

References

- [1] Geed SR, Kureel MK, Prasad S, Singh RS, Rai BN. Novel study on biodegradation of malathion and investigation of mass transfer correlation using alginate beads immobilized *Bacillus* sp. S4 in bioreactor. *J Environ Chem Eng* 2018;6:3444–50. <https://doi.org/10.1016/J.JECE.2018.05.025>.
- [2] Ihsanullah I, Jamal A, Ilyas M, Zubair M, Khan G, Atieh MA. Bioremediation of dyes: Current status and prospects. *Journal of Water Process Engineering* 2020;38:101680. <https://doi.org/10.1016/J.JWPE.2020.101680>.
- [3] Nowik W. dyes Liquid Chromatography. *Encyclopedia of Separation Science* 2000;2602–18. <https://doi.org/10.1016/B0-12-226770-2/00811-5>.
- [4] Travis AS. Perkin's Mauve: Ancestor of the Organic Chemical Industry. *Technol Cult* 1990;31:51. <https://doi.org/10.2307/3105760>.
- [5] Chavan RB. Environmentally friendly dyes. *Handbook of Textile and Industrial Dyeing: Principles, Processes and Types of Dyes* 2011;1:515–61. <https://doi.org/10.1533/9780857093974.2.515>.
- [6] Bafana A, Devi SS, Chakrabarti T. Azo dyes: past, present and the future. *Environmental Reviews* 2011;19:350–70. <https://doi.org/10.1139/A11-018>.
- [7] Zubair M, Aziz HA, Ihsanullah I, Ahmad MA, Al-Harhi MA. Enhanced removal of Eriochrome Black T from water using biochar/layered double hydroxide/chitosan hybrid composite: Performance evaluation and optimization using BBD-RSM approach. *Environ Res* 2022;209:112861. <https://doi.org/10.1016/J.ENVRES.2022.112861>.
- [8] Lellis B, Fávaro-Polonio CZ, Pamphile JA, Polonio JC. Effects of textile dyes on health and the environment and bioremediation potential of living organisms. *Biotechnology Research and Innovation* 2019;3:275–90. <https://doi.org/10.1016/J.BIORI.2019.09.001>.
- [9] Al-Tohamy R, Ali SS, Li F, Okasha KM, Mahmoud YAG, Elsamahy T, et al. A critical review on the treatment of dye-containing wastewater: Ecotoxicological and health concerns of textile dyes and possible remediation approaches for environmental safety. *Ecotoxicol Environ Saf* 2022;231:113160. <https://doi.org/10.1016/J.ECOENV.2021.113160>.
- [10] Oladoye PO, Ajiboye TO, Omotola EO, Oyewola OJ. Methylene blue dye: Toxicity and potential elimination technology from wastewater. *Results in Engineering* 2022;16:100678. <https://doi.org/10.1016/J.RINENG.2022.100678>.
- [11] Islam T, Repon MR, Islam T, Sarwar Z, Rahman MM. Impact of textile dyes on health and ecosystem: a review of structure, causes, and potential solutions. *Environmental Science and Pollution Research* 2022 30:4 2022;30:9207–42. <https://doi.org/10.1007/S11356-022-24398-3>.

- [12] Kishor R, Purchase D, Saratale GD, Saratale RG, Ferreira LFR, Bilal M, et al. Ecotoxicological and health concerns of persistent coloring pollutants of textile industry wastewater and treatment approaches for environmental safety. *J Environ Chem Eng* 2021;9:105012. <https://doi.org/10.1016/J.JECE.2020.105012>.
- [13] Mani S, Bharagava RN. Exposure to Crystal Violet, Its Toxic, Genotoxic and Carcinogenic Effects on Environment and Its Degradation and Detoxification for Environmental Safety. *Rev Environ Contam Toxicol* 2016;237:71–104. https://doi.org/10.1007/978-3-319-23573-8_4.
- [14] Ali AE, Chowdhury ZZ, Devnath R, Ahmed MM, Rahman MM, Khalid K, et al. Removal of Azo Dyes from Aqueous Effluent Using Bio-Based Activated Carbons: Toxicity Aspects and Environmental Impact. *Separations* 2023;10. <https://doi.org/10.3390/SEPARATIONS10090506>.
- [15] Morin-Crini N, Lichtfouse E, Fourmentin M, Ribeiro ARL, Noutsopoulos C, Mapelli F, et al. Remediation of Emerging Contaminants 2021:1–106. https://doi.org/10.1007/978-3-030-69090-8_1.
- [16] Rashed MN, Rashed MN. Adsorption Technique for the Removal of Organic Pollutants from Water and Wastewater. *Organic Pollutants - Monitoring, Risk and Treatment* 2013. <https://doi.org/10.5772/54048>.
- [17] Charcosset C. Ultrafiltration, Microfiltration, Nanofiltration and Reverse Osmosis in Integrated Membrane Processes. *Integrated Membrane Systems and Processes* 2016:1–22. <https://doi.org/10.1002/9781118739167.CH1>.
- [18] Santo CE, Vilar VJP, Botelho CMS, Bhatnagar A, Kumar E, Boaventura RAR. Optimization of coagulation–flocculation and flotation parameters for the treatment of a petroleum refinery effluent from a Portuguese plant. *Chemical Engineering Journal* 2012;183:117–23. <https://doi.org/10.1016/J.CEJ.2011.12.041>.
- [19] Feijoo S, Xiaobin ·, Mohammadreza Kamali Y·, Appels L, Dewil R, Feijoo S, et al. Generation of oxidative radicals by advanced oxidation processes (AOPs) in wastewater treatment: a mechanistic, environmental and economic review. *Reviews in Environmental Science and Bio/Technology* 2023 22:1 2023;22:205–48. <https://doi.org/10.1007/S11157-023-09645-4>.
- [20] Bilińska L, Gmurek M. Novel trends in AOPs for textile wastewater treatment. Enhanced dye by-products removal by catalytic and synergistic actions. *Water Resour Ind* 2021;26:100160. <https://doi.org/10.1016/J.WRI.2021.100160>.
- [21] Junploy P, Janta R, Wongchai P, Deethae A, Thongtem T, Thongtem S. Photodegradation of organic dyes and antibacterial activity of *Escherichia coli* and *Staphylococcus aureus* by ZnO nanoparticles under UVA radiation. *Materials Technology* 2022;37:789–97. <https://doi.org/10.1080/10667857.2021.1885226>.
- [22] Liu L, Chen Z, Zhang J, Shan D, Wu Y, Bai L, et al. Treatment of industrial dye wastewater and pharmaceutical residue wastewater by advanced oxidation processes and its combination with nanocatalysts: A review. *Journal of Water Process Engineering* 2021;42:102122. <https://doi.org/10.1016/J.JWPE.2021.102122>.

- [23] Hafeez A, Javed F, Fazal T, Shezad N, Amjad U e. S, Rehman MS ur, et al. Intensification of ozone generation and degradation of azo dye in non-thermal hybrid corona-DBD plasma micro-reactor. *Chemical Engineering and Processing - Process Intensification* 2021;159:108205. <https://doi.org/10.1016/J.CEP.2020.108205>.
- [24] Babu Ponnusami A, Sinha S, Ashokan H, V Paul M, Hariharan SP, Arun J, et al. Advanced oxidation process (AOP) combined biological process for wastewater treatment: A review on advancements, feasibility and practicability of combined techniques. *Environ Res* 2023;237:116944. <https://doi.org/10.1016/J.ENVRES.2023.116944>.
- [25] Mortazavian S, Saber I, James DE. Optimization of Photocatalytic Degradation of Acid Suspension System : Application of Response Surface. *Catalysts* 2019.
- [26] Al-Mamun MR, Kader S, Islam MS, Khan MZH. Photocatalytic activity improvement and application of UV-TiO₂ photocatalysis in textile wastewater treatment: A review. *J Environ Chem Eng* 2019;7:103248. <https://doi.org/10.1016/J.JECE.2019.103248>.
- [27] Silva AA, Sousa AMF, Furtado CRG, Carvalho NMF. Green magnesium oxide prepared by plant extracts: synthesis, properties and applications. *Materials Today Sustainability* 2022;20. <https://doi.org/10.1016/j.mtsust.2022.100203>.
- [28] Abdel Latef AAH, Srivastava AK, El-sadek MSA, Kordrostami M, Tran LSP. Titanium Dioxide Nanoparticles Improve Growth and Enhance Tolerance of Broad Bean Plants under Saline Soil Conditions. *Land Degrad Dev* 2018;29:1065–73. <https://doi.org/10.1002/LDR.2780>.
- [29] Rani M, Shanker U. Green synthesis of TiO₂ and its photocatalytic activity. 2020. <https://doi.org/10.1016/b978-0-12-819051-7.00002-6>.
- [30] Gupta SM, Tripathi M. A review of TiO₂ nanoparticles. *Chinese Science Bulletin* 2011;56:1639–57. <https://doi.org/10.1007/s11434-011-4476-1>.
- [31] Zhu Y, Murali S, Cai W, Li X, Suk JW, Potts JR, et al. Graphene and graphene oxide: Synthesis, properties, and applications. *Advanced Materials* 2010;22:3906–24. <https://doi.org/10.1002/adma.201001068>.
- [32] Guoxiu W, Juan Y, Jinsoo P, Xinglong G, Bei W, Hao L, et al. Facile synthesis and characterization of graphene nanosheets. *Journal of Physical Chemistry C* 2008;112:8192–5. <https://doi.org/10.1021/jp710931h>.
- [33] Liu S, Tian J, Wang L, Li H, Zhang Y, Sun X. Stable aqueous dispersion of graphene nanosheets: Noncovalent functionalization by a polymeric reducing agent and their subsequent decoration with Ag nanoparticles for enzymeless hydrogen peroxide detection. *Macromolecules* 2010;43:10078–83. <https://doi.org/10.1021/ma102230m>.
- [34] Wang L, Hu C, Shao L. The antimicrobial activity of nanoparticles: present situation and prospects for the future. *Int J Nanomedicine* 2017;12:1227. <https://doi.org/10.2147/IJN.S121956>.

- [35] Huq MA, Ashrafudoulla M, Rahman MM, Balusamy SR, Akter S. Green Synthesis and Potential Antibacterial Applications of Bioactive Silver Nanoparticles: A Review. *Polymers (Basel)* 2022;14. <https://doi.org/10.3390/POLYM14040742>.
- [36] Basso D, Patuzzi F, Castello D, Baratieri M, Rada EC, Weiss-Hortala E, et al. Agro-industrial waste to solid biofuel through hydrothermal carbonization. *Waste Management* 2016;47:114–21. <https://doi.org/10.1016/J.WASMAN.2015.05.013>.
- [37] Ji B, Wang J, Song H, Chen W. Removal of methylene blue from aqueous solutions using biochar derived from a fallen leaf by slow pyrolysis: Behavior and mechanism. *J Environ Chem Eng* 2019;7:103036. <https://doi.org/10.1016/J.JECE.2019.103036>.
- [38] Elhassan M, Abdullah R, Kooh MRR, Chou Chau YF. Hydrothermal liquefaction: A technological review on reactor design and operating parameters. *Bioresour Technol Rep* 2023;21:101314. <https://doi.org/10.1016/J.BITEB.2022.101314>.
- [39] Baamer DF, Helmy ET, Mostafa MMM, Pan JH. Synthesis of TiO₂ nanoparticles using different routes with enhanced photocatalytic and antibacterial properties. *Ceram Int* 2024;50:15780–9. <https://doi.org/10.1016/J.CERAMINT.2024.02.058>.
- [40] Mehta M, Bhushan I. Potential of biosynthesized titanium dioxide nanoparticles towards wastewater treatment and antimicrobial activity. *3 Biotech* 2024;14:1–12. <https://doi.org/10.1007/S13205-024-03915-W/FIGURES/10>.
- [41] Girigoswami A, Deepika B, Pandurangan AK, Girigoswami K. Preparation of titanium dioxide nanoparticles from *Solanum Tuberosum* peel extract and its applications. *Artif Cells Nanomed Biotechnol* 2024;52:59–68. <https://doi.org/10.1080/21691401.2023.2301068>.
- [42] Khoiriah K, Putri RA. Biosynthesis of titanium dioxide nanoparticles using peel extract of *Parkia speciosa* for methyl orange degradation. *South African Journal of Botany* 2024;170:120–9. <https://doi.org/10.1016/J.SAJB.2024.05.021>.
- [43] Yitagesu GB, Leku DT, Workneh GA. Green Synthesis of TiO₂ Using *Impatiens rothii* Hook.f. Leaf Extract for Efficient Removal of Methylene Blue Dye. *ACS Omega* 2023;8:43999–4012. https://doi.org/10.1021/ACSOMEGA.3C06142/ASSET/IMAGES/LARGE/AO3C06142_0013.JPEG.
- [44] Pavithra S, Bessy TC, Bindhu MR, Venkatesan R, Parimaladevi R, Alam MM, et al. Photocatalytic and photovoltaic applications of green synthesized titanium oxide (TiO₂) nanoparticles by *Calotropis gigantea* extract. *J Alloys Compd* 2023;960:170638. <https://doi.org/10.1016/J.JALLCOM.2023.170638>.
- [45] Bopape DA, Tetana ZN, Mabuba N, Motaung DE, Hintsho-Mbita NC. Biosynthesis of TiO₂ nanoparticles using *Commelina benghanlensis* for the photodegradation of methylene blue dye and antibiotics: Effect of plant concentration. *Results Chem* 2023;5:100825. <https://doi.org/10.1016/J.RECHEM.2023.100825>.
- [46] Rathi VH, Jeice AR. Green fabrication of titanium dioxide nanoparticles and their applications in photocatalytic dye degradation and microbial activities. *Chemical Physics Impact* 2023;6:100197. <https://doi.org/10.1016/J.CHPHI.2023.100197>.

- [47] Sharma A, Mittal R, Sharma P, Pal K, Mona S. Sustainable approach for adsorptive removal of cationic and anionic dyes by titanium oxide nanoparticles synthesized biogenically using algal extract of *Spirulina*. *Nanotechnology* 2023;34:485301. <https://doi.org/10.1088/1361-6528/ACF37E>.
- [48] Ansari A, Siddiqui VU, Rehman WU, Akram MK, Siddiqi WA, Alosaimi AM, et al. Green Synthesis of TiO₂ Nanoparticles Using *Acorus calamus* Leaf Extract and Evaluating Its Photocatalytic and In Vitro Antimicrobial Activity. *Catalysts* 2022, Vol 12, Page 181 2022;12:181. <https://doi.org/10.3390/CATAL12020181>.
- [49] Shimi AK, Ahmed HM, Wahab M, Katheria S, Wabaidur SM, Eldesoky GE, et al. Synthesis and Applications of Green Synthesized TiO₂ Nanoparticles for Photocatalytic Dye Degradation and Antibacterial Activity. *J Nanomater* 2022;2022. <https://doi.org/10.1155/2022/7060388>.
- [50] Saka A, Shifera Y, Jule LT, Badassa B, Nagaprasad N, Shanmugam R, et al. Biosynthesis of TiO₂ nanoparticles by *Caricaceae* (Papaya) shell extracts for antifungal application. *Scientific Reports* 2022 12:1 2022;12:1–10. <https://doi.org/10.1038/s41598-022-19440-w>.
- [51] Shimi AK, Wabaidur SM, Siddiqui MR, Islam MA, Rane KP, Jeevan TSA. Photocatalytic Activity of Green Construction TiO₂ Nanoparticles from *Phyllanthus niruri* Leaf Extract. *J Nanomater* 2022;2022:7011539. <https://doi.org/10.1155/2022/7011539>.
- [52] Nabi G, Majid A, Riaz A, Alharbi T, Arshad Kamran M, Al-Habardi M. Green synthesis of spherical TiO₂ nanoparticles using *Citrus Limetta* extract: Excellent photocatalytic water decontamination agent for RhB dye. *Inorg Chem Commun* 2021;129:108618. <https://doi.org/10.1016/J.INOCHE.2021.108618>.
- [53] Achudhan D, Vijayakumar S, Malaikozhundan B, Divya M, Jothirajan M, Subbian K, et al. The antibacterial, antibiofilm, antifogging and mosquitocidal activities of titanium dioxide (TiO₂) nanoparticles green-synthesized using multiple plants extracts. *J Environ Chem Eng* 2020;8:104521. <https://doi.org/10.1016/J.JECE.2020.104521>.
- [54] Kaur H, Kaur S, Kumar S, Singh J, Rawat M. Eco-friendly Approach: Synthesis of Novel Green TiO₂ Nanoparticles for Degradation of Reactive Green 19 Dye and Replacement of Chemical Synthesized TiO₂. *J Clust Sci* 2021;32:1191–204. <https://doi.org/10.1007/S10876-020-01881-W/TABLES/3>.
- [55] Akhi AA, Hasan A, Saha N, Howlader S, Bhattacharjee S, Dey K, et al. Ophiorrhiza mungos-Mediated Silver Nanoparticles as Effective and Reusable Adsorbents for the Removal of Methylene Blue from Water. *ACS Omega* 2024;9:4324–38. https://doi.org/10.1021/ACSOMEGA.3C05992/ASSET/IMAGES/LARGE/AO3C05992_0014.JPEG.
- [56] Shahbazarab Z, Nasr-Esfahani M. Diopside nanoparticles from rice husk ash: green synthesis, characterization and investigation of congo red dye removal, antibacterial properties, and Biginelli catalytic reaction (statistical approach to optimize parameters). *Journal of the Iranian Chemical Society* 2024;21:805–20. <https://doi.org/10.1007/S13738-023-02962-Z/TABLES/11>.

- [57] Ghoohestani E, Samari F, Homaei A, Yosuefinejad S. A facile strategy for preparation of Fe₃O₄ magnetic nanoparticles using *Cordia myxa* leaf extract and investigating its adsorption activity in dye removal. *Scientific Reports* 2024 14:1 2024;14:1–15. <https://doi.org/10.1038/s41598-023-50550-1>.
- [58] Norbert A, Surya Mary A, John SS, Shaji S, Jacob M V., Philip RR. Green synthesized Cu-doped CeO₂ nanoparticles for Congo red dye adsorption and antibacterial action. *Nanotechnology* 2024;35:265708. <https://doi.org/10.1088/1361-6528/AD3649>.
- [59] Sachin, Jaishree, Singh N, Singh R, Shah K, Pramanik BK. Green synthesis of zinc oxide nanoparticles using lychee peel and its application in anti-bacterial properties and CR dye removal from wastewater. *Chemosphere* 2023;327:138497. <https://doi.org/10.1016/J.CHEMOSPHERE.2023.138497>.
- [60] Parimelazhagan V, Natarajan K, Shanbhag S, Madivada S, Kumar HS. Effective Adsorptive Removal of Coomassie Violet Dye from Aqueous Solutions Using Green Synthesized Zinc Hydroxide Nanoparticles Prepared from *Calotropis gigantea* Leaf Extract. *ChemEngineering* 2023;7:31. <https://doi.org/10.3390/CHEMENGINEERING7020031/S1>.
- [61] Bui DXM, Nguyen UTP, Nguyen TTT, Nguyen DTD, Nguyen DTC, Tran T Van. Biosynthesis of green CuO@C nanocomposite using *Combretum indicum* flower extract for organic dye removal: adsorption performance, modeling, and recyclability studies. *Environmental Science and Pollution Research* 2023;1:1–20. <https://doi.org/10.1007/S11356-023-29707-Y/FIGURES/6>.
- [62] Vinayagam R, Pai S, Murugesan G, Varadavenkatesan T, Kaviyarasu K, Selvaraj R. Green synthesized hydroxyapatite nanoadsorbent for the adsorptive removal of AB113 dye for environmental applications. *Environ Res* 2022;212:113274. <https://doi.org/10.1016/J.ENVRES.2022.113274>.
- [63] Rashid IM, Salman SD, Mohammed AK, Salih Mahdi Y. Green Synthesis of Nickle Oxide Nanoparticles for Adsorption of Dyes n.d. <https://doi.org/10.17576/jsm-2022-5102-17>.
- [64] G BP, S XT. A critical green biosynthesis of novel CuO/C porous nanocomposite via the aqueous leaf extract of *Ficus religiosa* and their antimicrobial, antioxidant, and adsorption properties. *Chemical Engineering Journal Advances* 2021;8:100152. <https://doi.org/10.1016/J.CEJA.2021.100152>.
- [65] Khasay MH. Synthesis and characterization of ZnO nanoparticles using aqueous extract of *Becium grandiflorum* for antimicrobial activity and adsorption of methylene blue. *Appl Water Sci* 2021;11:1–12. <https://doi.org/10.1007/S13201-021-01373-W/FIGURES/12>.
- [66] Saruchi, Thakur P, Kumar V. Kinetics and thermodynamic studies for removal of methylene blue dye by biosynthesize copper oxide nanoparticles and its antibacterial activity. *J Environ Health Sci Eng* 2019;17:367–76. <https://doi.org/10.1007/S40201-019-00354-1/METRICS>.

- [67] Khani R, Roostaei B, Bagherzade G, Moudi M. Green synthesis of copper nanoparticles by fruit extract of *Ziziphus spina-christi* (L.) Willd.: Application for adsorption of triphenylmethane dye and antibacterial assay. *J Mol Liq* 2018;255:541–9. <https://doi.org/10.1016/J.MOLLIQ.2018.02.010>.
- [68] Sharma M, Das P, Datta S. Green Synthesis of Silver – Soil Nanocomposite from Two Different Sources and Its Application for the Removal of Dye Solution 2016. <https://doi.org/10.22606/epp.2016.12001>.
- [69] Sewu DD, Boakye P, Woo SH. Highly efficient adsorption of cationic dye by biochar produced with Korean cabbage waste. *Bioresour Technol* 2017;224:206–13. <https://doi.org/10.1016/J.BIORTECH.2016.11.009>.
- [70] Rawat AP, Kumar V, Singh DP. A combined effect of adsorption and reduction potential of biochar derived from Mentha plant waste on removal of methylene blue dye from aqueous solution. *Sep Sci Technol* 2020;55:907–21. <https://doi.org/10.1080/01496395.2019.1580732>.
- [71] Guo D, Li Y, Cui B, Hu M, Luo S, Ji B, et al. Natural adsorption of methylene blue by waste fallen leaves of *Magnoliaceae* and its repeated thermal regeneration for reuse. *J Clean Prod* 2020;267:121903. <https://doi.org/10.1016/J.JCLEPRO.2020.121903>.
- [72] Saniya A, Sathya K, Nagarajan K, Yogesh M, Jayalakshmi H, Praveena P, et al. Modelling of the removal of crystal violet dye from textile effluent using *Murraya koenigii* stem biochar 2020. <https://doi.org/10.5004/dwt.2020.26191>.
- [73] Suwunwong T, Hussain N, Chantrapromma S, Phoungthong K. Facile synthesis of corncob biochar via in-house modified pyrolysis for removal of methylene blue in wastewater. *Mater Res Express* 2020;7:015518. <https://doi.org/10.1088/2053-1591/AB6767>.
- [74] Saleh M, Bilici Z, Ozay Y, Yalvac M, Dizge N, Yabalak E. Green synthesis of *Quercus coccifera* hydrochar in subcritical water medium and evaluation of its adsorption performance for BR18 dye. *Water Science and Technology* 2021;83:701–14. <https://doi.org/10.2166/WST.2020.607>.
- [75] Cuong Nguyen X, Thanh Huyen Nguyen T, Hong Chuong Nguyen T, Van Le Q, Yen Binh Vo T, Cuc Phuong Tran T, et al. Sustainable carbonaceous biochar adsorbents derived from agro-wastes and invasive plants for cation dye adsorption from water. *Chemosphere* 2021;282:131009. <https://doi.org/10.1016/J.CHEMOSPHERE.2021.131009>.
- [76] Tu W, Liu Y, Xie Z, Chen M, Ma L, Du G, et al. A novel activation-hydrochar via hydrothermal carbonization and KOH activation of sewage sludge and coconut shell for biomass wastes: Preparation, characterization and adsorption properties. *J Colloid Interface Sci* 2021;593:390–407. <https://doi.org/10.1016/J.JCIS.2021.02.133>.
- [77] Hammud HH, Hammoud MH, Hussein AA, Fawaz YB, Abdul Hamid MHS, Sheikh NS. Removal of Malachite Green Using Hydrochar from PALM Leaves. *Sustainability (Switzerland)* 2023;15:8939. <https://doi.org/10.3390/SU15118939/S1>.

- [78] Goyi AA, Sher Mohammad NM, Omer KM. Preparation and characterization of potato peel derived hydrochar and its application for removal of Congo red: a comparative study with potato peel powder. *International Journal of Environmental Science and Technology* 2024;21:631–42. <https://doi.org/10.1007/S13762-023-04965-Y/TABLES/5>.
- [79] Li Y, Meas A, Shan S, Yang R, Gai X. Production and optimization of bamboo hydrochars for adsorption of Congo red and 2-naphthol. *Bioresour Technol* 2016;207:379–86. <https://doi.org/10.1016/J.BIORTECH.2016.02.012>.
- [80] Hamad N, Galhoum AA, Saad A, Wageh S. Efficient adsorption of cationic and anionic dyes using hydrochar nanoparticles prepared from orange peel. *J Mol Liq* 2024;409:125349. <https://doi.org/10.1016/J.MOLLIQ.2024.125349>.
- [81] Tiwari H, Sonwani RK, Singh RS. A comprehensive evaluation of the integrated photocatalytic-fixed bed bioreactor system for the treatment of Acid Blue 113 dye. *Bioresour Technol* 2022;364:128037. <https://doi.org/10.1016/J.BIORTECH.2022.128037>.
- [82] Tiwari H, Sonwani RK, Singh RS. Biodegradation and detoxification study of triphenylmethane dye (Brilliant green) in a recirculating packed-bed bioreactor by bacterial consortium. <https://doi.org/10.1080/0959333020222131469> 2022. <https://doi.org/10.1080/09593330.2022.2131469>.
- [83] Tiwari H, Sonwani RK, Singh RS. Bioremediation of dyes: a brief review of bioreactor performance. <https://doi.org/10.1080/2162251520232184276> 2023;12:83–128. <https://doi.org/10.1080/21622515.2023.2184276>.
- [84] Arif Z, Sethy NK, Kumari L, Mishra PK, Verma B. Green synthesis of TiO₂ nanoparticles using *Cajanus cajan* extract and their use in controlling the fouling of ultrafiltration PVDF membranes. *Korean Journal of Chemical Engineering* 2019;36:1148–56. <https://doi.org/10.1007/s11814-019-0297-8>.
- [85] Nabi G, Majid A, Riaz A, Alharbi T, Arshad Kamran M, Al-Habardi M. Green synthesis of spherical TiO₂ nanoparticles using *Citrus Limetta* extract: Excellent photocatalytic water decontamination agent for RhB dye. *Inorg Chem Commun* 2021;129:108618. <https://doi.org/10.1016/j.inoche.2021.108618>.
- [86] Kaur H, Kaur S, Singh J, Rawat M, Kumar S. Expanding horizon: Green synthesis of TiO₂ nanoparticles using *Carica papaya* leaves for photocatalysis application. *Mater Res Express* 2019;6. <https://doi.org/10.1088/2053-1591/ab2ec5>.
- [87] Mobeen Amanulla A, Sundaram R. Green synthesis of TiO₂ nanoparticles using orange peel extract for antibacterial, cytotoxicity and humidity sensor applications. *Mater Today Proc* 2019;8:323–31. <https://doi.org/10.1016/j.matpr.2019.02.118>.
- [88] Kiriarachchi HD, Abouzeid KM, Bo L, El-shall MS. Growth Mechanism of Sea Urchin ZnO Nanostructures in Aqueous Solutions and Their Photocatalytic Activity for the Degradation of Organic Dyes 2019. <https://doi.org/10.1021/acsomega.9b01772>.
- [89] Reyes-Coronado D, Rodriguez-Gattorno G, Espinosa-Pesqueira M, Gardner JM, Meyer GJ, Oskam G. Synthesis and characterization of TiO₂ nanoparticles: anatase,

- brookite, and rutile. *Solar Hydrogen and Nanotechnology II* 2007;6650:66500X. <https://doi.org/10.1117/12.732647>.
- [90] Li Y, White TJ, Lim SH. Low-temperature synthesis and microstructural control of titania nano-particles. *J Solid State Chem* 2004;177:1372–81. <https://doi.org/10.1016/j.jssc.2003.11.016>.
- [91] Byranvand MM, Kharat AN, Fatholahi L, Beiranvand ZM. A Review on Synthesis of Nano-TiO₂ via Different Methods 2013;3:1–9.
- [92] Fujishima A, Rao TN, Tryk DA. Titanium dioxide photocatalysis. *Journal of Photochemistry and Photobiology C: Photochemistry Reviews* 2000;1:1–21. [https://doi.org/10.1016/S1389-5567\(00\)00002-2](https://doi.org/10.1016/S1389-5567(00)00002-2).
- [93] Udayabhanu, Nethravathi PC, Pavan Kumar MA, Suresh D, Lingaraju K, Rajanaika H, et al. *Tinospora cordifolia* mediated facile green synthesis of cupric oxide nanoparticles and their photocatalytic, antioxidant and antibacterial properties. *Mater Sci Semicond Process* 2015;33:81–8. <https://doi.org/10.1016/j.mssp.2015.01.034>.
- [94] Suresh D, Nethravathi PC, Udayabhanu, Rajanaika H, Nagabhushana H, Sharma SC. Green synthesis of multifunctional zinc oxide (ZnO) nanoparticles using *Cassia fistula* plant extract and their photodegradative, antioxidant and antibacterial activities. *Mater Sci Semicond Process* 2015;31:446–54. <https://doi.org/10.1016/j.mssp.2014.12.023>.
- [95] Sharma U, Bala M, Kumar N, Singh B, Munshi RK, Bhalerao S. Immunomodulatory active compounds from *Tinospora cordifolia*. *J Ethnopharmacol* 2012;141:918–26. <https://doi.org/10.1016/j.jep.2012.03.027>.
- [96] Cameselle C, Pazos M, Sanromán MA. Selection of an electrolyte to enhance the electrochemical decolourisation of indigo. Optimisation and scale-up. *Chemosphere* 2005;60:1080–6. <https://doi.org/10.1016/j.chemosphere.2005.01.018>.
- [97] Asghar A, Mohammed M, Aziz A, Raman A, Mohd W, Wan A, et al. Heliyon Predicting the degradation potential of Acid blue 113 by different oxidants using quantum chemical analysis. *Heliyon* 2019;5:e02396. <https://doi.org/10.1016/j.heliyon.2019.e02396>.
- [98] Kurade MB, Waghmode TR, Khandare R V., Jeon BH, Govindwar SP. Biodegradation and detoxification of textile dye Disperse Red 54 by *Brevibacillus laterosporus* and determination of its metabolic fate. *J Biosci Bioeng* 2016;121:442–9. <https://doi.org/10.1016/j.jbiosc.2015.08.014>.
- [99] Saratale GD, Saratale RG, Chang JS, Govindwar SP. Fixed-bed decolorization of Reactive Blue 172 by *Proteus vulgaris* NCIM-2027 immobilized on *Luffa cylindrica* sponge. *Int Biodeterior Biodegradation* 2011;65:494–503. <https://doi.org/10.1016/j.ibiod.2011.01.012>.
- [100] Rathnasamy R, Thangasamy P, Thangamuthu R, Sampath S, Alagan V. Green synthesis of ZnO nanoparticles using *Carica papaya* leaf extracts for photocatalytic and photovoltaic applications. *Journal of Materials Science: Materials in Electronics* 2017;28:10374–81. <https://doi.org/10.1007/S10854-017-6807-8/FIGURES/11>.

- [101] Abu-dalo M, Jaradat A, Albiss BA, Al-rawashdeh NAF. Journal of Environmental Chemical Engineering Green synthesis of TiO₂ NPs / pristine pomegranate peel extract nanocomposite and its antimicrobial activity for water disinfection. J Environ Chem Eng 2019;7:103370. <https://doi.org/10.1016/j.jece.2019.103370>.
- [102] Winefordner EJD. Introduction to X-ray Powder Diffractometry chemical analysis a series of monographs on analytical chemistry and its applications Introduction to X-ray Powder Diffractometry n.d.
- [103] Mol JC, Moulijn JA, Boelhouwer C. Optical properties and electronic structure of amorphous Ge and Si J. Chemical Communications 1968;5:1–8.
- [104] Ansari A, Siddiqui VU, Rehman WU, Akram MK, Siddiqi WA, Alosaimi AM, et al. Green Synthesis of TiO₂ Nanoparticles Using *Acorus calamus* Leaf Extract and Evaluating its Photocatalytic and In Vitro Antimicrobial Activity. Catalysts 2022;12. <https://doi.org/10.3390/catal12020181>.
- [105] Poolwong J, Kiatboonyarit T, Achiwawanich S, Butburee T, Khemthong P, Kityakarn S. Three-dimensional hierarchical porous TiO₂ for enhanced adsorption and photocatalytic degradation of remazol dye. Nanomaterials 2021;11. <https://doi.org/10.3390/nano11071715>.
- [106] Thommes M, Kaneko K, Neimark A V., Olivier JP, Rodriguez-Reinoso F, Rouquerol J, et al. Physisorption of gases, with special reference to the evaluation of surface area and pore size distribution (IUPAC Technical Report). Pure and Applied Chemistry 2015;87:1051–69. <https://doi.org/10.1515/PAC-2014-1117/MACHINEREADABLECITATION/RIS>.
- [107] Rajakumar G, Rahuman AA, Jayaseelan C, Santhoshkumar T, Marimuthu S, Kamaraj C, et al. Solanum trilobatum extract-mediated synthesis of titanium dioxide nanoparticles to control *Pediculus humanus capitis*, *Hyalomma anatolicum anatolicum* and *Anopheles subpictus*. Parasitol Res 2014;113:469–79. <https://doi.org/10.1007/s00436-013-3676-9>.
- [108] Lu X, Lv X, Sun Z, Zheng Y. Nanocomposites of poly(l-lactide) and surface-grafted TiO₂ nanoparticles: Synthesis and characterization. Eur Polym J 2008;44:2476–81. <https://doi.org/10.1016/j.eurpolymj.2008.06.002>.
- [109] Olurode K, Neelgund GM, Oki A, Luo Z. A facile hydrothermal approach for construction of carbon coating on TiO₂ nanoparticles. Spectrochim Acta A Mol Biomol Spectrosc 2012;89:333–6. <https://doi.org/10.1016/j.saa.2011.12.025>.
- [110] Wei J, Zhao L, Peng S, Shi J, Liu Z, Wen W. Wettability of urea-doped TiO₂ nanoparticles and their high electrorheological effects. J Solgel Sci Technol 2008;47:311–5. <https://doi.org/10.1007/s10971-008-1787-z>.
- [111] Praveen P, Viruthagiri G, Mugundan S, Shanmugam N. Structural, optical and morphological analyses of pristine titanium di-oxide nanoparticles - Synthesized via sol-gel route. Spectrochim Acta A Mol Biomol Spectrosc 2014;117:622–9. <https://doi.org/10.1016/j.saa.2013.09.037>.

- [112] Wong MS, Sun DS, Chang HH. Bactericidal performance of visible-light responsive titania photocatalyst with silver nanostructures. PLoS One 2010;5. <https://doi.org/10.1371/journal.pone.0010394>.
- [113] Maurya. Surface Functionalization of TiO₂ with Plant Extracts and their Combined Antimicrobial Activities Against *E. faecalis* and *E. Coli*. Journal of Research Updates in Polymer Science 2012;43–51. <https://doi.org/10.6000/1929-5995.2012.01.01.6>.
- [114] Jafari A, Rashidipour M, Kamarehi B, Alipour S, Ghaderpoori M. Toxicity of green synthesized TiO₂ nanoparticles (TiO₂ NPs) on zebra fish. Environ Res 2022;212:113542. <https://doi.org/10.1016/J.ENVRES.2022.113542>.
- [115] Mohammadzadeh S, Olya ME, Arabi AM, Shariati A, Khosravi Nikou MR. Synthesis, characterization and application of ZnO-Ag as a nanophotocatalyst for organic compounds degradation, mechanism and economic study. J Environ Sci (China) 2015;35:194–207. <https://doi.org/10.1016/j.jes.2015.03.030>.
- [116] Mohan D, Pittman CU. Activated carbons and low cost adsorbents for remediation of tri- and hexavalent chromium from water. J Hazard Mater 2006;137:762–811. <https://doi.org/10.1016/J.JHAZMAT.2006.06.060>.
- [117] Rajesh Y, Boricha H, Suryavanshi A, Gajare A, Jain S, Suresh K. Synthesis, characterization and adsorption studies on activated carbon adsorbent synthesized from *Kigelia africana* for removal of acid blue 113 dye from synthetic solution. Mater Today Proc 2023. <https://doi.org/10.1016/J.MATPR.2023.11.046>.
- [118] Solayman HM, Hossen MA, Abd Aziz A, Yahya NY, Leong KH, Sim LC, et al. Performance evaluation of dye wastewater treatment technologies: A review. J Environ Chem Eng 2023;11:109610. <https://doi.org/10.1016/J.JECE.2023.109610>.
- [119] Sci-Hub, Solar-TiO₂ immobilized photocatalytic reactors performance assessment in the degradation of methyl orange dye in aqueous solution. Environmental Nanotechnology, Monitoring & Management, 16, 100514 | [10.1016/j.enmm.2021.100514](https://doi.org/10.1016/j.enmm.2021.100514) n.d.
- [120] Nabi G, Majid A, Riaz A, Alharbi T, Arshad Kamran M, Al-Habardi M. Green synthesis of spherical TiO₂ nanoparticles using *Citrus Limetta* extract: Excellent photocatalytic water decontamination agent for RhB dye. Inorg Chem Commun 2021;129:108618. <https://doi.org/10.1016/j.inoche.2021.108618>.
- [121] Sci-Hub | Three-Dimensional Hierarchical Porous TiO₂ for Enhanced Adsorption and Photocatalytic Degradation of Remazol Dye. Nanomaterials, 11(7), 1715 | [10.3390/nano11071715](https://doi.org/10.3390/nano11071715) n.d.
- [122] Nethravathi PC, Udayabhanu, Nagaraju G, Suresh D. TiO₂ and Ag-TiO₂ nanomaterials for enhanced photocatalytic and antioxidant activity: Green synthesis using *Cucumis melo* juice. Mater Today Proc 2021;49:841–8. <https://doi.org/10.1016/j.matpr.2021.05.670>.
- [123] Khan S, Sadiq M, Kim D sung, Ullah M, Muhammad N. TiO₂ and its binary ZnTiO₂ and ternary CdZnTiO₂ nanocomposites as efficient photocatalysts for the organic dyes

- degradation. *Appl Water Sci* 2022;12:1–12. <https://doi.org/10.1007/S13201-022-01628-0/FIGURES/11>.
- [124] Sci-Hub | Biosynthesis of TiO₂ nanoparticles by *Acalypha indica*; photocatalytic degradation of methylene blue. *Applied Nanoscience* | 10.1007/s13204-021-01761-3 n.d.
- [125] Sundrarajan M, Bama K, Bhavani M, Jegatheeswaran S, Ambika S, Sangili A, et al. Obtaining titanium dioxide nanoparticles with spherical shape and antimicrobial properties using *M. citrifolia* leaves extract by hydrothermal method. *J Photochem Photobiol B* 2017;171:117–24. <https://doi.org/10.1016/j.jphotobiol.2017.05.003>.
- [126] Bavanilatha M, Yoshitha L, Nivedhitha S, Sahithya S. Bioactive studies of TiO₂ nanoparticles synthesized using *Glycyrrhiza glabra*. *Biocatal Agric Biotechnol* 2019;19:101131. <https://doi.org/10.1016/j.bcab.2019.101131>.
- [127] Jayaseelan C, Rahuman AA, Roopan SM, Kirthi AV, Venkatesan J, Kim SK, et al. Biological approach to synthesize TiO₂ nanoparticles using *Aeromonas hydrophila* and its antibacterial activity. *Spectrochim Acta A Mol Biomol Spectrosc* 2013;107:82–9. <https://doi.org/10.1016/J.SAA.2012.12.083>.
- [128] Koseki H, Shiraishi K, Asahara T, Tsurumoto T, Shindo H, Baba K, et al. Photocatalytic bactericidal action of fluorescent light in a titanium dioxide particle mixture: An in vitro study. *Biomedical Research* 2009;30:189–92. <https://doi.org/10.2220/biomedres.30.189>.
- [129] Parida KM, Sahu S, Reddy KH, Sahoo PC. A kinetic, thermodynamic, and mechanistic approach toward adsorption of methylene blue over water-washed manganese nodule leached residues. *Ind Eng Chem Res*, vol. 50, 2011, p. 843–8. <https://doi.org/10.1021/ie101866a>.
- [130] Vinothkannan M, Karthikeyan C, Gnana Kumar G, Kim AR, Yoo DJ. One-pot green synthesis of reduced graphene oxide (RGO)/Fe₃O₄ nanocomposites and its catalytic activity toward methylene blue dye degradation. *Spectrochim Acta A Mol Biomol Spectrosc* 2015;136:256–64. <https://doi.org/10.1016/j.saa.2014.09.031>.
- [131] Gouamid M, Ouahrani MR, Bensaci MB. Adsorption equilibrium, kinetics and thermodynamics of methylene blue from aqueous solutions using Date palm Leaves. *Energy Procedia*, vol. 36, Elsevier Ltd; 2013, p. 898–907. <https://doi.org/10.1016/j.egypro.2013.07.103>.
- [132] Sangpour P, Hashemi F, Moshfegh AZ. Photoenhanced degradation of methylene blue on cosputtered M:TiO₂ (M = Au, Ag, Cu) nanocomposite systems: A comparative study. *Journal of Physical Chemistry C* 2010;114:13955–61. <https://doi.org/10.1021/jp910454r>.
- [133] Gao Y, Wei Z, Li F, Yang ZM, Chen YM, Zrinyi M, et al. Synthesis of a morphology controllable Fe₃O₄ nanoparticle/hydrogel magnetic nanocomposite inspired by magnetotactic bacteria and its application in H₂O₂ detection. *Green Chemistry* 2014;16:1255–61. <https://doi.org/10.1039/c3gc41535j>.

- [134] Majeed MI, Lu Q, Yan W, Li Z, Hussain I, Tahir MN, et al. Highly water-soluble magnetic iron oxide (Fe₃O₄) nanoparticles for drug delivery: Enhanced in vitro therapeutic efficacy of doxorubicin and MION conjugates. *J Mater Chem B* 2013;1:2874–84. <https://doi.org/10.1039/c3tb20322k>.
- [135] Hass J, De Heer WA, Conrad EH. The growth and morphology of epitaxial multilayer graphene. *Journal of Physics Condensed Matter* 2008;20. <https://doi.org/10.1088/0953-8984/20/32/323202>.
- [136] Shen B, Ding J, Yan X, Feng W, Li J, Xue Q. Influence of different buffer gases on synthesis of few-layered graphene by arc discharge method. *Appl Surf Sci* 2012;258:4523–31. <https://doi.org/10.1016/j.apsusc.2012.01.019>.
- [137] Qin X, Lu W, Asiri AM, Al-Youbi AO, Sun X. Green, low-cost synthesis of photoluminescent carbon dots by hydrothermal treatment of willow bark and their application as an effective photocatalyst for fabricating Au nanoparticles-reduced graphene oxide nanocomposites for glucose detection. *Catal Sci Technol* 2013;3:1027–35. <https://doi.org/10.1039/c2cy20635h>.
- [138] Tian J, Liu S, Zhang Y, Li H, Wang L, Luo Y, et al. Environmentally friendly, one-pot synthesis of Ag nanoparticle-decorated reduced graphene oxide composites and their application to photocurrent generation. *Inorg Chem* 2012;51:4742–6. <https://doi.org/10.1021/ic300332x>.
- [139] Kim NH, Khanra P, Kuila T, Jung D, Lee JH. Efficient reduction of graphene oxide using Tin-powder and its electrochemical performances for use as an energy storage electrode material. *J Mater Chem A Mater* 2013;1:11320–8. <https://doi.org/10.1039/c3ta11987d>.
- [140] Das AK, Srivastav M, Layek RK, Uddin ME, Jung D, Kim NH, et al. Iodide-mediated room temperature reduction of graphene oxide: A rapid chemical route for the synthesis of a bifunctional electrocatalyst. *J Mater Chem A Mater* 2014;2:1332–40. <https://doi.org/10.1039/c3ta13688d>.
- [141] Thakur N, Thakur N, Kumar K, Kumar A. *Tinospora cordifolia* mediated eco-friendly synthesis of Cobalt doped TiO₂ NPs for degradation of organic methylene blue dye. *Mater Today Proc* 2023. <https://doi.org/10.1016/J.MATPR.2023.01.253>.
- [142] Saini R, Kumar P. Green synthesis of TiO₂ nanoparticles using *Tinospora cordifolia* plant extract & its potential application for photocatalysis and antibacterial activity. *Inorg Chem Commun* 2023;156:111221. <https://doi.org/10.1016/j.inoche.2023.111221>.
- [143] Yu H, Zhang B, Bulin C, Li R, Xing R. High-efficient Synthesis of Graphene Oxide Based on Improved Hummers Method. *Sci Rep* 2016;6:1–7. <https://doi.org/10.1038/srep36143>.
- [144] Boulahbal M, Malouki MA, Canle M, Redouane-Salah Z, Devanesan S, AlSalhi MS, et al. Removal of the industrial azo dye crystal violet using a natural clay: Characterization, kinetic modeling, and RSM optimization. *Chemosphere* 2022;306:135516. <https://doi.org/10.1016/j.chemosphere.2022.135516>.

- [145] Nakajima T, Matsuo Y. Formation process and structure of graphite oxide. *Carbon* N Y 1994;32:469–75. [https://doi.org/10.1016/0008-6223\(94\)90168-6](https://doi.org/10.1016/0008-6223(94)90168-6).
- [146] Guo H, Wang X, Qian Q, Wang F, Xia X. ARTICLE A Green Approach to the Synthesis of. *ACS Nano* 2009;3:2653–9. <https://doi.org/10.1021/nn900227d>.
- [147] Manchala S, Tandava VSRK, Jampaiah D, Bhargava SK, Shanker V. Novel and Highly Efficient Strategy for the Green Synthesis of Soluble Graphene by Aqueous Polyphenol Extracts of Eucalyptus Bark and Its Applications in High-Performance Supercapacitors. *ACS Sustain Chem Eng* 2019;7:11612–20. <https://doi.org/10.1021/acssuschemeng.9b01506>.
- [148] Lingaraju K, Raja Naika H, Nagaraju G, Nagabhushana H. Biocompatible synthesis of reduced graphene oxide from *Euphorbia heterophylla* (L.) and their in-vitro cytotoxicity against human cancer cell lines. *Biotechnology Reports* 2019;24:e00376. <https://doi.org/10.1016/j.btre.2019.e00376>.
- [149] Saleh TA, Al-Shalalfeh MM, Al-Saadi AA. Graphene Dendrimer-stabilized silver nanoparticles for detection of methimazole using Surface-enhanced Raman scattering with computational assignment. *Sci Rep* 2016;6. <https://doi.org/10.1038/srep32185>.
- [150] Haghighi B, Tabrizi MA. Green-synthesis of reduced graphene oxide nanosheets using rose water and a survey on their characteristics and applications. *RSC Adv* 2013;3:13365–71. <https://doi.org/10.1039/c3ra40856f>.
- [151] Sengupta I, Bhattacharya P, Talukdar M, Neogi S, Pal SK, Chakraborty S. Bactericidal effect of graphene oxide and reduced graphene oxide: Influence of shape of bacteria. *Colloids and Interface Science Communications* 2019;28:60–8. <https://doi.org/10.1016/j.colcom.2018.12.001>.
- [152] Ahmed S, Saifullah, Ahmad M, Swami BL, Ikram S. Green synthesis of silver nanoparticles using *Azadirachta indica* aqueous leaf extract. *J Radiat Res Appl Sci* 2016;9:1–7. <https://doi.org/10.1016/j.jrras.2015.06.006>.
- [153] Yadav C, Maji PK. Synergistic effect of cellulose nanofibres and bio- extracts for fabricating high strength sodium alginate based composite bio-sponges with antibacterial properties. *Carbohydr Polym* 2019;203:396–408. <https://doi.org/10.1016/j.carbpol.2018.09.050>.
- [154] Khanra P, Kuila T, Kim NH, Bae SH, Yu D sheng, Lee JH. Simultaneous bio-functionalization and reduction of graphene oxide by baker's yeast. *Chemical Engineering Journal* 2012;183:526–33. <https://doi.org/10.1016/J.CEJ.2011.12.075>.
- [155] Ebrahimi Naghani M, Neghabi M, Zadsar M, Abbastabar Ahangar H. Synthesis and characterization of linear/nonlinear optical properties of graphene oxide and reduced graphene oxide-based zinc oxide nanocomposite. *Scientific Reports* 2023 13:1 2023;13:1–10. <https://doi.org/10.1038/s41598-023-28307-7>.
- [156] Kuila T, Bose S, Khanra P, Mishra AK, Kim NH, Lee JH. Recent advances in graphene-based biosensors. *Biosens Bioelectron* 2011;26:4637–48. <https://doi.org/10.1016/J.BIOS.2011.05.039>.

- [157] Mahiuddin M, Ochiai B. Lemon Juice Assisted Green Synthesis of Reduced Graphene Oxide and Its Application for Adsorption of Methylene Blue. *Technologies* 2021, Vol 9, Page 96 2021;9:96. <https://doi.org/10.3390/TECHNOLOGIES9040096>.
- [158] Vinodhkumar G, Ramya R, Potheher IV, Vimalan M, Peter AC. Synthesis of reduced graphene oxide/Co₃O₄ nanocomposite electrode material for sensor application. *Research on Chemical Intermediates* 2019;45:3033–51. <https://doi.org/10.1007/S11164-019-03777-5/TABLES/2>.
- [159] Johnson DW, Dobson BP, Coleman KS. A manufacturing perspective on graphene dispersions. *Curr Opin Colloid Interface Sci* 2015;20:367–82. <https://doi.org/10.1016/j.cocis.2015.11.004>.
- [160] Bengtson S, Knudsen KB, Kyjovska ZO, Berthing T, Skaug V, Levin M, et al. Differences in inflammation and acute phase response but similar genotoxicity in mice following pulmonary exposure to graphene oxide and reduced graphene oxide. *PLoS One* 2017;12:1–25. <https://doi.org/10.1371/journal.pone.0178355>.
- [161] Nikam S, Mandal D. Experimental study of the effect of different parameters on the adsorption and desorption of trichloroethylene vapor on activated carbon particles. *ACS Omega* 2020;5:28080–7. <https://doi.org/10.1021/acsomega.0c03648>.
- [162] Gurunathan S, Han JW, Kim ES, Park JH, Kim JH. Reduction of graphene oxide by resveratrol: A novel and simple biological method for the synthesis of an effective anticancer nanotherapeutic molecule. *Int J Nanomedicine* 2015;10:2951–69. <https://doi.org/10.2147/IJN.S79879>.
- [163] Ahmad H, Tajdidzadeh M, Thambiratnam K, Yasin M. Infrared photodetectors based on reduced graphene oxide nanoparticles and graphene oxide. *Laser Phys* 2018;28. <https://doi.org/10.1088/1555-6611/aab451>.
- [164] Rápó E, Tonk S. Factors affecting synthetic dye adsorption; desorption studies: A review of results from the last five years (2017–2021). *Molecules* 2021;26. <https://doi.org/10.3390/molecules26175419>.
- [165] Asgarifard P, Rahimi M, Tafreshi N. Response surface modelling of CO₂ capture by ammonia aqueous solution in a microchannel. *Canadian Journal of Chemical Engineering* 2021;99:601–12. <https://doi.org/10.1002/cjce.23881>.
- [166] Gautam A, Kumar Mondal M. Post-combustion capture of CO₂ using novel aqueous Triethylenetetramine and 2-Dimethylaminoethanol amine blend: Equilibrium CO₂ loading-empirical model and optimization, CO₂ desorption, absorption heat, and ¹³C NMR analysis. *Fuel* 2023;331:125864. <https://doi.org/10.1016/j.fuel.2022.125864>.
- [167] Davarnejad R, Azizi A, Mohammadi M, Mansoori S. A green technique for synthesising iron oxide nanoparticles by extract of *centaurea cyanus* plant: an optimised adsorption process for methylene blue. *Int J Environ Anal Chem* 2022;102:2379–93. <https://doi.org/10.1080/03067319.2020.1756273>.
- [168] Umesh AS, Puttaiahgowda YM, Thottathil S. Enhanced adsorption: Reviewing the potential of reinforcing polymers and hydrogels with nanomaterials for methylene blue

- dye removal. *Surfaces and Interfaces* 2024;51:104670.
<https://doi.org/10.1016/J.SURFIN.2024.104670>.
- [169] Hoseinzadeh H, Hayati B, Shahmoradi Ghaheh F, Seifpanahi-Shabani K, Mahmoodi NM. Development of room temperature synthesized and functionalized metal-organic framework/graphene oxide composite and pollutant adsorption ability. *Mater Res Bull* 2021;142. <https://doi.org/10.1016/j.materresbull.2021.111408>.
- [170] Tran TH, Le AH, Pham TH, Nguyen DT, Chang SW, Chung WJ, et al. Adsorption isotherms and kinetic modeling of methylene blue dye onto a carbonaceous hydrochar adsorbent derived from coffee husk waste. *Science of the Total Environment* 2020;725. <https://doi.org/10.1016/j.scitotenv.2020.138325>.
- [171] Rajumon R, Anand JC, Ealias AM, Desai DS, George G, Saravanakumar MP. Adsorption of textile dyes with ultrasonic assistance using green reduced graphene oxide: An in-depth investigation on sonochemical factors. *J Environ Chem Eng* 2019;7:103479. <https://doi.org/10.1016/J.JECE.2019.103479>.
- [172] Mann R, Mitsidis D, Xie Z, McNeilly O, Ng YH, Amal R, et al. Antibacterial Activity of Reduced Graphene Oxide. *J Nanomater* 2021;2021. <https://doi.org/10.1155/2021/9941577>.
- [173] Xu LQ, Liao YB, Li NN, Li YJ, Zhang JY, Wang YB, et al. Vancomycin-assisted green synthesis of reduced graphene oxide for antimicrobial applications. *J Colloid Interface Sci* 2018;514:733–9. <https://doi.org/10.1016/j.jcis.2018.01.014>.
- [174] Khan S, Ahamad Z, Nasar · Abu. Development and utilization of raw and NaOH-modified peanut hull as potential adsorbents for crystal violet dye removal from wastewater. *Biomass Conversion and Biorefinery* 2023 2023;1:1–21. <https://doi.org/10.1007/S13399-023-05232-3>.
- [175] Zhai S, Li M, Wang D, Zhang L, Yang Y, Fu S. In situ loading metal oxide particles on bio-chars: Reusable materials for efficient removal of methylene blue from wastewater. *J Clean Prod* 2019;220:460–74. <https://doi.org/10.1016/j.jclepro.2019.02.152>.
- [176] Wanassi B, Hariz I Ben, Ghimbeu CM, Vaultot C, Hassen M Ben, Jeguirim M. Carbonaceous adsorbents derived from textile cotton waste for the removal of Alizarin S dye from aqueous effluent: kinetic and equilibrium studies. *Environmental Science and Pollution Research* 2017;24:10041–55. <https://doi.org/10.1007/s11356-017-8410-1>.
- [177] Benhouria A, Islam MA, Zaghouane-Boudiaf H, Boutahala M, Hameed BH. Calcium alginate-bentonite-activated carbon composite beads as highly effective adsorbent for methylene blue. *Chemical Engineering Journal* 2015;270:621–30. <https://doi.org/10.1016/j.cej.2015.02.030>.
- [178] Warnock DD, Lehmann J, Kuyper TW, Rillig MC. Mycorrhizal responses to biochar in soil - Concepts and mechanisms. *Plant Soil* 2007;300:9–20. <https://doi.org/10.1007/s11104-007-9391-5>.

- [179] Petrović J, Ercegović M, Simić M, Kalderis D, Koprivica M, Milojković J, et al. Novel Mg-doped pyro-hydrochars as methylene blue adsorbents: Adsorption behavior and mechanism. *J Mol Liq* 2023;376:121424. <https://doi.org/10.1016/J.MOLLIQ.2023.121424>.
- [180] Shafie ST, Mohd MA, Hang LL, Azlina W, Abdul W, Ghani K. Effect of pyrolysis temperature on the biochar nutrient and water retention capacity. *Purity, Utility Reaction and Environment* 2012;1:323–37.
- [181] Liesch AM, Weyers SL, Gaskin JW, Das KC. Impact of Two Different Biochars on Earthworm Growth and Survival 2010;4:1–9.
- [182] Zhang P, O'Connor D, Wang Y, Jiang L, Xia T, Wang L, et al. A green biochar/iron oxide composite for methylene blue removal. *J Hazard Mater* 2020;384:121286. <https://doi.org/10.1016/j.jhazmat.2019.121286>.
- [183] Trakal L, Šigut R, Šillerová H, Faturíková D, Komárek M. Copper removal from aqueous solution using biochar: Effect of chemical activation. *Arabian Journal of Chemistry* 2014;7:43–52. <https://doi.org/10.1016/j.arabjc.2013.08.001>.
- [184] Uchimiya M, Lima IM, Thomas Klasson K, Chang S, Wartelle LH, Rodgers JE. Immobilization of heavy metal ions (CuII, CdII, NiII, and PbII) by broiler litter-derived biochars in water and soil. *J Agric Food Chem* 2010;58:5538–44. <https://doi.org/10.1021/jf9044217>.
- [185] Singh S, Chakraborty JP, Mondal MK. Torrefaction of woody biomass (*Acacia nilotica*): Investigation of fuel and flow properties to study its suitability as a good quality solid fuel. *Renew Energy* 2020;153:711–24. <https://doi.org/10.1016/j.renene.2020.02.037>.
- [186] Mishra RK, Saini R, Kumar DJP, Sankannavar R, Binnal P, Dwivedi N, et al. Thermocatalytic pyrolysis of *Azadirachta indica* seeds over CaO and CuO: Pyrolysis kinetics, impact of catalysts on yield, fuel properties and its chemical compositions. *Journal of the Energy Institute* 2023;111:101366. <https://doi.org/10.1016/J.JOEI.2023.101366>.
- [187] Gautam R, Vinu R. Reaction engineering and kinetics of algae conversion to biofuels and chemicals via pyrolysis and hydrothermal liquefaction. *React Chem Eng* 2020;5:1320–73. <https://doi.org/10.1039/D0RE00084A>.
- [188] Zhang X, Zhang L, Li A. Co-hydrothermal carbonization of lignocellulosic biomass and waste polyvinyl chloride for high-quality solid fuel production: Hydrochar properties and its combustion and pyrolysis behaviors. *Bioresour Technol* 2019;294:122113. <https://doi.org/10.1016/j.biortech.2019.122113>.
- [189] Elhassan M, Kooh MRR, Chou Chau YF, Abdullah R. Hydrochar from *Shorea spp.*: a dual-purpose approach for sustainable biofuel and efficient methylene blue adsorbent. *Biomass Convers Biorefin* 2024:1–15. <https://doi.org/10.1007/S13399-024-05376-W/FIGURES/11>.
- [190] Gao P, Zhou Y, Meng F, Zhang Y, Liu Z, Zhang W, et al. Preparation and characterization of hydrochar from waste eucalyptus bark by hydrothermal carbonization. *Energy* 2016;97:238–45. <https://doi.org/10.1016/j.energy.2015.12.123>.

- [191] Ronix A, Pezoti O, Souza LS, Souza IPAF, Bedin KC, Souza PSC, et al. Hydrothermal carbonization of coffee husk: Optimization of experimental parameters and adsorption of methylene blue dye. *J Environ Chem Eng* 2017;5:4841–9. <https://doi.org/10.1016/j.jece.2017.08.035>.
- [192] Basso D, Patuzzi F, Castello D, Baratieri M, Rada EC, Weiss-Hortala E, et al. Agro-industrial waste to solid biofuel through hydrothermal carbonization. *Waste Management* 2016;47:114–21. <https://doi.org/10.1016/j.wasman.2015.05.013>.
- [193] Ji B, Wang J, Song H, Chen W. Removal of methylene blue from aqueous solutions using biochar derived from a fallen leaf by slow pyrolysis: Behavior and mechanism. *J Environ Chem Eng* 2019;7:103036. <https://doi.org/10.1016/j.jece.2019.103036>.
- [194] Elhassan M, Abdullah R, Kooh MRR, Chou Chau YF. Hydrothermal liquefaction: A technological review on reactor design and operating parameters. *Bioresour Technol Rep* 2023;21:101314. <https://doi.org/10.1016/J.BITEB.2022.101314>.
- [195] Determination of Point of Zero Charge (PZC) of Concrete Particles Adsorbents n.d. <https://doi.org/10.1088/1757-899X/1184/1/012004>.
- [196] Saini R, Mishra RK, Kumar P. Green Synthesis of Reduced Graphene Oxide Using the *Tinospora cordifolia* Plant Extract: Exploring Its Potential for Methylene Blue Dye Degradation and Antibacterial Activity. *ACS Omega* 2024. <https://doi.org/10.1021/ACSOMEGA.4C00748>.
- [197] Mishra RK, Mohanty K, Wang X. Pyrolysis kinetic behavior and Py-GC–MS analysis of waste dahlia flowers into renewable fuel and value-added chemicals. *Fuel* 2020;260:116338. <https://doi.org/10.1016/J.FUEL.2019.116338>.
- [198] Raj T, Kapoor M, Gaur R, Christopher J, Lamba B, Tuli DK, et al. Physical and chemical characterization of various indian agriculture residues for biofuels production. *Energy and Fuels* 2015;29:3111–8. https://doi.org/10.1021/EF5027373/SUPPL_FILE/EF5027373_SI_001.PDF.
- [199] Sci-Hub | Structural characterization of the solid residue produced by hydrothermal treatment of sunflower stalks and subsequent enzymatic hydrolysis. *Journal of Industrial and Engineering Chemistry*, 23, 72–78 | 10.1016/j.jiec.2014.07.044 n.d. <https://sci-hub.se/https://doi.org/10.1016/j.jiec.2014.07.044> (accessed April 28, 2024).
- [200] Yao X, Xu K, Yan F, Liang Y. The Influence of Ashing Temperature on Ash Fouling and Slagging Characteristics during Combustion of Biomass Fuels. *Bioresources* 2017;12:1593–610.
- [201] Khan AA, de Jong W, Jansens PJ, Spliethoff H. Biomass combustion in fluidized bed boilers: Potential problems and remedies. *Fuel Processing Technology* 2009;90:21–50. <https://doi.org/10.1016/J.FUPROC.2008.07.012>.
- [202] Dhanavath KN, Bankupalli S, Sugali CS, Perupogu V, V Nandury S, Bhargava S, et al. Optimization of process parameters for slow pyrolysis of neem press seed cake for liquid and char production. *J Environ Chem Eng* 2019;7:102905. <https://doi.org/10.1016/j.jece.2019.102905>.

- [203] Durmaz E, Ateş S. Comparison of properties of cellulose nanomaterials (CNMs) obtained from sunflower stalks. *Cellulose chemistry and technology Cellulose Chem Technol* 2021;55:755–70.
- [204] Gupta GK, Mondal MK. Bio-energy generation from sagwan sawdust via pyrolysis: Product distributions, characterizations and optimization using response surface methodology. *Energy* 2019;170:423–37. <https://doi.org/10.1016/j.energy.2018.12.166>.
- [205] Gupta GK, Mondal MK. Bio-energy generation from sagwan sawdust via pyrolysis: Product distributions, characterizations and optimization using response surface methodology. *Energy* 2019;170:423–37. <https://doi.org/10.1016/j.energy.2018.12.166>.
- [206] Yao X, Ji L, Guo J, Ge S, Lu W, Cai L, et al. Magnetic activated biochar nanocomposites derived from wakame and its application in methylene blue adsorption. *Bioresour Technol* 2020;302:122842. <https://doi.org/10.1016/j.biortech.2020.122842>.
- [207] Yao X, Ji L, Guo J, Ge S, Lu W, Chen Y, et al. An abundant porous biochar material derived from wakame (*Undaria pinnatifida*) with high adsorption performance for three organic dyes. *Bioresour Technol* 2020;318:124082. <https://doi.org/10.1016/j.biortech.2020.124082>.
- [208] Huang Y, Yin X, Wu C, Wang C, Xie J, Zhou Z, et al. Effects of metal catalysts on CO₂ gasification reactivity of biomass char. *Biotechnol Adv* 2009;27:568–72. <https://doi.org/10.1016/j.biotechadv.2009.04.013>.
- [209] Mohan D, Abhishek K, Sarswat A, Patel M, Singh P, Pittman CU. Biochar production and applications in soil fertility and carbon sequestration-a sustainable solution to crop-residue burning in India. *RSC Adv* 2018;8:508–20. <https://doi.org/10.1039/c7ra10353k>.
- [210] Huang Y, Yin X, Wu C, Wang C, Xie J, Zhou Z, et al. Effects of metal catalysts on CO₂ gasification reactivity of biomass char. *Biotechnol Adv* 2009;27:568–72. <https://doi.org/10.1016/j.biotechadv.2009.04.013>.
- [211] Li Y, Zhang Y, Zhang Y, Wang G, Li S, Han R, et al. Reed biochar supported hydroxyapatite nanocomposite: Characterization and reactivity for methylene blue removal from aqueous media. *J Mol Liq* 2018;263:53–63. <https://doi.org/10.1016/j.molliq.2018.04.132>.
- [212] Mir AA, Amooey AA, Ghasemi S. Adsorption of direct yellow 12 from aqueous solutions by an iron oxide-gelatin nano-adsorbent; kinetic, isotherm and mechanism analysis. *J Clean Prod* 2018;170:570–80. <https://doi.org/10.1016/j.jclepro.2017.09.101>.
- [213] Liu S, Li J, Xu S, Wang M, Zhang Y, Xue X. A modified method for enhancing adsorption capability of banana pseudostem biochar towards methylene blue at low temperature. *Bioresour Technol* 2019;282:48–55. <https://doi.org/10.1016/j.biortech.2019.02.092>.
- [214] Ye J, Cong X, Zhang P, Hoffmann E, Zeng G, Wu Y, et al. Phosphate Adsorption onto Granular-Acid-Activated-Neutralized Red Mud: Parameter Optimization, Kinetics,

- Isotherms, and Mechanism Analysis. *Water Air Soil Pollut* 2015;226. <https://doi.org/10.1007/s11270-015-2577-1>.
- [215] Saini J, Garg VK, Gupta RK. Removal of Methylene Blue from aqueous solution by Fe₃O₄@Ag/SiO₂ nanospheres: Synthesis, characterization and adsorption performance. *J Mol Liq* 2018;250:413–22. <https://doi.org/10.1016/j.molliq.2017.11.180>.
- [216] Huang T, Yan M, He K, Huang Z, Zeng G, Chen A, et al. Efficient removal of methylene blue from aqueous solutions using magnetic graphene oxide modified zeolite. *J Colloid Interface Sci* 2019;543:43–51. <https://doi.org/10.1016/j.jcis.2019.02.030>.
- [217] Wanassi B, Hariz I Ben, Ghimbeu CM, Vaultot C, Hassen M Ben, Jeguirim M, et al. Valorisation of waste rice straw for the production of highly effective carbon based adsorbents for dyes removal. *Bioresour Technol* 2018;220:568–72. <https://doi.org/10.1016/j.molliq.2019.04.035>.
- [218] Wang H, Xie R, Zhang J, Zhao J. Preparation and characterization of distillers' grain based activated carbon as low cost methylene blue adsorbent: Mass transfer and equilibrium modeling. *Advanced Powder Technology* 2018;29:27–35. <https://doi.org/10.1016/j.appt.2017.09.027>.
- [219] Ray SS, Gusain R, Kumar N. Adsorption equilibrium isotherms, kinetics and thermodynamics. *Carbon Nanomaterial-Based Adsorbents for Water Purification*, Elsevier; 2020, p. 101–18. <https://doi.org/10.1016/b978-0-12-821959-1.00005-2>.
- [220] Wanassi B, Hariz I Ben, Ghimbeu CM, Vaultot C, Hassen M Ben, Jeguirim M, et al. Valorisation of waste rice straw for the production of highly effective carbon based adsorbents for dyes removal. *Bioresour Technol* 2018;220:568–72. <https://doi.org/10.1016/j.molliq.2019.04.035>.
- [221] Prajapati AK, Mondal MK. Hazardous As (III) removal using nanoporous activated carbon of waste garlic stem as adsorbent: Kinetic and mass transfer mechanisms. *Korean Journal of Chemical Engineering* 2019;36:1900–14. <https://doi.org/10.1007/s11814-019-0376-x>.
- [222] Vargas AMM, Cazetta AL, Kunita MH, Silva TL, Almeida VC. Adsorption of methylene blue on activated carbon produced from flamboyant pods (*Delonix regia*): Study of adsorption isotherms and kinetic models. *Chemical Engineering Journal* 2011;168:722–30. <https://doi.org/10.1016/j.cej.2011.01.067>.
- [223] Shahryari Z, Goharrizi AS, Azadi M. Experimental study of methylene blue adsorption from aqueous solutions onto carbon nano tubes. *International Journal of Water Resources and Environmental Engineering* 2010;2:16–028.
- [224] Suwunwong T, Hussain N, Chantrapromma S, Phoungthong K. Facile synthesis of corncob biochar via in-house modified pyrolysis for removal of methylene blue in wastewater. *Mater Res Express* 2020;7:015518. <https://doi.org/10.1088/2053-1591/AB6767>.

- [225] Tran HN, You SJ, Hosseini-Bandegharaei A, Chao HP. Mistakes and inconsistencies regarding adsorption of contaminants from aqueous solutions: A critical review. *Water Res* 2017;120:88–116. <https://doi.org/10.1016/j.watres.2017.04.014>.
- [226] Fan S, Wang Y, Wang Z, Tang J, Tang J, Li X. Removal of methylene blue from aqueous solution by sewage sludge-derived biochar: Adsorption kinetics, equilibrium, thermodynamics and mechanism. *J Environ Chem Eng* 2017;5:601–11. <https://doi.org/10.1016/j.jece.2016.12.019>.

Publications

- ❖ **Ravi Saini**, Pradeep Kumar. Green Synthesis of TiO₂ Nanoparticles Using *Tinospora Cordifolia* Plant Extract & its Potential Application for Photocatalysis and Antibacterial Activity. **Inorganic Chemistry Communications** 2023, 156, 111221. <https://doi.org/10.1016/j.inoche.2023.111221> (**I.F- 3.8**)
- ❖ **Ravi Saini**, Ranjeet Kumar Mishra, Pradeep Kumar. Green synthesis of reduced graphene oxide using *Tinospora cordifolia* plant extract: Exploring its potential for methylene blue dye degradation and antibacterial activity. **ACS Omega** 2024, 9, 18, 20304–20321 <https://doi.org/10.1021/acsomega.4c00748> (**I.F- 4.1**)
- ❖ **Ravi Saini**, Manish Pandey, Ranjeet Kumar Mishra, Pradeep Kumar. Adsorption potential of hydrochar derived from hydrothermal carbonization of Sunflower stalks towards the removal of methylene blue dye from wastewater. **Biomass Conversion and Biorefinery** 2024, 1-21 <https://doi.org/10.1007/s13399-024-05743-7> (**I.F- 4.0**)
- ❖ Ranjeet Kumar Mishra, **Ravi Saini**, D. Jaya Prasanna Kumar, Ravi Sankannavar, Prakash Binnal, Naveen Dwivedi, Pradeep Kumar. Thermo-catalytic pyrolysis of *Azadirachta indica* seeds over CaO and CuO: Pyrolysis kinetics, impact of catalysts on yield, fuel properties, and its chemical compositions. **Journal of the Energy Institute** 2023, 111, 101366. <https://doi.org/10.1016/j.joei.2023.101366> (**I.F- 5.7**)

Conferences and Workshops

- ❖ **Ravi Saini**, Pradeep Kumar. 2021. Green synthesis of reduced graphene oxide by using *Azolla Pinnata* plant extract, International Conference on Recent Trends in Energy Science and Engineering (ICRTESE), Rajiv Gandhi Institute of Petroleum Technology (RGIPT), Jais, Amethi, India, October 26-28, 2021.
- ❖ **Ravi Saini**, Pradeep Kumar. 2022. Facile Green Synthesis of TiO₂ using *Tinospora Cordifolia* Extract as Photocatalyst for Degradation of Acid Blue 113 Dye, International Conference on Nanotechnology: Opportunities & Challenges (ICNOC), Jamia Millia Islamia, New Delhi, India, November 28-30, 2022.
- ❖ **Ravi Saini**, Pradeep Kumar. 2023. Green synthesis of TiO₂ using *Tinospora cordifolia* extract as photocatalyst for degradation of acid blue 113 dye, ChEmference, BITS PILANI, Goa, India, September 30th-October 2nd, 2023.
- ❖ Ravi Saini. 2020. Online workshop on MATLAB Applications in Process Simulation and Control, Sri Venkateshwara College of Engineering, Sriperumbudur Tk., Tamil Nadu, India, May 23-24, 2020.
- ❖ Ravi Saini. 2021. International virtual workshop 'Bioelectronic Medicine', IIT(BHU), Varanasi, India, and IISc Bangalore, India and co-hosted by the Henry Royce Institute, The University of Manchester, UK, December 16, 2021.