

DAFTAR PUSTAKA

- Acosta, R., Fierro, V., Martinez de Yuso, A., Nabarlantz, D., and Celzard, A., 2016, Tetracycline Adsorption onto Activated Carbons Produced by KOH Activation of Tyre Pyrolysis Char, *Chemosphere*, 149, 168–176.
- Aliyu, M., Abdullah, A.H., and Tahir, M.I. bin M., 2022, Adsorption Tetracycline from Aqueous Solution Using A Novel Polymeric Adsorbent Derived from the Rubber Waste, *J. Taiwan Inst. Chem. Eng.*, 136, 1–11.
- Almeida-Naranjo, C.E., Tejedor, J., Villamar-Ayala, C.A., and Vizuite, G., 2025, Transforming Waste into Solutions: Raw and Modified Bioadsorbents for Emerging Contaminant Removal, *J. Environ. Chem. Eng.*, 13, 1–28.
- Al-Zboon, K., Al-Harashsheh, M.S., and Hani, F.B., 2011, Fly Ash-Based Geopolymer for Pb Removal from Aqueous Solution, *J. Hazard. Mater.*, 188, 414–421.
- Amrillah, N.A.Z., Rahayu, A., Dhias Cahya Hakika, Vivi Sisca, Veranica, Firda Mahira Alfia Chusna, Lia Anggresani, and Lee Wah Lim, 2025, Isothermic Adsorption Study of Nitrate Ion Adsorption in Bioethanol Waste Using Quaternary Ammonium Polymer, *Sains Nat. J. Biol. Chem.*, 15, 01–09.
- Anggraini, N., Agustina, T.E., and Hadiah, F., 2022, Pengaruh pH dalam Pengolahan Air Limbah Laboratorium Dengan Metode Adsorpsi untuk Penurunan Kadar Logam Berat Pb, Cu, dan Cd, *J. Ilmu Lingkungan*, 20, 345–355.
- Bouaziz, F., Koubaa, M., Kallel, F., Chaari, F., Driss, D., Ghorbel, R.E., and Chaabouni, S.E., 2015, Efficiency of Almond Gum as A Low-Cost Adsorbent for Methylene Blue Dye Removal from Aqueous Solutions, *Ind. Crops Prod.*, 74, 903–911.
- Chang, P.H., Li, Z., Jiang, W.T., Kuo, C.Y., and Jean, J.S., 2015, Adsorption of Tetracycline on Montmorillonite: Influence of Solution pH, Temperature, and Ionic Strength, *Desalin. Water Treat.*, 55, 1380–1392.
- Das, B., Mondal, N.K., Bhaumik, R., and Roy, P., 2014, Insight into Adsorption Equilibrium, Kinetics and Thermodynamics of Lead onto Alluvial Soil, *Int. J. Environ. Sci. Technol.*, 11, 1101–1114.
- Drumm, F.C., Franco, D.S.P., Grassi, P., Georgin, J., Foletto, E.L., Dotto, G.L., and Jahn, S.L., 2022, Effective Adsorptive Removal of Textile Pollutant Using Coal Bottom Ash with High Surface Area Obtained by Alkaline Fusion Route, *Environ. Technol.*, 43, 2418–2429.
- Drumm, F.C., Grassi, P., Sulkowski, A.A., Franco, D.S.P., Georgin, J., Dotto, G.L., Foletto, E.L., and Jahn, S.L., 2019, Applicability of Coal Bottom Ash from Thermoelectric Power Plant as an Alternative Heterogeneous Catalyst in Photo-Fenton Reaction, *Water Air Soil Pollut.*, 230, 1–12.

- Fan, X., Peng, L., Wang, X., Han, S., Yang, L., Wang, H., and Hao, C., 2022, Efficient Capture of Lead Ion and Methylene Blue by Functionalized Biomass Carbon-Based Adsorbent for Wastewater Treatment, *Ind. Crops Prod.*, 183, 1–12.
- Fernández-Jiménez, A., Palomo, A., and Criado, M., 2006, Alkali Activated Fly Ash Binders: A Comparative Study Between Sodium and Potassium Activators, *Mater. Construcc.*, 56, 51–65.
- Gopal, G., Alex, S.A., Chandrasekaran, N., and Mukherjee, A., 2020, A Review on Tetracycline Removal from Aqueous Systems by Advanced Treatment Techniques, *RSC Adv.*, 10, 27081–27095.
- Hamada, H., Alattar, A., Tayeh, B., Yahaya, F., and Adesina, A., 2022, Sustainable Application of Coal Bottom ash as Fine Aggregates in Concrete: A Comprehensive Review, *Case Stud. Constr. Mater.*, 16, 1–17.
- Hanh, P.T.H., Phoungthong, K., Chantrapromma, S., Choto, P., Thanomsilp, C., Siriwat, P., Wisittipanit, N., and Suwunwong, T., 2023, Adsorption of Tetracycline by Magnetic Mesoporous Silica Derived from Bottom Ash—Biomass Power Plant, *Sustainability*, 15, 1–13.
- Hansen, S.I., Sjølin, B.H., Castelli, I.E., Vegge, T., Jensen, A.D., and Christensen, J.M., 2025, An Adsorption Isotherm That Includes the Interactions between Adsorbates, *J. Phys. Chem.*, 129, 5393–5407.
- Haryanto, B., Sinaga, W.K., and Saragih, F.T., 2019, Kajian Model Interaksi pada Adsorpsi Logam Berat Kadmium (Cd^{2+}) dengan Menggunakan Adsorben dari Pasir Hitam, *J. Teknik Kimia USU*, 8, 79–84.
- He, J., Ma, P., Xie, A., Gao, L., Zhou, Z., Yan, Y., Dai, J., and Li, C., 2016, From Black Liquor to Highly Porous Carbon Adsorbents with Tunable Microstructure and Excellent Adsorption of Tetracycline From Water: Performance and Mechanism Study, *J. Taiwan Inst. Chem. Eng.*, 63, 295–302.
- Houghton, E.E., Yapi, L., Haneklaus, N., Brink, H.G., and Tichapondwa, S.M., 2025, Coal Fly Ash-Based Adsorbents for Tetracycline Removal: Comparative Insights into Modification and Zeolite Conversion, *J. Xenobiot.*, 15, 1–18.
- Houghton, E.E., Yapi, L., and Tichapondwa, S.M., 2025, Adsorption of Tetracycline Using Silica Nanoparticles: a Comparative Study of Sodium Silicate-Derived and Fly Ash-Derived Silica Nanoparticles, *Results Eng.*, 27, 1–9.
- Jadoun, S., Fuentes, J.P., Urbano, B.F., and Yáñez, J., 2023, A Review on Adsorption of Heavy Metals from Wastewater Using Conducting Polymer-Based Materials, *J. Environ. Chem. Eng.*, 11, 1–13.
- Kang, J., Liu, H., Zheng, Y.M., Qu, J., and Chen, J.P., 2011, Application of Nuclear Magnetic Resonance Spectroscopy, Fourier Transform Infrared Spectroscopy, UV-Visible Spectroscopy and Kinetic Modeling for Elucidation of Adsorption

- Chemistry in Uptake of Tetracycline by Zeolite Beta, *J. Colloid Interface Sci.*, 354, 261–267.
- Kantasamy, N. and Sumari, S.M., 2016, Equilibrium and Thermodynamic Studies of Anionic Dyes Removal By an Anionic Clay-Layered Double Hydroxide, *Malays. J. Anal. Sci.*, 20, 358–364.
- Khanday, W.A. and Hameed, B.H., 2018, Zeolite-Hydroxyapatite-Activated Oil Palm Ash Composite for Antibiotic Tetracycline Adsorption, *Fuel*, 215, 499–505.
- Kim, H.K. and Lee, H.K., 2015, Coal Bottom Ash in Field of Civil Engineering: A Review of Advanced Applications and Environmental Considerations, *KSCE J. Civ. Eng.*, 19, 1802–1818.
- Kuenzel, C. and Ranjbar, N., 2019, Dissolution Mechanism of Fly Ash to Quantify the Reactive Aluminosilicates in Geopolymerisation, *Resour. Conserv. Recycl.*, 150, 1–10.
- Kurtulus, C. and Luukkonen, T., 2025, Adsorption Properties of Alkali-Activated Stone Wool, *Ceram. Int.*, 51, 1534–1545.
- Kusumaningrum, D., Sudarni, D., and Wahyuningsih, S., 2022, Optimasi Pengaruh Waktu Kontak dan Dosis Adsorben Limbah Daun Kayu Putih (*Melaleuca cajuputi*) dengan Metode Isoterm Adsorpsi Langmuir, *J. Teknik Kimia USU*, 11, 72–79.
- Kyzas, G.Z. and Deliyanni, E.A., 2015, Modified Activated Carbons from Potato Peels as Green Environmental-Friendly Adsorbents for The Treatment of Pharmaceutical Effluents, *Chem. Eng. Res. Des.*, 97, 135–144.
- Lai, Q.T. and Ahn, J.W., 2026, Mechanistic Elucidation and Optimization of Alkali Activation for Si–Al Recovery from Coal Fly Ash, *ACS Omega*, 11, 41543–41553.
- Li, M., Su, Q., Liu, J., Yang, C., Yang, Q., Liu, L., and Shi, C., 2025, Effect of Precursor Compositions on The Pb(II) Adsorption of Slag-Based Geopolymer Microspheres, *Constr. Build. Mater.*, 495, 1–15.
- Liu, W., Cheng, X., Jiang, Y., Fan, M., Zhang, S., Wang, S., and Hu, X., 2026, Activation of Cellulose and Peach Wood Impregnated with Lignin Dissolved in Formic Acid: Influence of Evolution of Mass Yield and Pore Structure of AC, *J. Taiwan Inst. Chem. Eng.*, 187, 1–16.
- Liu, X., Tang, Y., Wang, X., Sarwar, M.T., Zhao, X., Liao, J., Zhang, J., and Yang, H., 2024, Efficient Adsorbent Derived from Phytolith-Rich Ore for Removal of Tetracycline in Wastewater, *ACS Omega*, 9, 8287–8296.
- Liu, Y., Peng, X., Hu, Z., Yu, M., Fu, J., and Huang, Y., 2021, Fabrication of A Novel Nitrogen-Containing Porous Carbon Adsorbent for Protein-Bound Uremic Toxins Removal, *Mater. Sci. Eng. C*, 121, 1–13.

- Luna, Y., Arenas, C.G., Cornejo, A., Leiva, C., Vilches, L.F., and Fernández-Pereira, C., 2014, Recycling by-Products From Coal-Fired Power Stations Into Different Construction Materials, *Int. J. Energi Environ. Eng.*, 5, 387–397.
- Malakootian, M. and Shiri, M.A., 2021, Investigating the Removal of Tetracycline Antibiotic from Aqueous Solution Using Synthesized Fe₃O₄ @cuttlebone Magnetic Nanocomposite, *Desalin. Water Treat.*, 221, 343–358.
- Mishra, S., Prasad, A.K., Vinod, A., Shukla, A., Mukherjee, S., Purkait, B., Varma, A.K., and Sarkar, B.C., 2025, A Multi-Model Approach for Estimation of Ash Yield in Coal Using Fourier Transform Infrared Spectroscopy, *Sci. Rep.*, 15, 1–18.
- Mohammed, S.A., Koting, S., Katman, H.Y.B., Babalghaith, A.M., Patah, M.F.A., Ibrahim, M.R., and Karim, M.R., 2021, A Review of the Utilization of Coal Bottom Ash (CBA) in the Construction Industry, *Sustainability*, 13, 1–16.
- Muhib, R., Supriyadi, N., and Pranoto, K., 2022, Pemanfaatan Fly Ash Dan Bottom Ash (FABA) Sebagai Penudung Material Potential Acid Forming (PAF) –Hal – Hal Yang Mempengaruhi Pembacaan Kadar Oksigen, *Indones. Min. Prof. J.*, 4, 1–10.
- Nasiri, A., Rajabi, S., Amiri, A., Fattahizade, M., Hasani, O., Lalehzari, A., and Hashemi, M., 2022, Adsorption of Tetracycline Using CuCoFe₂O₄@Chitosan as A New and Green Magnetic Nanohybrid Adsorbent from Aqueous solutions: Isotherm, Kinetic and Thermodynamic Study, *Arab. J. Chem.*, 15, 1–22.
- Ortiz-Ramos, U., Leyva-Ramos, R., Mendoza-Mendoza, E., and Aragón-Piña, A., 2022, Removal of Tetracycline From Aqueous Solutions by Adsorption on Raw Ca-Bentonite. Effect of Operating Conditions and Adsorption Mechanism, *Chem. Eng. J.*, 432, 1–13.
- Parolo, M.E., Avena, M.J., Pettinari, G.R., and Baschini, M.T., 2012, Influence of Ca 2+ on Tetracycline Adsorption on Montmorillonite, *J. Colloid Interface Sci.*, 368, 420–426.
- Parolo, M.E., Savini, M.C., Vallés, J.M., Baschini, M.T., and Avena, M.J., 2008, Tetracycline Adsorption on Montmorillonite: pH and Ionic Strength Effects, *Appl. Clay Sci.*, 40, 179–186.
- Pearson, J.C., Gillett, E., Gadri, N.D., and Dionne, B., 2025, Tetracyclines, the Old and the New: A Narrative Review, *CMI Commun.*, 2, 1–11.
- Peng, Z., Vance, K., Dakhane, A., Marzke, R., and Neithalath, N., 2015, Microstructural and 29Si MAS NMR Spectroscopic Evaluations of Alkali Cationic Effects on Fly Ash Activation, *Cem. Concr. Compos.*, 57, 34–43.
- Pulicharla, R., Hegde, K., Brar, S.K., and Surampalli, R.Y., 2017, Tetracyclines Metal Complexation: Significance and Fate of Mutual Existence in the Environment, *Environ. Pollut.*, 221, 1–14.

- Putri, A.S., Suratman, A., and Mudasir, M., 2026, Dithizone-Modified Magnetic Core-Shell of Fe₃O₄@SiO₂ Derived from Beach Iron Sand and Volcanic Ash and Its Application as Cu(II) Adsorbent, *Case Stud. Chem. Environ. Eng.*, 13, 1–19.
- Raj, P., Patel, M., and Karamalidis, A.K., 2023, Functionalization of Cellulose Adsorbents with Catechol Derivatives for the Effective Separation and Recovery of Gallium from Acidic Solutions, *Sep. Purif. Technol.*, 323, 1–12.
- Ramachandran, R. and Schaefer, B., 2021, Tetracycline Antibiotics, *ChemTexts*, 18, 1–42.
- Rashidi, N.A. and Yusup, S., 2016, Overview on the Potential of Coal-Based Bottom Ash as Low-Cost Adsorbents, *ACS Sustain. Chem. Eng.*, 4, 1870–1884.
- Revellame, E.D., Fortela, D.L., Sharp, W., Hernandez, R., and Zappi, M.E., 2020, Adsorption Kinetic Modeling Using Pseudo-First Order and Pseudo-Second Order Rate Laws: A Review, *Clean. Eng. Technol.*, 1, 1–13.
- Ríos R., C.A., Williams, C.D., and Roberts, C.L., 2009, A Comparative Study of Two Methods for the Synthesis of Fly Ash-Based Sodium and Potassium Type Zeolites, *Fuel*, 88, 1403–1416.
- Santa, A.B.R.A., Soares, C., and Riella, H.G., 2017, Geopolymers Obtained from Bottom Ash as Source of Aluminosilicate Cured at Room Temperature, *Constr. Build. Mater.*, 157, 459–466.
- Saremi, F., Miroliaei, M.R., Shahabi Nejad, M., and Sheibani, H., 2020, Adsorption of Tetracycline Antibiotic from Aqueous Solutions onto Vitamin B6-Upgraded Biochar Derived from Date Palm Leaves, *J. Mol. Liq.*, 318, 1–11.
- Scaria, J., Anupama, K. V., and Nidheesh, P. V., 2021, Tetracyclines in the Environment: An Overview on the Occurrence, Fate, Toxicity, Detection, Removal Methods, and Sludge Management, *Sci. Total Environ.*, 771, 1–23.
- Seraj, S., Mirzayi, B., and Nematollahzadeh, A., 2018, Engineered Maghemite Nanoparticles with Polyrhodanine for Efficient Removal of Cr(VI) from Water, *Environ. Nanotechnol. Monit. Manag.*, 10, 94–103.
- Shahbaz, M., Yusup, S., Al-Ansari, T., Inayat, A., Inayat, M., Zeb, H., and Alnarabiji, M.S., 2019, Characterization and Reactivity Study of Coal Bottom Ash for Utilization in Biomass Gasification as an Adsorbent/Catalyst for Cleaner Fuel Production, *Energy and Fuels*, 33, 11318–11327.
- Singh, M. and Siddique, R., 2013, Effect of Coal Bottom Ash as Partial Replacement of Sand on Properties of Concrete, *Resour. Conserv. Recycl.*, 72, 20–32.
- Smarzewski, P., 2025, Microstructure and Mechanical Properties of Sustainable Concrete Incorporating Used Foundry Sand and Coal Bottom Ash, *Sustainability*, 17, 1–26.

- Sun, Y., Dai, Y., Wang, X., and Shan, D., 2022, Rapid Adsorption of Tetracycline from Aqueous Solution on Fly Ash, *Desalin. Water Treat.*, 248, 226–236.
- Thi, H.P.N., Vuong, T.T., Cao, P.A., Nguyen Thi, H.P., and La, D.D., 2026, Hierarchically Porous Carbon from Coffee Husk: Pore Development and Antibiotic Adsorption Behavior, *Desalin. Water Treat.*, 326, 1–11.
- To, M.D., Nguyen, T.N.K., Dao, T.A., Doan, T.L.H., Pham, M.T., Lee, W.J., Nguyen, T.H., Le, V.H., and Huynh, L.T.N., 2025, Tunnel-Phase α -, β -, and γ -MnO₂ for Salt Removal in Hybrid Capacitive Deionization, *Desalination*, 605, 1–13.
- Wardhana, B.S., Hanum, F.F., Mufrodi, Z., Febriani, A.V., and Salamah, S., 2025, Comparison of Activation Methods for Coal Ash as an Adsorbent in the Removal of Lead (Pb²⁺) from Aqueous Solution, *J. Kim. Sains Apl.*, 28, 452–462.
- Wijaya, D.P., Bonaventura, R., Munandar, N., Hutagalung, F., and Anwar, C., 2025, Adsorption-Desorption of Cd(II) and Mg(II) Ions by Dithizone-Immobilized Coal Bottom Ash, *Indones. J. Chem. Stud.*, 4, 92–100.
- Wu, F.C., Wu, P.H., Tseng, R.L., and Juang, R.S., 2010, Preparation of Activated Carbons from Unburnt Coal in Bottom Ash with KOH Activation for Liquid-Phase Adsorption, *J. Environ. Manage.*, 91, 1097–1102.
- Xu, L., Zhang, H., Xiong, P., Zhu, Q., Liao, C., and Jiang, G., 2021, Occurrence, Fate, and Risk Assessment of Typical Tetracycline Antibiotics in the Aquatic Environment: A Review, *Sci. Total Environ.*, 753, 1–17.
- Yang, J., Han, L., Yang, W., Liu, Q., Fei, Z., Chen, X., Zhang, Z., Tang, J., Cui, M., and Qiao, X., 2022, In Situ Synthetic Hierarchical Porous MIL-53(Cr) as an Efficient Adsorbent for Mesopores-Controlled Adsorption of Tetracycline, *Microporous and Mesoporous Mater.*, 332, 1–10.
- Yin, C.Y., Aroua, M.K., and Daud, W.M.A.W., 2007, Review of Modifications of Activated Carbon for Enhancing Contaminant Uptakes from Aqueous Solutions, *Sep. Purif. Technol.*, 52, 403–415.
- Yuliani, H., Tri, H., Abiagel, T., Isma, A.N.P.Z., Ida, A.I., and Musfirah, A.A., 2021, Model Keseimbangan Adsorpsi Methylene Blue Menggunakan Karbon Tempurung Kluwak, *SNP2M*, 116–120.
- Zang, J., Wu, T., Song, H., Zhou, N., Fan, S., Xie, Z., and Tang, J., 2019, Removal of Tetracycline by Hydrous Ferric Oxide: Adsorption Kinetics, Isotherms, and Mechanism, *Int. J. Environ. Res. Public Health*, 16, 1–13.
- Zhang, Y., Li, Y., Wang, M., Chen, B., Sun, Y., Chen, K., and Du, Q., 2022, Adsorption Capacity of Tetracycline in Solution by Cu-BTC@Carboxyl-Functionalized Carbon Nanotubes@Copper Alginate Composite Aerogel Beads, *Coatings*, 12, 1–20.



- Zhao, Y., Geng, J., Wang, X., Gu, X., and Gao, S., 2011, Tetracycline Adsorption on Kaolinite: pH, Metal Cations and Humic Acid Effects, *Ecotoxicology*, 20, 1141–1147.
- Zou, Y., Song, Q., Zhang, P., Xu, S., Bao, J., Xue, S., Qin, L., Wang, H., Lin, L., and Liu, C., 2024, Research Status of Building Materials Utilization and CO₂ Curing Technology on Typical Coal-Based Solid Waste: A Critical Review, *J. CO₂ Util.*, 84, 1–17.