

DAFTAR REFERENSI

- [1] W. Zhao, H. Yang, S. He, Q. Zhao, and L. Wei, "A review of biochar in anaerobic digestion to improve biogas production: Performances, mechanisms and economic assessments," *Bioresour. Technol.*, vol. 341, no. June, p. 125797, 2021, doi: 10.1016/j.biortech.2021.125797.
- [2] H. M. Jang, Y. K. Choi, and E. Kan, "Effects of dairy manure-derived biochar on psychrophilic, mesophilic and thermophilic anaerobic digestions of dairy manure," *Bioresour. Technol.*, vol. 250, no. November, pp. 927–931, 2018, doi: 10.1016/j.biortech.2017.11.074.
- [3] M. Liu, Y. Wei, and X. Leng, "Improving biogas production using additives in anaerobic digestion: A review," *J. Clean. Prod.*, vol. 297, p. 126666, 2021, doi: 10.1016/j.jclepro.2021.126666.
- [4] M. Chiappero *et al.*, "Review of biochar role as additive in anaerobic digestion processes," *Renew. Sustain. Energy Rev.*, vol. 131, no. July, 2020, doi: 10.1016/j.rser.2020.110037.
- [5] M. A. Sanchez-Monedero, M. L. Cayuela, A. Roig, K. Jindo, C. Mondini, and N. Bolan, "Role of biochar as an additive in organic waste composting," *Bioresour. Technol.*, vol. 247, pp. 1155–1164, 2018, doi: 10.1016/j.biortech.2017.09.193.
- [6] C. B. of Statistic, *Aceh Province in Figures 2021*, 48th ed., vol. 148. Indonesia: BPS-Statistics of Aceh Province, 2021.
- [7] R. Raihan, A. Setiawan, L. Hakim, M. Muhammad, M. Arif, and H. Hosseiniamoli, "Preparation and Characterization of Activated Carbon Made from Robusta Coffee Skin (*Coffea Canephora*)," *J. Rekayasa Kim. Lingkungan.*, vol. 15, no. 2, pp. 104–110, Oct. 2020, doi: 10.23955/rkl.v15i2.17618.
- [8] J. P. Rojas-Sossa *et al.*, "Effects of coffee processing residues on anaerobic microorganisms and corresponding digestion performance," *Bioresour. Technol.*, vol. 245, no. August, pp. 714–723, 2017, doi: 10.1016/j.biortech.2017.08.098.
- [9] USDA, "Indonesia Coffee Annual Report 2020," *USDA Foreign Agric. Serv.*, p. 9, 2020.
- [10] B. Chala, H. Oechsner, S. Latif, and J. Müller, "Biogas potential of coffee processing waste in Ethiopia," *Sustain.*, vol. 10, no. 8, pp. 1–14, 2018, doi: 10.3390/su10082678.
- [11] B. Chala, H. Oechsner, and J. Müller, "Introducing temperature as variable parameter into kinetic models for anaerobic fermentation of coffee husk, pulp and mucilage," *Appl. Sci.*, vol. 9, no. 3, 2019, doi: 10.3390/app9030412.
- [12] J. H. Windeatt, A. B. Ross, P. T. Williams, P. M. Forster, M. A. Nahil, and S. Singh, "Characteristics of biochars from crop residues: Potential for carbon sequestration and soil amendment," *J. Environ. Manage.*, vol. 146, pp. 189–197, 2014, doi: 10.1016/j.jenvman.2014.08.003.
- [13] F. Lü, Z. Hua, L. Shao, and P. He, "Loop bioenergy production and carbon sequestration of polymeric waste by integrating biochemical and thermochemical conversion processes: A conceptual framework and recent advances," *Renew. Energy*, vol. 124, pp. 202–211, 2018, doi: 10.1016/j.renene.2017.10.084.

- [14] K. B. Cantrell, P. G. Hunt, M. Uchimiya, J. M. Novak, and K. S. Ro, "Impact of pyrolysis temperature and manure source on physicochemical characteristics of biochar," *Bioresour. Technol.*, vol. 107, pp. 419–428, 2012, doi: 10.1016/j.biortech.2011.11.084.
- [15] D. Pandey, A. Daverey, and K. Arunachalam, "Biochar: Production, properties and emerging role as a support for enzyme immobilization," *J. Clean. Prod.*, vol. 255, p. 120267, 2020, doi: 10.1016/j.jclepro.2020.120267.
- [16] T. G. Ambaye, E. R. Rene, A. S. Nizami, C. Dupont, M. Vaccari, and E. D. van Hullebusch, "Beneficial role of biochar addition on the anaerobic digestion of food waste: A systematic and critical review of the operational parameters and mechanisms," *J. Environ. Manage.*, vol. 290, no. March, p. 112537, 2021, doi: 10.1016/j.jenvman.2021.112537.
- [17] P. R. Yaashikaa, P. Senthil Kumar, S. J. Varjani, and A. Saravanan, "Advances in production and application of biochar from lignocellulosic feedstocks for remediation of environmental pollutants," *Bioresour. Technol.*, vol. 292, no. August, p. 122030, 2019, doi: 10.1016/j.biortech.2019.122030.
- [18] B. Zhao *et al.*, "Study on hydrogen-rich gas production by biomass catalytic pyrolysis assisted with magnetic field," *J. Anal. Appl. Pyrolysis*, vol. 157, no. January, p. 105227, 2021, doi: 10.1016/j.jaap.2021.105227.
- [19] Badan Pusat Statistik, *STATISTIK KOPI INDONESIA*, vol. Jakarta: Badan pusat statistik, 2018.
- [20] S. and D. Najiyati, *Budidaya Kopi dan Penangan Pasca Panen*. Jakarta: Penebar Swadaya, 2001.
- [21] A. Farah and T. F. Dos Santos, *The Coffee Plant and Beans: An Introduction*. Elsevier Inc., 2015. doi: 10.1016/B978-0-12-409517-5.00001-2.
- [22] P. Rahardjo, *Kopi*. Penebar Swadaya Grup, 2012.
- [23] J. Andrea, J. A. Siles, and D. L. Á, "A Review on the Applications of Coffee Waste Derived from Primary Processing : Strategies for Revalorization," pp. 1–24, 2022.
- [24] B. Y. Pérez-Sariñana, A. De León-Rodríguez, S. Saldaña-Trinidad, and S. P. Joseph, "Optimization of bioethanol production from coffee mucilage," *BioResources*, vol. 10, no. 3, pp. 4326–4338, 2015, doi: 10.15376/biores.10.3.4326-4338.
- [25] A. M. Ritonga and Masrukhi, "Optimasi Kandungan Metana (CH₄) Biogas Kotoran Sapi Menggunakan Berbagai Jenis Adsorben Abdul," *J. Rona Tek. Pertan.*, vol. 11, no. 1, pp. 1–11, 2018.
- [26] Suyitno, A. Sujono, and Dharmanto, *TEKNOLOGI BIOGAS Pembuatan, Operasional, dan Pemanfaatan*, 1st ed. Yogyakarta: Graha Ilmu, 2010.
- [27] Ditjenppi, "Pengelolaan Limbah Ternak Menjadi Biogas," Kementerian Lingkungan Hidup dan Kehutanan.
- [28] O. Steviano and E. Kustanti, *Biogas untuk kehidupan*. Bogor: pusat perpustakaan dan penyebaran teknologi pertanian, 2021.
- [29] I. Mustikawati, "Manfaat Biogas Sebagai Bahan Bakar Alternatif Bagi Rumah Tangga," *Maj. Ilm. Pelita Ilmu*, vol. 2, no. 2, pp. 27–34, 2019, doi: 10.37849/mipi.v2i2.170.
- [30] A. Pertiwiningrum, *instalasi biogas*. Yogyakarta: CV. KOLOM CETAK, 2015.

- [31] N. J. Horan, *Introduction*, vol. 0, no. 9789811081286. 2018. doi: 10.1007/978-981-10-8129-3_1.
- [32] Q. Li, M. Xu, G. Wang, R. Chen, W. Qiao, and X. Wang, “Biochar assisted thermophilic co-digestion of food waste and waste activated sludge under high feedstock to seed sludge ratio in batch experiment,” *Bioresour. Technol.*, vol. 249, pp. 1009–1016, 2018, doi: 10.1016/j.biortech.2017.11.002.
- [33] M. Zhang and Y. Wang, “Effects of Fe-Mn-modified biochar addition on anaerobic digestion of sewage sludge: Biomethane production, heavy metal speciation and performance stability,” *Bioresour. Technol.*, vol. 313, no. April, 2020, doi: 10.1016/j.biortech.2020.123695.
- [34] X. Yue, U. Arena, D. Chen, K. Lei, and X. Dai, “Anaerobic digestion disposal of sewage sludge pyrolysis liquid in cow dung matrix and the enhancing effect of sewage sludge char,” *J. Clean. Prod.*, vol. 235, pp. 801–811, 2019, doi: 10.1016/j.jclepro.2019.07.033.
- [35] H. Wang, R. A. Larson, and T. Runge, “Impacts to hydrogen sulfide concentrations in biogas when poplar wood chips, steam treated wood chips, and biochar are added to manure-based anaerobic digestion systems,” *Bioresour. Technol. Reports*, vol. 7, no. April, p. 100232, 2019, doi: 10.1016/j.biteb.2019.100232.
- [36] D. Cheng *et al.*, “Improving sulfonamide antibiotics removal from swine wastewater by supplying a new pomelo peel derived biochar in an anaerobic membrane bioreactor,” *Bioresour. Technol.*, vol. 319, no. September 2020, p. 124160, 2021, doi: 10.1016/j.biortech.2020.124160.
- [37] X. Pan *et al.*, “Carbon- and metal-based mediators modulate anaerobic methanogenesis and phenol removal: Focusing on stimulatory and inhibitory mechanism,” *J. Hazard. Mater.*, vol. 420, no. March, p. 126615, 2021, doi: 10.1016/j.jhazmat.2021.126615.
- [38] A. Setiawan, A. G. Randa, Faisal, T. Bin Nur, and Rusdianasari, “Thermal decomposition of Gayo Arabica coffee-pulp in a segmented chamber,” in *Journal of Physics: Conference Series*, Institute of Physics Publishing, May 2020. doi: 10.1088/1742-6596/1500/1/012076.
- [39] A. Setiabudi, R. Hardian, and A. Muzakir, *Karakterisasi Material: Prinsip dan Aplikasinya dalam Penelitian Kimia*, vol. 1. 2012.
- [40] H. Saryanto, “Teori Dasar X-Ray Diffraction (XRD),” 2013.
- [41] A. Setiabudi, R. Hardian, and A. Muzakir, *Karakterisasi Material: Prinsip dan Aplikasinya dalam Penelitian Kimia*, vol. 1. 2012.
- [42] Phani, *GAS ANALYZERS*, (2017).
- [43] M. Sekar *et al.*, “A review on the pyrolysis of algal biomass for biochar and bio-oil – Bottlenecks and scope,” *Fuel*, vol. 283, no. September 2020, p. 119190, 2021, doi: 10.1016/j.fuel.2020.119190.
- [44] R. Kumar *et al.*, “Lignocellulose biomass pyrolysis for bio-oil production: A review of biomass pre-treatment methods for production of drop-in fuels,” *Renew. Sustain. Energy Rev.*, vol. 123, no. May 2019, 2020, doi: 10.1016/j.rser.2020.109763.
- [45] R. Moreira, R. dos Reis Orsini, J. M. Vaz, J. C. Penteadó, and E. V. Spinacé, “Production of Biochar, Bio-Oil and Synthesis Gas from Cashew Nut Shell by Slow Pyrolysis,” *Waste and Biomass Valorization*, vol. 8, no. 1, pp. 217–

- 224, 2017, doi: 10.1007/s12649-016-9569-2.
- [46] J. L. Linville, Y. Shen, P. A. Ignacio-de Leon, R. P. Schoene, and M. Urgun-Demirtas, “In-situ biogas upgrading during anaerobic digestion of food waste amended with walnut shell biochar at bench scale,” *Waste Manag. Res.*, vol. 35, no. 6, pp. 669–679, 2017, doi: 10.1177/0734242X17704716.
- [47] N. Khan, P. Chowdhary, A. Ahmad, B. Shekher Giri, and P. Chaturvedi, “Hydrothermal liquefaction of rice husk and cow dung in Mixed-Bed-Rotating Pyrolyzer and application of biochar for dye removal,” *Bioresour. Technol.*, vol. 309, no. April, p. 123294, 2020, doi: 10.1016/j.biortech.2020.123294.
- [48] M. Chiappero, F. Cillerai, F. Berruti, O. Mašek, and S. Fiore, “Addition of different biochars as catalysts during the mesophilic anaerobic digestion of mixed wastewater sludge,” *Catalysts*, vol. 11, no. 9, pp. 1–13, 2021, doi: 10.3390/catal11091094.
- [49] M. Thommes *et al.*, “Physisorption of gases, with special reference to the evaluation of surface area and pore size distribution (IUPAC Technical Report),” *Pure Appl. Chem.*, vol. 87, no. 9–10, pp. 1051–1069, 2015, doi: 10.1515/pac-2014-1117.
- [50] K. S. W. Sing *et al.*, “Reporting Physisorption Data for Gas/Solid Systems with Special Reference to the Determination of Surface Area and Porosity,” *Pure Appl. Chem.*, vol. 57, no. 4, pp. 603–619, 1985, doi: 10.1351/pac198557040603.
- [51] V. Vishwakarma and S. Uthaman, *Environmental impact of sustainable green concrete*. Elsevier Inc., 2019. doi: 10.1016/B978-0-12-817854-6.00009-X.
- [52] B. Tan *et al.*, “Preparation and thermal properties of shape-stabilized composite phase change materials based on polyethylene glycol and porous carbon prepared from potato,” *RSC Adv.*, vol. 6, no. 19, pp. 15821–15830, 2016, doi: 10.1039/c5ra25685b.
- [53] L. F. de S. Lima, C. R. Coelho, G. H. M. Gomes, and N. D. S. Mohallem, “Nb₂O₅/SiO₂ mesoporous monoliths synthesized by sol–gel process using ammonium niobate oxalate hydrate as porogenic agent,” *J. Sol-Gel Sci. Technol.*, vol. 93, no. 1, pp. 168–174, 2020, doi: 10.1007/s10971-019-05146-5.
- [54] Y. Wang, S. Lin, and Y. Suzuki, “Experimental study on CO₂ capture conditions of a fluidized bed limestone decomposition reactor,” *Fuel Process. Technol.*, vol. 91, no. 8, pp. 958–963, 2010, doi: 10.1016/j.fuproc.2009.07.011.
- [55] H. Gupta and L. S. Fan, “Carbonation-calcination cycle using high reactivity calcium oxide for carbon dioxide separation from flue gas,” *Ind. Eng. Chem. Res.*, vol. 41, no. 16, pp. 4035–4042, 2002, doi: 10.1021/ie010867l.
- [56] G. Corro, U. Pal, F. Bañuelos, and M. Rosas, “Generation of biogas from coffee-pulp and cow-dung co-digestion: Infrared studies of postcombustion emissions,” *Energy Convers. Manag.*, vol. 74, pp. 471–481, 2013, doi: 10.1016/j.enconman.2013.07.017.
- [57] H. Anwar, A. Sukma, and R. Ulya, “Effect of Effective Microorganisms Addition on Methane Production From Coffee Husks,” *Konversi*, vol. 11, no. 1, pp. 1–7, 2022, doi: 10.20527/k.v11i1.11761.

- [58] N. Kiggundu and J. Sittamukyoto, "Pyrolysis of Coffee Husks for Biochar Production," *J. Environ. Prot. (Irvine, Calif.)*, vol. 10, no. 12, pp. 1553–1564, 2019, doi: 10.4236/jep.2019.1012092.
- [59] D. Deublein and A. Steinhauser, *Biogas from Waste and Renewable Resources*, 1st ed., no. 1. John Wiley & Sons, 2011.
- [60] N. Batta, "Bridging Thermochemical and Biochemical Conversion : Impact of Biochar Addition on the Anaerobic Digestion of Aqueous Pyrolysis Condensate," *Electron. Thesis Diss. Repos.*, 2020.
- [61] T. Aryati, A. Williansyah, Zulnazri, and A. Setiawan, "Slow Pyrolysis of Areca-Nut Fibres in a-Pilot Scale Batch Reactor," in *Lecture Notes in Mechanical Engineering*, Springer Science and Business Media Deutschland GmbH, 2021, pp. 263–270. doi: 10.1007/978-981-16-0736-3_26.
- [62] F. Lü, C. Luo, L. Shao, and P. He, "Biochar alleviates combined stress of ammonium and acids by firstly enriching *Methanosaeta* and then *Methanosarcina*," *Water Res.*, vol. 90, pp. 34–43, 2016, doi: 10.1016/j.watres.2015.12.029.
- [63] J. Cai, P. He, Y. Wang, L. Shao, and F. Lü, "Effects and optimization of the use of biochar in anaerobic digestion of food wastes," *Waste Manag. Res.*, vol. 34, no. 5, pp. 409–416, 2016, doi: 10.1177/0734242X16634196.