

DAFTAR PUSTAKA

- Abbou, B., Lebkiri, I., Ouaddari, H., Elkhatabi, O., Habsaoui, A., Lebkiri, A., dan Rifi, E.H., 2021, Kinetic and Thermodynamic Study on Adsorption of Cadmium from Aqueous Solutions Using Natural Clay, *J. Turk. Chem. Soc. Sect. A*, 8(2), 677-692.
- Abdullah, N., Yusof, N., Lau, W.J., Jaafar, J., dan Ismail, A.F., 2019, Recent Trends of Heavy Metal Removal from Water/Wastewater by Membrane Technologies, *J. Ind. Eng. Chem.*, 76, 17-38.
- Ahmaruzzaman, M., 2010, A Review on the Utilization of Fly Ash, *Prog. Energy Combust. Sci.*, 36(3), 327-363.
- Ahn, C.K., Park, D., Woo, S.H., dan Park, J.M., 2009, Removal of Cationic Heavy Metal from Aqueous Solution by Activated Carbon Impregnated with Anionic Surfactants, *J. Hazard. Mater.*, 164(2-3), 1130-1136.
- Aigbe, U.O., Ukhurebor, K.E., Onyancha, R.B., Osibote, O.A., Darmokoesoemo, H., dan Kusuma, H.S., 2021, Fly Ash-Based Adsorbent for Adsorption of Heavy Metals and Dyes from Aqueous Solution: A Review, *J. Mater. Res. Technol.*, 14, 2751-2774.
- Ali, W., Bian, Y., Zhang, H., Qazi, I.H., Zou, H., Zhu, J., dan Liu, Z., 2023, Effect of Cadmium Exposure during and After Pregnancy of Female, *Environ. Pollut. Bioavailability*, 35(1), 2181124.
- Anwar, J., Shafique, U., Zaman, W.U., Salman, M., Dar, A., dan Anwar, S., 2009, Removal of Pb(II) and Cd(II) from Water by Adsorption on Peels of Banana, *Bioresour. Technol.*, 101(6), 1752-1755.
- Atkin, R., Craig, V.S.J., Wanless, E.J., dan Biggs, S., 2003, Mechanism of Cationic Surfactant Adsorption at the Solid-Aqueous Interface, *Adv. Colloid Interface Sci.*, 103(3), 219-304.
- Atmaja, A.T., 2019, Adsorpsi Zat Warna Metil Violet pada Abu Layang Batubara Teraktivasi HCl dan HNO₃, *Skripsi*, Departemen Kimia Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Gadjah Mada, Yogyakarta.
- Azizian, S., Haerifar, M., dan Basiri-Parsa, J., 2007, Extended Geometric Method: A Simple Approach to Derive Adsorption Rate Constants of Langmuir-Freundlich Kinetics, *Chemosphere*, 68(11), 2040-2046.
- Babel, S. dan Kurniawan, T.A., 2003, Low-Cost Adsorbents for Heavy Metals Uptake from Contaminated Water: A Review, *J. Hazard. Mater.*, 97(1-3), 219-243.
- Baja, M.M., 2023, Adsorption Capacity of Cadmium (Cd) from Wastewater Using Corn Cob, *Skripsi*, Faculty of Applied Sciences, Universiti Teknologi MARA, Malaysia.
- Barido, J., Badong, V., dan Zabala, G., 2026, Biosorption of cadmium(II) ions from wastewater using carabao grass (*Paspalum conjugatum*): Morphological char-

- racterization and adsorption kinetic studies, *Asian J. Chem.*, 38(4), 895-900.
- Bitting, D. dan Harwell, J.H., 1987, Effects of Counterions on Surfactant Surface Aggregates at the Alumina/Aqueous Solution Interface, *Langmuir*, 3(4), 500-511.
- Caporale, A.G. dan Violante, A., 2016, Chemical Processes Affecting the Mobility of Heavy Metals and Metalloids in Soil Environments, *Curr. Pollut. Rep.*, 2(1), 15-27.
- Chen, X. dan He, L., 2017, Microwave Irradiation Assisted Preparation of Chitosan Composite Microsphere for Dye Adsorption, *Int. J. Polym. Sci.*, 1, 1-8.
- Chinh, N.T., Mai, T.T., Trang, N.T.T., Huong, N.T.T., dan Hoang, T., 2017, Using Fly Ash Treated by NaOH and H₂SO₄ Solutions for Hg²⁺ and Cd²⁺ Ion Adsorption, *Vietnam J. Chem.*, 55(2), 196-201.
- Cimino, G., Passerini, A., dan Toscano, G., 2000, Removal of Toxic Cations and Cr(VI) from Aqueous Solution by Hazelnut Shell, *Water Res.*, 34(11), 2955-2962.
- Constantin, M.A., Constantin, L.A., Constantinov, F.D., Badescu, V.R., Nicolescu, C.M., dan Bumbac, M., 2025, Fly Ash Waste Conversion to Zeolite and Its Application for Cd²⁺ and Ni²⁺ Adsorption from Aqueous Solutions, *Water*, 17(4), 593.
- Crini, G. dan Lichtfouse, E., 2019, Advantages and Disadvantages of Techniques Used for Wastewater Treatment, *Environ. Chem. Lett.*, 17(1), 145-155.
- Darmawan, E., 2023, Preparasi Komposit Fe₃O₄/Kitosan/Abu Layang Batubara-CeO₂ sebagai Adsorben untuk Adsorpsi Larutan Kongo Merah, *Skripsi*, Departemen Kimia Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Gadjah Mada, Yogyakarta.
- Ding, H., Li, Y., Zhao, H., dan Sang, M., 2025, Adsorption Characteristics of Pb²⁺ onto Porous Steel Slag-Based Geopolymer Block, *Arabian J. Chem.*, 18(4), 105421.
- Dwivedi, D.K., Sharma, B., Bochar, R., dan Dwivedi, M.K., 2025, Coal Fly Ash as an Adsorbent for Crystal Violet Removal from Wastewater, *Total Environ. Eng.*, 5, 100045.
- Eastoe, J. dan Tabor, R.F., 2014, Surfactants and Nanoscience, dalam Berti, D. dan Palazzo, G. (ed.), *Colloidal Foundations of Nanoscience*, JAI-Elsevier Science Inc, Amsterdam, 135-157.
- El-Naggar, A., Shaheen, S.M., Ok, Y.S., dan Rinklebe, J., 2018, Biochar Affects the Dissolved and Colloidal Concentrations of Cd, Cu, Ni, and Zn and Their Phytoavailability and Potential Mobility in a Mining Soil Under Dynamic Redox-Conditions, *Sci. Total Environ.*, 624, 1059-1071.
- Estiaty, L.M., 2013, Kesetimbangan dan Kinetika Adsorpsi Ion Cu²⁺ pada Zeolit-H, *Ris. Geol. Pertamb.*, 22(2), 127-141.

- Fainerman, V.B., Lylyk, S.V., Aksenenko, E.V., Kovalchuk, N.M., Kovalchuk, V.I., Petkov, J.T., dan Miller, R., 2012, Effect of Water Hardness on Surface Tension and Dilational Visco-Elasticity of Sodium Dodecyl Sulphate Solutions, *J. Colloid Interface Sci.*, 377(1), 1-6.
- Fan, A., Somasundaran, P., dan Turro, N.J., 1997, Adsorption of Alkyltrimethylammonium Bromides on Negatively Charged Alumina, *Langmuir*, 13(3), 506-510.
- Fraïha, O., Hadoudi, N., Zaki, N., Salhi, A., Amhamdi, H., Akichouh, E.H., Mourabit, F., dan Ahari, M., 2024, Comprehensive Review on the Adsorption of Pharmaceutical Products from Wastewater by Clay Materials, *Desalin. Water Treat.*, 317, 100114.
- Fu, F. dan Wang, Q., 2011, Removal of Heavy Metal Ions from Wastewaters: A Review, *J. Environ. Manage.*, 92(3), 407-418.
- Guo, X., Zhao, Z., Gao, X., Dong, Y., Fu, H., dan Zhang, X., 2024, Study on the Adsorption Performance of Modified High Silica Fly Ash for Methylene Blue, *RSC Adv.*, 14(30), 21342-21354.
- Gupta, G., Khan, J., dan Singh, N.K., 2021, Application and Efficacy of Low-Cost Adsorbents for Metal Removal from Contaminated Water: A Review, *Mater. Today: Proc.*, 43(5), 2958-2964.
- Guzmán-Carrillo, H.R., Pérez, J.M., dan Romero, M., 2018, Coal Fly Ash and Steel Slag Valorisation Throughout a Vitrification Process, *Int. J. Environ. Sci. Technol.*, 15, 1757-1766.
- Hamoudi, S.A., Nouri, L., Khelifa, N., Hemidouche, S., Khelifi, A., Boudjemaa, A., dan Bachari, K., 2025, Adsorption of Cd²⁺ from Aqueous Solution onto Composites Based on Powdered Activated Carbon and Maghnia Clay Adsorbents: Experimental Design, Kinetic, Equilibrium and Thermodynamic Study, *Int. J. Environ. Anal. Chem.*, 105(3), 581-600.
- Hankins, N.P., O'Have, J.H., dan Harwell, J.H., 1996, Modeling Effects of pH And Counterions on Surfactant Adsorption at the Oxide/Water Interface, *Ind. Eng. Chem. Res.*, 35(9), 2844-2855.
- Hao, J.N. dan Yan, B., 2015, A Water-Stable Lanthanide-Functionalized MOF as a Highly Selective and Sensitive Fluorescent Probe for Cd²⁺, *Chem. Commun.*, 51(36), 7737-7740.
- Harwell, J.H., Hoskins, J.C., Schechter, R.S., dan Wade, W.H., 1985, Pseudophase Separation Model for Surfactant Adsorption: Isomerically Pure Surfactants, *Langmuir*, 1(2), 251-262.
- Ho, Y.S. dan McKay, G., 1999, Pseudo-Second Order Model for Sorption Processes, *Process Biochem.*, 34(5), 451-465.
- Ismail, K.N., Hussin, K., dan Idris, M.S., 2007, Physical, Chemical, and Mineralogical Properties of Fly Ash, *J. Nucl. Relat. Technol.*, 4, 47-51.

- Iwuozor, K.O., Ighalo, J.O., Emenike, E.C., Ogunfowora, L.A., dan Igwegbe, C.A., 2021, Adsorption of Methyl Orange: A Review on Adsorbent Performance, *Curr. Res. Green Sustainable Chem.*, 4, 100179.
- Jiang, J., Miao, Y., Ran, Q., Li, Y., Li, Y., Tao, Z., dan Lu, Z., 2025, Highly Activated Pozzolanic Materials to Develop Sustainable Concrete: A New Perspective from Photoexcited Nano-TiO₂, *Cem. Concr. Compos.*, 162, 106149.
- Kalam, S., Abu-Khamsin, S.A., Kamal, M.S., dan Patil, S., 2021, Surfactant Adsorption Isotherms: A Review, *ACS Omega*, 6(48), 32342-32348.
- Kansara, N., Bhati, L., Narang, M., dan Vaishnavi, R., 2016, Wastewater Treatment by Ion Exchange Method: A Review of Past and Recent Researches, *Environ. Sci.: Indian J.*, 12(4), 143-150.
- Kou, B., Yuan, Y., Zhu, X., Ke, Y., Wang, H., Yu, T., dan Tan, W., 2024, Effect of Soil Organic Matter-Mediated Electron Transfer on Heavy Metal Remediation: Current Status and Perspectives, *Sci. Total Environ.*, 917, 170451.
- Krasnyi, B.L., Ikonnikov, K.I., Lemeshev, D.O., dan Sizova, A.S., 2021, Fly Ash as Technogenic Raw Material for Producing Refractory and Insulating Ceramic Materials (Review), *Glass Ceram.*, 78(1-2), 48-56.
- Kumar, S., Mucsi, G., Kristály, F., dan Pekker, P., 2017, Mechanical Activation of Fly Ash and Its Influence on Micro and Nano-Structural Behaviour of Resulting Geopolymers, *Adv. Powder Technol.*, 28(3), 805-813.
- Lagergren, S., 1898, Zur Theorie der sogenannten Adsorption gelöster Stoffe, *K. Sven. Vetenskapsakad. Handl.*, 24(4), 1-39.
- Li, Y. dan Gong, X., 2021, Effects of Dissolved Organic Matter on the Bioavailability of Heavy Metals during Microbial Dissimilatory Iron Reduction: A Review, *Rev. Environ. Contam. Toxicol.*, 257, 69-92.
- Maarof, H., Daud, W., dan Aroua, M., 2017, Recent Trends in Removal and Recovery of Heavy Metals from Wastewater by Electrochemical Technologies, *Rev. Chem. Eng.*, 33(4), 359-386.
- Magdy, Y.H., Altaher, H., dan Abdelghany, E.A., 2018, Equilibrium and Kinetic Modeling for the Adsorption of Three Phenolic Compounds onto Cement Kiln Dust, *J. Mater. Environ. Sci.*, 9(2), 570-584.
- Mahajan, T., Paikaray, S., dan Mahajan, P., 2023, Applicability of the Equilibrium Adsorption Isotherms and the Statistical Tools on to Them: A Case Study for the Adsorption of Fluoride onto Mg-Fe-CO₃ LDH, *J. Phys.: Conf. Ser.*, 2603, 012056.
- Mohamed, H.S., Soliman, N.K., Abdelrheem, D.A., Ramadan, A.A., Elghandour, A.H., dan Ahmed, S.A., 2019, Adsorption of Cd²⁺ and Cr³⁺ Ions from Aqueous Solutions by Using Residue of *Padina gymnospora* Waste as Promising Low-Cost Adsorbent, *Heliyon*, 5(3), e01287.

- Mukerjee, P. dan Mysels, K.J., 1971, *Critical Micelle Concentration of Aqueous Surfactant Systems*, Vol. 36, US Government Printing Office, Washington D.C.
- Mustapha, L.S., Kolade, S.O., Durosinmi, S.O., Tan, I.S., Lau, S.Y., dan Obayomi, K.S., 2024, Anthill Clay Activated *Ocimum gratissimum* Extract for Effective Adsorption of Methylene Blue and Chromium (VI) Ion from Wastewater: Insights into the Adsorption Isotherms, Kinetics, Thermodynamics, and Mechanisms, *J. Water Process Eng.*, 67, 106286.
- Nakama, Y., 2017, Surfactants, dalam *Cosmetic Science and Technology: Theoretical Principles and Applications*, Elsevier, Amsterdam, 231-244.
- Nguyen, T.C., Tran, T.D.M., Dao, V.B., Vu, Q.T., Nguyen, T.D., dan Thai, H., 2020, Using Modified Fly Ash for Removal of Heavy Metal Ions from Aqueous Solution, *J. Chem.*, 2020, 8428473.
- Niraula, T.P., Bhattarai, A., dan Chatterjee, S.K., 2014, Sodium Dodecylsulphate: A Very Useful Surfactant for Scientific Investigations, *J. Knowl. Innov.*, 2(1), 111-113.
- Ofudje, E.A., Sodiya, E.F., Olanrele, O.S., dan Akinwunmi, F., 2023, Adsorption of Cd²⁺ onto Apatite Surface: Equilibrium, Kinetics and Thermodynamic Studies, *Heliyon*, 9(2), e12971.
- Olatunji, M.A., Salam, K.A., dan Evuti, A.M., 2024, Continuous Removal of Pb(II) and Cu(II) Ions from Synthetic Aqueous Solutions in a Fixed-Bed Packed Column with Surfactant-Modified Activated Carbon, *Sep. Sci. Technol.*, 59(4), 561-579.
- Pearson, R.G., 1963, Hard and Soft Acids and Bases, *J. Am. Chem. Soc.*, 85(22), 3533-3539.
- Prado, M.C., dan Neves, B.R.A., 2025, Self-Assembled Sodium Dodecyl Sulfate Structures on Mineral Surfaces Following Rapid Solvent Removal, *Langmuir*, 41(21), 13079-13091.
- Purbalia, W.A., 2018, Modifikasi Abu Dasar Batubara dengan Natrium Dodesil Sulfat sebagai Adsorben Ion Logam Cu²⁺, *Skripsi*, Departemen Kimia Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Gadjah Mada, Yogyakarta.
- Qasem, N.A.A., Mohammed, R.H., dan Lawal, D.U., 2021, Removal of Heavy Metal Ions from Wastewater: A Comprehensive and Critical Review, *npj Clean Water*, 4, 36.
- Rao, K.S., Mohapatra, M., Anand, S., dan Venkateswarlu, P., 2010, Review on Cadmium Removal from Aqueous Solutions, *Int. J. Eng. Sci. Technol.*, 2(7), 81-103.
- Reed, B.E. dan Matsumoto, M.R., 1993, Modeling Cadmium Adsorption by Activated Carbon Using the Langmuir and Freundlich Isotherm Expressions, *Sep. Sci. Technol.*, 28(13-14), 2179-2195.

- Sakhi, D., Elmchaouri, A., Rakhila, Y., Abouri, M., Souabi, S., Hamdani, M., dan Jada, A., 2020, Optimization of the Treatment of a Real Textile Wastewater by Coagulation-Flocculation Processes Using Central Composite Design, *Desalin. Water Treat.*, 196, 33-40.
- Saputro, S., Mahardiani, L., Masykuri, M., Yamtinah, S., Amri, A., Novitasari, C.E., Srilingi, T., dan Cinthia, C., 2026, Valorization of Coal Fly Ash into a Magnetic Fe₃O₄-Decorated Composite for Cu(II) Removal from Aqueous Systems, *Sci. Rep.*, 16(1), 12098.
- Shami, R.B., Shojaei, V., dan Khoshdast, H., 2021, Removal of Some Cationic Contaminants from Aqueous Solutions Using Sodium Dodecyl Sulfate-Modified Coal Tailings, *Iran. J. Chem. Chem. Eng.*, 40(4), 1105-1120.
- Simon, C.M., Smit, B., dan Haranczyk, M., 2016, pyIAST: Ideal Adsorbed Solution Theory (IAST) Python Package, *Comput. Phys. Commun.*, 200, 364-380.
- Solihin, K.I., Mardiana, S., Rusli, H., dan Kadja, G.T.M., 2023, Removal of Heavy Metal Ions Using Pristine and Functionalized Natural Zeolites, *Indones. J. Chem.*, 23(3), 863-880.
- Somasundaran, P., Healy, T.W., dan Fuerstenau, D.W., 1964, Surfactant Adsorption at the Solid-Liquid Interface-Dependence of Mechanism on Chain Length, *J. Phys. Chem.*, 68(12), 3562-3566.
- Stoeppler, M., 1992, Cadmium, dalam *Techniques and Instrumentation in Analytical Chemistry*, Vol. 12, Elsevier, Amsterdam, 177-230.
- Svehla, G., 1996, *Vogel's Qualitative Inorganic Analysis*, 7th ed., Longman, London.
- Teo, S.H., Ng, C.H., Islam, A., Abdulkareem-Alsultan, G., Joseph, C.G., Janaun, J., Taufiq-Yap, Y.H., Khandaker, S., Islam, G.J., Znad, H., dan Awual, M.R., 2022, Sustainable Toxic Dyes Removal with Advanced Materials for Clean Water Production: A Comprehensive Review, *J. Cleaner Prod.*, 332, 130039.
- Turro, N.J. dan Yekta, A., 1978, Luminescent Probes for Detergent Solutions: A Simple Procedure for Determination of Mean Aggregation Number of Micelles, *J. Am. Chem. Soc.*, 100, 5951-5952.
- United Nations Environment Programme, 2019, *Global Chemicals Outlook II: From Legacies to Innovative Solutions*, United Nations Environment Programme, Nairobi.
- Visa, M., 2016, Synthesis and Characterization of New Zeolite Materials Obtained from Fly Ash for Heavy Metals Removal in Advanced Wastewater Treatment, *Powder Technol.*, 294, 338-347.
- Wang, S. dan Wu, H., 2006, Environmental-Benign Utilisation of Fly Ash as Low-Cost Adsorbents, *J. Hazard. Mater.*, 136(3), 482-501.

- Wang, T., Jiang, M., Yu, X., Niu, N., dan Chen, L., 2022, Application of Lignin Adsorbent in Wastewater Treatment: A Review, *Sep. Purif. Technol.*, 302, 122116.
- Widyaningrum, S.R., Roza, F.N., Hanifah, W., dan Assalami, A., 2025, Penyisihan Cadmium dalam Sintesis Air Limbah Industri dengan Proses Adsorpsi Batch Menggunakan Zeolit Alam, *Chem. Eng. J. Storage*, 5(5), 682-692.
- World Health Organization, 2011, *Cadmium in Drinking-water: Background Document for Development of WHO Guidelines for Drinking-water Quality*, World Health Organization, Geneva.
- Yeskie, M.A. dan Harwell, J.H., 1988, On the Structure of Aggregates of Adsorbed Surfactants: The Surface Charge Density at the Hemimicelle/Admicelle Transition, *J. Phys. Chem.*, 92(8), 2346-2352.
- Yusop, M.F.M., Rashid, M.M., Alam, M.M., dan Ahmad, M.A., 2025, Enhanced Cd²⁺ Removal Via Deprotonated-Mango Trunk Functionalized Carbon: Optimization And F-Test for Linear and Non-Linear Isotherm and Kinetic Models, *Chem. Eng. Res. Des.*, 220, 96-116.
- Zhang, J.B., Li, S.P., Li, H.Q., dan He, M.M., 2016, Acid Activation for Pre-Desilicated High-Alumina Fly Ash, *Fuel Process. Technol.*, 151, 64-71.
- Zhang, J.X. dan Qu, L.L., 2013, Kinetic, Isotherm and Thermodynamic Studies of the Adsorption of Crystal Violet by Activated Carbon from Peanut Shells, *Water Sci. Technol.*, 67, 737-744.
- Zhang, R. dan Somasundaran, P., 2006, Advances in Adsorption of Surfactants and Their Mixtures at Solid/Solution Interfaces, *Adv. Colloid Interface Sci.*, 123-126, 213-229.
- Zhu, B.Y. dan Gu, T., 1991, Surfactant Adsorption at Solid-Liquid Interfaces, *Adv. Colloid Interface Sci.*, 37(1-2), 1-32.
- Zhu, W., Wang, J., Wu, D., Li, X., Luo, Y., Han, C., Ma, W., dan He, S., 2017, Investigating the Heavy Metal Adsorption of Mesoporous Silica Materials Prepared by Microwave Synthesis, *Nanoscale Res. Lett.*, 12, 323.
- Zunino, F., Bentz, D.P., dan Castro, J., 2018, Reducing Setting Time of Blended Cement Paste Containing High-SO₃ Fly Ash (HSFA) Using Chemical/Physical Accelerators and by Fly Ash Pre-Washing, *Cem. Concr. Compos.*, 90, 14-26.