). Hydrochar as a bio-based adsorbent for heavy metals removal: A review of production processes, adsorption mechanisms, kinetic models, regeneration and reusability. *Science of The Total Environment*, *945*, 173972. https://doi.org/https://doi.org/10.1016/j.scitotenv.2024.173972

Li, T., Xia, J., & Tang, X. (2024). Effect of eco-friendly pervious concrete pavement with travertine waste and sand on the heavy metal removal and runoff reduction performance. *Journal of Environmental Management*, *366*, 121757. https://doi.org/https://doi.org/10.1016/j.jenvman.2024.121757

Liu, N., Zhao, J., Du, J., Hou, C., Zhou, X., Chen, J., & Zhang, Y. (2024). Non-phytoremediation and phytoremediation technologies of integrated remediation for water and soil heavy metal pollution: A comprehensive review. *Science of The Total Environment*, *948*, 174237. https://doi.org/https://doi.org/10.1016/j.scitotenv.2024.174237

Liu, X., Han, Z., Lin, N., Hao, Y., Qu, J., Gao, P., He, X., Liu, B., & Duan, X. (2024). Immature persimmon residue as a novel biosorbent for efficient removal of Pb(II) and Cr(VI) from wastewater: Performance and mechanisms. *International Journal of Biological Macromolecules*, *266*, 131083. https://doi.org/https://doi.org/10.1016/j.ijbiomac.2024.131083

Mabroum, H., Noukrati, H., Lefeuvre, B., Oudadesse, H., & Barroug, A. (2021). Physicochemical, setting, rheological, and mechanical properties of a novel bio-composite based on apatite cement, bioactive glass, and alginate hydrogel. *Ceramics International*, *47*(17), 23973–23983.

Muthulakshmi, L., Mohan, S., Kanthimathi, G., & Rajaram, R. (2024). Immobilization of EPS-modified sodium alginate microcapsule by co-polymerization for methylene blue dye adsorption and kinetics. *Total Environment Advances*, *11*, 200109. https://doi.org/https://doi.org/10.1016/j.teadva.2024.200109

Nandiyanto, A. B. D., Oktiani, R., & Ragadhita, R. (2019). How to read and interpret ftir spectroscope of organic material. *Indonesian Journal of Science and Technology*, *4*(1), 97–118. https://doi.org/10.17509/ijost.v4i1.15806

Nie, J., Wang, Q., Han, L., & Li, J. (2024). Synergistic remediation strategies for soil contaminated with compound heavy metals and organic pollutants. *Journal of Environmental Chemical Engineering*, *12*(4), 113145. https://doi.org/https://doi.org/10.1016/j.jece.2024.113145

Nie, L., Chang, P., Liang, S., Hu, K., Hua, D., Liu, S., Sun, J., Sun, M., Wang, T., Okoro, O. V., & Shavandi, A. (2021). Polyphenol rich green tea waste hydrogel for removal of copper and chromium ions from aqueous solution. *Cleaner Engineering and Technology*, *4*, 100167. https://doi.org/https://doi.org/10.1016/j.clet.2021.100167

Purkait, M. K., Haldar, D., & Debnath, B. (2023). 6 - Removal of heavy metals from aqueous medium using tea waste derived adsorbent materials. In M. K. Purkait, D. Haldar, & B. Debnath (Eds.), *Technological Advancements in Product Valorization of Tea Waste* (pp. 121–149). Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-443-19239-5.00006-1

Sable, H., Kumar, V., Singh, V., Rustagi, S., Chahal, S., & Chaudhary, V. (2024). Strategically engineering advanced nanomaterials for heavy-metal remediation from wastewater. *Coordination Chemistry Reviews*, *518*, 216079. https://doi.org/https://doi.org/10.1016/j.ccr.2024.216079

See, W. Q., Nasir, N. A. F. M., & Farizal, M. A. M. (2023). Extraction and Characterization of Natural Fiber from Herbaceous Residues of Orthosiphon aristatus Chang Koon Wong®, Nadia Adrus®, Jamarosliza Jamaluddin®. *Proceedings of the International Symposium on Lightweight and Sustainable Polymeric Materials (LSPM23)*, *32*, 3.

Thomas, N., Moussaoui, S., Reyes-Suarez, B., Lafon, O., & Reddy, G. N. M. (2024). Dual cross-linked cellulose based hydrogel films. *Materials Advances*.

Vinayagam, V., Sikarwar, D., Das, S., & Pugazhendhi, A. (2024). Envisioning the innovative approaches to achieve circular economy in the water and wastewater sector. *Environmental Research*, *241*, 117663. https://doi.org/https://doi.org/10.1016/j.envres.2023.117663

Violet, C., Ball, A., Heiranian, M., Villalobos, L. F., Zhang, J., Uralcan, B., Kulik, H., Haji-Akbari, A., & Elimelech, M. (2024). Designing membranes with specific binding sites for selective ion separations. *Nature Water*, *2*(8), 706–718.

Wang, Z., Ahmad, W., Zhu, A., Zhao, S., Ouyang, Q., & Chen, Q. (2024). Recent advances review in tea waste: High-value applications, processing technology, and value-added products. *Science of The Total Environment*, *946*, 174225. https://doi.org/https://doi.org/10.1016/j.scitotenv.2024.174225

Wanjiya, M., Zhang, J.-C., Wu, B., Yin, M.-J., & An, Q.-F. (2024). Nanofiltration membranes for sustainable removal of heavy metal ions from polluted water: A review and future perspective. *Desalination*, *578*, 117441. https://doi.org/https://doi.org/10.1016/j.desal.2024.117441

Wu, J., Annath, H., Chen, H., & Mangwandi, C. (2023). Upcycling tea waste particles into magnetic adsorbent materials for removal of Cr(VI) from aqueous solutions. *Particuology*, *80*, 115–126. https://doi.org/https://doi.org/10.1016/j.partic.2022.11.017

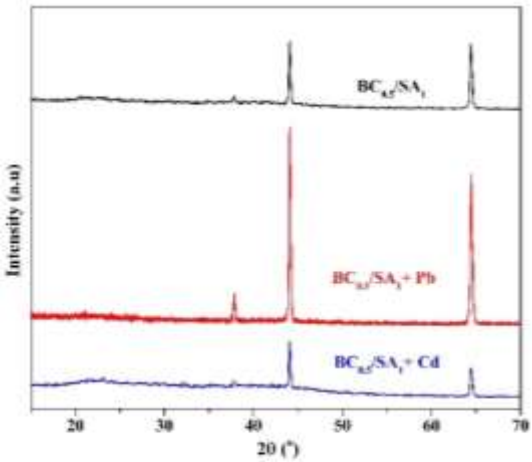
Wu, M., Xu, Y., Zhao, C., Huang, H., Liu, C., Duan, X., Zhang, X., Zhao, G., & Chen, Y. (2024). Efficient nitrate and Cr(VI) removal by denitrifier: The mechanism of S. oneidensis MR-1 promoting electron production, transportation and consumption. *Journal of Hazardous Materials*, *469*, 133675. https://doi.org/10.1016/j.jhazmat.2024.133675

Xu, H., Zhou, Q., Yan, T., Jia, X., Lu, D., Ren, Y., & He, J. (2024). Enhanced removal efficiency of Cd2+ and Pb2+ from aqueous solution by H3PO4–modified tea branch biochar: Characterization, adsorption performance and mechanism. *Journal of Environmental Chemical Engineering*, *12*(2), 112183. https://doi.org/https://doi.org/10.1016/j.jece.2024.112183

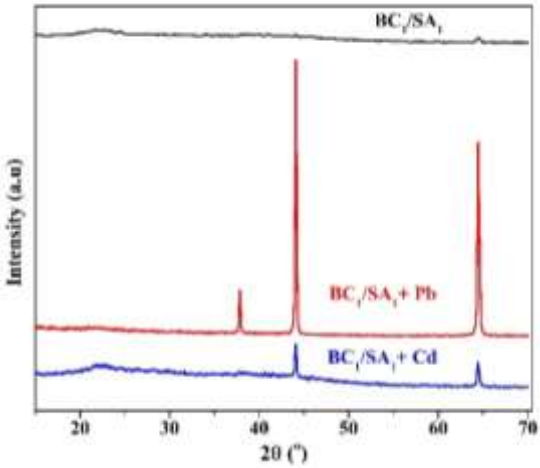
Yao, Y., Feng, Y., Li, H., Liu, M., Cui, Y., Xu, C., Li, Y., & Wang, J. (2024). Investigation of the adsorption performance and mechanism of multi-source mineral composite calcination materials on heavy metal ions. *Desalination*, *586*, 117847. https://doi.org/https://doi.org/10.1016/j.desal.2024.117847

Zhang, Y., Gao, F., Wang, D., Li, Z., Wang, X., Wang, C., Zhang, K., & Du, Y. (2023). Amorphous/crystalline heterostructure transition-metal-based catalysts for high-performance water splitting. *Coordination Chemistry Reviews*, *475*, 214916.

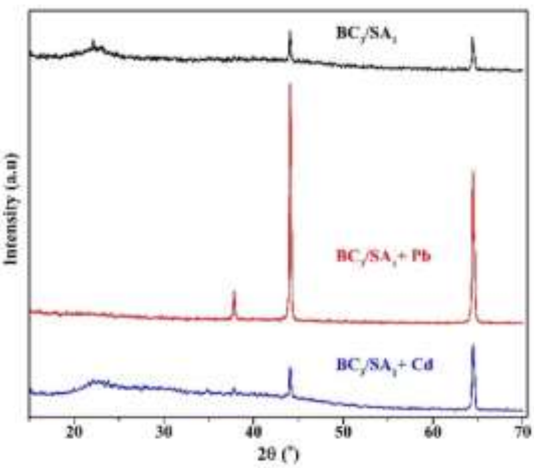
Lampiran



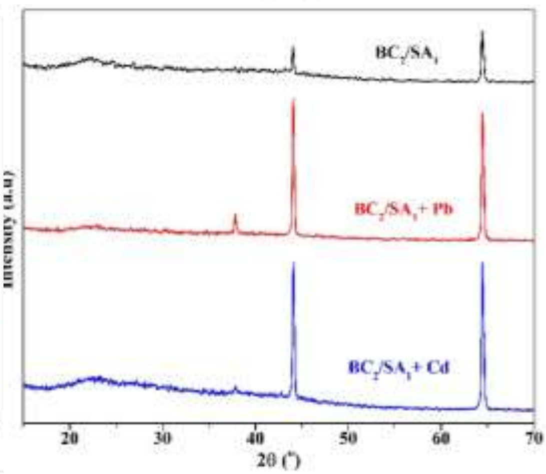
$BC_{0.5}/SA_1$
$BC_{0.5}/SA_1$+ Pb
$BC_{0.5}/SA_1$+ Cd
Intensity (a.u)
20
30
40
50
60
70
2θ (°)



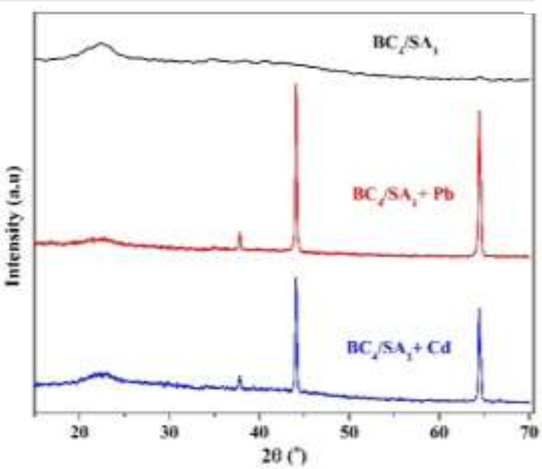
BC_1/SA_1
BC_1/SA_1+ Pb
BC_1/SA_1+ Cd
Intensity (a.u)
20
30
40
50
60
70
2θ (°)



BC_3/SA_1
BC_3/SA_1+ Pb
BC_3/SA_1+ Cd
Intensity (a.u)
20
30
40
50
60
70
2θ (°)



BC_2/SA_1
BC_2/SA_1+ Pb
BC_2/SA_1+ Cd
Intensity (a.u)
20
30
40
50
60
70
2θ (°)



BC_4/SA_1
BC_4/SA_1+ Pb
BC_4/SA_1+ Cd
Intensity (a.u)
20
30
40
50
60
70
2θ (°)

Sample	Dosis (Mg/L)	Dosis awal	% Adsorpsi	Qe
PB 0.5:1	12.55	200	93.725	93.725
PB 1:1	13.2	200	93.4	93.4
PB 2:1	11.9	200	94.05	94.05
PB 3:1	16.33	200	91.835	91.835
PB 4:1	13.85	200	93.075	93.075
PB Alginate	5.26	200	97.37	97.37

Sample	**Dosis (Mg/L)**	**Dosis awal**	**% Adsorpsi**	**Qe**
CD 0.5:1	27.88	200	86.06	34.424
CD 1:1	40.8	200	79.6	31.84
CD 2:1	25.34	200	87.33	34.932
CD 3:1	19.44	200	90.28	36.112
CD 4:1	14.41	200	92.795	37.118
CD Alginate	3.3	200	98.35	39.34