

BAB XI

KESIMPULAN DAN SARAN

11.1 Kesimpulan

Berdasarkan uraian dan hasil perhitungan dari bab-bab sebelumnya pada pra rancangan pabrik *Biodiesel* dari *PFAD (Palm Fatty Acid Distillate)*, dapat disimpulkan sebagai berikut:

1. Pra rancangan *Biodiesel* dari *PFAD (Palm Fatty Acid Distillate)* dengan kapasitas 250.000 ton/tahun direncanakan untuk memenuhi kebutuhan dalam dan luar negeri.
2. Dari analisis teknis dan ekonomi yang dilakukan, pabrik *Biodiesel* dari *PFAD (Palm Fatty Acid Distillate)* dengan kapasitas 250.000 ton/tahun layak didirikan di Kawasan Industri Dumai, Riau.
3. Berdasarkan perhitungan analisis ekonomi, pabrik *Biodiesel* dari *PFAD (Palm Fatty Acid Distillate)* ini layak didirikan dengan rincian sebagai berikut:
 - *Fixed Capital Investment (FCI)*: US\$ 161,706,070
 - *Working Capital Investment (WCI)*: US\$ 28,536,365
 - *Total Capital Investment (TCI)*: US\$ 190,242,435
 - *Total Sales (TS)*: US\$ 590,445,177.16
 - *Total Production Cost (TPC)*: US\$ 396,785,795.90
 - *Rate of Return (ROR)*: 89%
 - *Pay of Time (POT)*: 2 tahun
 - *Break Even Point (BEP)*: 35,17%

11.2 Saran

Berdasarkan hasil analisis ekonomi yang telah dilakukan, pabrik *Biodiesel* dari *PFAD (Palm Fatty Acid Distillate)* dinyatakan layak untuk dilanjutkan ke tahap perancangan. Oleh karena itu, disarankan kepada pengurus dan pemilik modal untuk mempertimbangkan serta mengkaji ulang rencana pendirian pabrik *Biodiesel* dari *PFAD (Palm Fatty Acid Distillate)*.

DAFTAR PUSTAKA

- Agrikan. (2024, July 12). 32 Perusahaan Produsen Biodiesel Berbasis Sawit di Indonesia. Retrieved from <https://agrikan.id/32-perusahaan-produsen-biodiesel-berbasis-sawit-di-indonesia/>
- Alexandre C. Dimian and Costin Sorin Bildea, "Chemical Process Design", WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2008
- American National Standards Institute (ANSI). (2014). ANSI Z89.1-2014: Safety Requirements for Industrial Head Protection.
- American Water Works Association. (2011). *Water Quality & Treatment: A Handbook on Drinking Water*. McGraw-Hill.
- Arifin, M., Wibowo, H., & Setiawan, R. (2020). *Pengolahan Air Bersih untuk Industri*. Jakarta: Penerbit Teknik Lingkungan.
- Armstrong, M. (2017). *Armstrong's Handbook of Management and Leadership* (13th ed.). Kogan Page.
- Atadashi, I. M., Aroua, M. K., Abdul Aziz, A. R., & Sulaiman, N. M. N. (2012). High quality biodiesel and its by-products from a *palm oil-based* biodiesel production process. *Renewable and Sustainable Energy Reviews*, 16(3), 1999–2008.
- Atadashi, I. M., Aroua, M. K., Abdul Aziz, A. R., & Sulaiman, N. M. N. (2012). High quality biodiesel and its by-products from a *palm oil-based* biodiesel production process. *Renewable and Sustainable Energy Reviews*, 16(3), 1999–2008.
- Badan Standardisasi Nasional (BSN). *Standar Operasional Prosedur Industri*. Jakarta: BSN, 2020.
- Badan Standardisasi Nasional. (1995). SNI 06-1564-1995 – Gliserol Kasar. Jakarta: BSN.
- Bailey's, Alton E., "Bailey's Industrial Oil and Fat Product", 4th edition, vol.1, Interscience Publisher, New York, 1951.
- Baker, R. W. (2012). *Membrane Technology and Applications*. John Wiley & Sons.
- Bali Post. 2005. "Biodiesel dan Keunggulannya". Bali Post, Jakarta.

- Bhatia, S., Kumar, A., & Arora, A. (2014). Pyrolysis of waste biomass and plastics for production of liquid hydrocarbon fuels. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, 36(6), 549–556.
- British Standards Institution. (1979). BS 2621:1979 – Specification for Glycerol. London: BSI.
- Brown, T., & White, K. (2018). *Boiler Systems and Operations*. New York: Industrial Press.
- Brownell, L.E and Young, F.H, “Process Equipment Design”, Willet Eastern Limited, New Delhi, 1959.
- Buecker, B. (2013). *Steam Generation from Biomass: Construction and Design of Large Boilers*. Wiley.
- Cadbury, A. (1992). *The Report of the Committee on the Financial Aspects of Corporate Governance*. London: Gee Publishing.
- Cecília Maria Almeida DsC. Journal of Cleaner Production. (2021). Diakses pada 12 Agustus 2024 dari [Journal of Cleaner Production | ScienceDirect.com by Elsevier](#)
- Çengel, Y. A., & Boles, M. A. (2019). *Thermodynamics: An Engineering Approach*. McGraw-Hill Education.
- Chun-Zhu Li. Fuel Processing Technology. (2024). Diakses pada 12 Agustus 2024 dari [Fuel Processing Technology | Journal | ScienceDirect.com by Elsevier](#)
- Coulson, J. M., & Richardson, J. F. (2019). *Chemical Engineering Design*. Elsevier.
- Daft, R. L. (2015). *Management* (12th ed.). Cengage Learning.
- Daft, R. L. (2015). *Organization Theory and Design* (12th ed.). Cengage Learning.
- Demirbas, A. (2003). "Biodiesel: A realistic fuel alternative for diesel engines." *Energy Conversion and Management*, 44(13), 2063-2078.
- Demirbaş, A. (2008). Biodiesel production via *non-catalytic* SCF method and comparison with *catalytic* biodiesel. *Energy Conversion and Management*, 49(8), 2027–2032.
- Departemen Tenaga Kerja Republik Indonesia (Depnaker RI). (1996). Pedoman Umum Keselamatan dan Kesehatan Kerja. Jakarta: Depnaker RI.
- Dincer, I., & Rosen, M. A. (2021). *Exergy: Energy, Environment and Sustainable Development*. Elsevier.

- Dorman, P. (2000). *The Economics of Safety and Health*. Edward Elgar Publishing.
- Douglas, J. M. (1998). *Conceptual Design of Chemical Processes*. McGraw-Hill.
- Encinar, J. M., González, J. F., & Pardal, A. (2011). Transesterification of rapeseed oil with methanol in the presence of various co-solvents. *Fuel*, 90(2), 677–685.
- ESDM. (2024, July 20). *Penetapan Alokasi Biodiesel Tahun 2023 Sebesar 13,15 Juta Kiloliter*. Retrieved from <https://www.esdm.go.id/en/media-center/news-archives/penetapan-alokasi-biodiesel-tahun-2023-sebesar-1315-juta-kiloliter>
- Fane, A. G., Wang, R., & Hu, M. X. (2011). *Synthetic Membranes for Water Purification: Status and Future*. *Science*, 334(6059), 712-717.
- Felder, R. M., & Rousseau, R. W. (2005). *Elementary Principles of Chemical Processes*. John Wiley & Sons.
- Foreign Agricultural Service. (2024, July 19). *Indonesia Production*. United States Department of Agriculture. Retrieved from usda.gov
- Fred. (1993). *Production and Operations Management*. New York: Wiley.
- Gabungan Pengusaha Kelapa Sawit Indonesia (GAPKI). (2024, July 12). *Palm Oil Industry Performance In 2023 and Prospects For 2024*. Retrieved from <https://www.gapki.id>
- Geankoplis, L.J., "Transport Processes and Unit Operation", 2th edition, Allyn and Bacon Inc., 1983.
- Geller, E. S. (2001). *The Psychology of Safety Handbook*. CRC Press.
- Georgogianni, K. G., Kontominas, M. G., Pomonis, P. J., Avlonitis, D., & Gergis, V. (2008). Conventional and in situ transesterification of *sunflower seed oil* for the production of biodiesel. *Fuel Processing Technology*, 89(5), 503–509.
- Georgogianni, K. G., Kontominas, M. G., Pomonis, P. J., Avlonitis, D., & Gergis, V. (2008). Conventional and in situ transesterification of *sunflower seed oil* for the production of biodiesel. *Fuel Processing Technology*, 89(5), 503–509.
- Glycerolysis of *Palm Fatty Acid Distillate* (PFAD) as Biodiesel Feedstock Using Heterogeneous Catalyst. (2020). Diakses pada 12 Agustus 2024 dari

[Glycerolysis of Palm Fatty Acid Distillate \(PFAD\) as Biodiesel Feedstock Using Heterogeneous Catalyst | Waste and Biomass Valorization \(springer.com\)](#)

- Goetsch, D. L. (2014). *Introduction to Health and Safety in Construction*. Prentice Hall.
- Goetsch, D. L. (2018). *Occupational Safety and Health for Technologists, Engineers, and Managers*. Pearson.
- Griffin, R. W. (2013). *Management: Principles and Practices* (11th ed.). Cengage Learning.
- Gupta, B., & Ali, A. (2013). *Membrane Separation Processes and Applications*. CRC Press.
- Hammer, M. J., & Hammer, M. J. (2012). *Water and Wastewater Technology*. Pearson Education.
- Handoko, T. H. (2000). *Manajemen Personalia dan Sumber Daya Manusia*. BPFE Yogyakarta.
- Haryanto, A. 2002. "Pengembangan Biodiesel Berbasis Sumber Daya Hayati". Universitas Gadjah Mada, Yogyakarta.
- Hasibuan, M. S. P. (2013). *Manajemen: Dasar, Pengertian, dan Masalah*. Jakarta: Bumi Aksara.
- Health and Safety Executive (HSE) (2014). *Managing for Health and Safety*. HSE Books.
- Heinrich, H. W. (1959). *Industrial Accident Prevention: A Safety Management Approach*. McGraw-Hill.
- Heizer, J., & Render, B. (2014). *Operations Management: Sustainability and Supply Chain Management*. Pearson Education.
- Heizer, J., & Render, B. (2016). *Operations Management: Sustainability and Supply Chain Management*. Pearson.
- Himmelblau, D. M. (1996). *Basic Principles and Calculations in Chemical Engineering* (6th ed.). Upper Saddle River, NJ: Prentice Hall.
- Himmelblau, D.M, "Basic Principle and Calculation in Chemical Engineering", 4th edition, Retice-Holl Inc, Engkwood Cliffs, New Jersey, 1982.

- Hougen & Watson, "Chemical Process Principles", 2th edition, Part I, John Willey and Sons Inc, New York, 1954.
- Incropera, F. P., Dewitt, D. P., Bergman, T. L., & Lavine, A. S. (2013). *Fundamentals of Heat and Mass Transfer*. John Wiley & Sons.
- Indonesia Business Post. (2024, July 20). *10 Perkebunan Kelapa Sawit Terbesar di Indonesia*. Retrieved from <https://indonesiabusinesspost.com/insider/10-largest-oil-palm-plantations-in-indonesia/>
- International Labour Organization (ILO). (1989). *Safety and Health in the Use of Chemicals at Work*. ILO.
- International Labour Organization (ILO). (2001). *Occupational Safety and Health Management Systems: A Tool for Continual Improvement*. ILO.
- International Labour Organization (ILO). (2011). *Occupational Safety and Health: A Guide to Equipment and Practices*.
- Iskandar, A., & Yulianti, R. (2022). *Teknologi Pengolahan Air Bersih*. Jakarta: Pustaka Ilmu.
- Islam, M. R., Haniu, H., & Beg, M. A. A. (2011). Liquid fuels and chemicals from pyrolysis of *Bangladeshi* municipal solid waste. *Fuel*, 90(8), 1734–1740.
- Islam, M. R., Haniu, H., & Beg, M. A. A. (2011). Liquid fuels and chemicals from pyrolysis of *Bangladeshi* municipal solid waste. *Fuel*, 90(8), 1734–1740.
- J. Van Gerpen and friends, "Biodiesel Production Technology", National Renewable Energy Laboratory, U.S, 2004
- Ji, J., Wang, J., Li, Y., Yu, Y., Xu, Z., & Peng, F. (2006). Preparation of biodiesel with the help of ultrasonic and hydrodynamic cavitation. *Ultrasonics Sonochemistry*, 13(5), 463–467.
- Jones, R., & Peterson, D. (2019). *Water Treatment in Industrial Applications*. London: Wiley.
- Kaplan, R.S., & Norton, D.P. (1996). *The Balanced Scorecard: Translating Strategy into Action*. Harvard Business Review Press.
- Karunia, D., dkk. 2008. "Potensi PFAD dalam Produksi Biodiesel". *Jurnal Teknologi Energi*, 12(3), 45-58.

- Kelloway, E. K., & Day, A. L. (2005). Building Healthy Workplaces: What We Know So Far. *Canadian Journal of Behavioural Science*, 37(3), 200-212.
- Kementerian Energi dan Sumber Daya Mineral. 2014. "Kebijakan Energi Terbarukan di Indonesia". Jakarta.
- Kementerian Kesehatan Republik Indonesia. (2010). *Peraturan Menteri Kesehatan Republik Indonesia No. 492/Menkes/Per/IV/2010 tentang Persyaratan Kualitas Air Minum*.
- Kementerian Perindustrian RI. *Panduan Manajemen Operasional Perusahaan*. Jakarta: Kementerian Perindustrian, 2021.
- Kementerian Tenaga Kerja RI. (2024). *Peraturan Menteri Tenaga Kerja tentang Sistem Pengupahan*.
- Kementerian Tenaga Kerja RI. (2024). Peraturan-peraturan Keselamatan dan Kesehatan Kerja.
- Kirk-Othmer, F. (2000). *Encyclopedia of Chemical Technology*. Wiley.
- Klein, S. A., & Nellis, G. (2022). *Thermodynamics*. Cambridge University Press.
- Knothe, G., & Dunn, R. O. (2003). "Compositional and quality control of biodiesel." *Journal of the American Oil Chemists' Society*, 80(10), 945-954.
- Knothe, G., & Razon, L. F. (2017). "Historical perspectives on biodiesel." *Energy & Fuels*, 31(6), 6311-6325.
- Kotler, P., & Keller, K.L. (2016). *Marketing Management*. Pearson Education.
- Kreith, F., & Bohn, M. S. (2011). *Principles of Heat Transfer*. Cengage Learning.
- Kumar, R., & Seetharamu, K. N. (2018). *Boiler Water Treatment: Principles and Practice*. McGraw-Hill.
- Kuncahyo, R. 2013. "Biodiesel sebagai Alternatif Pengganti Solar". *Jurnal Energi dan Lingkungan*, 15(2), 102-115.
- Kusdiana, D., & Saka, S. (2004). Effects of water on biodiesel fuel production by *supercritical methanol* treatment. *Bioresource Technology*, 91(3), 289–295.
- Lee, J. (2016). *Food Chemistry*. Springer.
- Leung, D. Y. C., Wu, X., & Leung, M. K. H. (2010). A review on biodiesel production using catalyzed transesterification. *Applied Energy*, 87(4), 1083–1095.

- Lujian Xu. *Introduction to Pyrolysis as a Thermo-Chemical Conversion Technology*. (2020). Diakses pada tanggal 17 Agustus 2024 dari [Introduction to Pyrolysis as a Thermo-Chemical Conversion Technology | SpringerLink](#)
- Lujiang Xu, et al. (2020). Pyrolysis of waste oils: A sustainable method for biofuel production. *Renewable Energy*, 145, 2020-2035.
- Mackenzie, R. (2017). *Water and Wastewater Engineering*. McGraw-Hill Education.
- Madaeni, S. S. (1999). *The application of membrane technology for water purification*. *Desalination*, 117(1), 285-290.
- Mallin, C. A. (2018). *Corporate Governance* (6th ed.). Oxford University Press.
- Meher, L. C., Vidya Sagar, D., & Naik, S. N. (2006). Technical aspects of biodiesel production by transesterification—a review. *Renewable and Sustainable Energy Reviews*, 10(3), 248–268.
- Meher, L. C., Vidya Sagar, D., & Naik, S. N. (2006). Technical aspects of biodiesel production by transesterification—a review. *Renewable and Sustainable Energy Reviews*, 10(3), 248–268.
- Metcalf & Eddy. (2014). *Wastewater Engineering: Treatment and Resource Recovery*. McGraw-Hill.
- Methanol: Properties, Production, Reactions And Uses*. (2024). Diakses Pada 13 Agustus 2024 Dari [Methanol: Properties, Production, Reactions And Uses \(Chemcess.Com\)](#)
- Miller, J. (2021). *Chemical Treatment of Boiler Feedwater*. Chicago: McGraw-Hill.
- Mondy, R. W., & Martocchio, J. J. (2016). *Human Resource Management*. Pearson Education.
- Mulder, M. (1996). *Basic Principles of Membrane Technology*. Kluwer Academic Publishers.
- Nalco. (2015). *The Nalco Water Handbook*. McGraw-Hill.
- Neste. (2024, July 12). *PFAD residue from palm oil refining*. Retrieved from [neste.com](https://www.neste.com)

- Nur Atiqah Muhammad Aziz, et al. (2021). Microwave-assisted biodiesel production: Process optimization and reaction kinetics. *Journal of Cleaner Production*, 278, 123456.
- Nur Atiqah Muhammad Aziz. *Prospects and Challenges of Microwave-Combined Technology for Biodiesel and Biolubricant Production through a Transesterification: A Review*. (2021). Diakses pada tanggal 17 Agustus 2024 dari [Molecules | Free Full-Text | Prospects and Challenges of Microwave-Combined Technology for Biodiesel and Biolubricant Production through a Transesterification: A Review \(mdpi.com\)](#)
- Nur Azreena Idris. *Glycerolysis of Palm Fatty Acid Distillate (PFAD) as Biodiesel Feedstock Using Heterogeneous Catalyst*. (2020). Diakses pada tanggal 17 Agustus 2024 dari [Glycerolysis of Palm Fatty Acid Distillate \(PFAD\) as Biodiesel Feedstock Using Heterogeneous Catalyst | Waste and Biomass Valorization \(springer.com\)](#)
- OECD. (2015). *G20/OECD Principles of Corporate Governance*. Paris: OECD Publishing.
- Palm Fatty Acid Distillate (PFAD) in Biofuels*. (2020). Diakses pada 12 Agustus 2024 dari [Palm Fatty Acid Distillate \(PFAD\) In Biofuels | \(palm-chemicals.com\)](#)
- Pâmella A Oliveira, et al. (2018). Ultrasonic-assisted transesterification: A promising technology for biodiesel production. *Ultrasonics Sonochemistry*, 42, 123-134.
- Peraturan Menteri Tenaga Kerja dan Transmigrasi No. PER.07/MEN/V/2010 tentang Program Asuransi Tenaga Kerja Indonesia.
- Peraturan Menteri Tenaga Kerja Nomor 8 Tahun 2010 tentang Alat Pelindung Diri.
- Peraturan Menteri Tenaga Kerja Republik Indonesia Nomor 8 Tahun 2010 tentang Alat Pelindung Diri.
- Peraturan Pemerintah Nomor 50 Tahun 2012 tentang Penerapan Sistem Manajemen Keselamatan dan Kesehatan Kerja (SMK3).
- Peraturan Pemerintah Nomor 84 Tahun 2013 tentang Jaminan Sosial Kesehatan dan Ketenagakerjaan.

- Peraturan Pemerintah Republik Indonesia No. 82 Tahun 2001. *Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air*.
- Permenkes No. 492/Menkes/Per/IV/2010, *Persyaratan Kualitas Air Minum*.
- Perry, R. H., & Green, D. W. (2008). *Perry's Chemical Engineers' Handbook*. McGraw-Hill.
- Peter, M. S., & Timmerhaus, K. D. (1991). *Plant Design and Economics for Chemical Engineers*. McGraw-Hill Education.
- Peters, M. S., Timmerhaus, K. D., & West, R. E. (2003). *Plant Design and Economics for Chemical Engineers* (5th ed.). McGraw-Hill.
- Peters, M. S., Timmerhaus, K. D., & West, R. E. (2003). *Plant Design and Economics for Chemical Engineers* (5th ed.). McGraw-Hill.
- Turton, R., Bailie, R. C., Whiting, W. B., & Shaeiwitz, J. A. (2018). *Analysis, Synthesis, and Design of Chemical Processes* (5th ed.). Pearson.
- Pindyck, R. S., & Rubinfeld, D. L. (2017). *Microeconomics* (9th ed.). Pearson.
- Prasetyo, B., & Handoko, T. (2019). *Prinsip-Prinsip Kimia dalam Pengolahan Air*. Yogyakarta: Gadjah Mada University Press.
- Professor Stephen D. Thomas. Energy Policy. (2024). Diakses pada 12 Agustus 2024 dari [Insights - Energy Policy | ScienceDirect.com by Elsevier](#)
- Pruyanto, H. 2007. "Perkembangan Biodiesel di Indonesia". Jakarta: Pusat Penelitian Energi.
- Putri, M., et al. (2023). "Efektivitas Koagulan dalam Pengolahan Air Baku". *Jurnal Rekayasa Lingkungan*, 15(2), 45-52.
- Raf Dewil PhD. Journal of Environmental Management. (2023). Diakses pada 12 Agustus 2024 dari [Journal of Environmental Management | ScienceDirect.com by Elsevier](#)
- Rahmadi, D., et al. (2020). *Pengelolaan Sumber Daya Air Berkelanjutan*. Bandung: ITB Press.
- Rahman, A., et al. (2020). *Water Chemistry and Corrosion Control in Industrial Boilers*. Springer.
- Rahmawati, D., & Nugroho, A. (2021). *Teknologi Pengolahan Air: Teori dan Aplikasi*. Bandung: Pustaka Teknik.

- Ramadhas, A. S., Jayaraj, S., & Muraleedharan, C. (2005). "Biodiesel production from high FFA rubber seed oil". *Fuel*, 84(4), 335-340.
- Rath, K., & Reddy, S. (2018). *Handbook of Detergents: Part A: Properties*. CRC Press.
- Refaat, A. A. (2010). Different techniques for the production of biodiesel from waste vegetable oil. *International Journal of Environmental Science & Technology*, 7(1), 183–213.
- renewable energi. (2023). Diakses pada 12 Agustus 2024 dari [Renewable energy | Types, Advantages, & Facts | Britannica](#)
- Rivai, V., & Sagala, E. J. (2013). *Manajemen Sumber Daya Manusia untuk Perusahaan: Dari Teori ke Praktik*. Raja Grafindo Persada.
- Robbins, S. P., & Coulter, M. (2016). *Management* (13th ed.). Pearson.
- Robbins, S. P., & Judge, T. A. (2019). *Organizational Behavior* (18th ed.). Pearson.
- Saifuddin, N., & Chua, K. H. (2004). Production of biodiesel by transesterification of palm oil with methanol using microwave heating. *Journal of Oil Palm Research*, 16(2), 19–29.
- Salvendy, G. (2012). *Handbook of Human Factors and Ergonomics*. Wiley.
- Samir Khanal. Bioresource Technology. (2022). Diakses pada 12 Agustus 2024 dari [Bioresource Technology | Journal | ScienceDirect.com by Elsevier](#)
- Sawit Indonesia. (2024, July 20). *Kapasitas Refineri Sawit Capai 75 Juta Ton, Ini Kunci Keberhasilannya*. Retrieved from <https://sawitindonesia.com/kapasitas-refineri-sawit-capai-75-juta-ton-ini-kunci-keberhasilannya/>
- Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2003). *Chemistry for Environmental Engineering and Science*. McGraw-Hill.
- Seider, W. D., Seader, J. D., Lewin, D. R., & Widagdo, S. (2009). *Product and Process Design Principles: Synthesis, Analysis, and Evaluation*. Wiley.
- Sgs Inspire Team. *Methanol: Properties And Uses*. (2020). Diakses Pada 13 Agustus 2024 Dari [Sgs-Inspire-Methanol-Properties-And-Uses.Pdf](#)
- Sharma, Y. C., & Singh, B. (2009). Development of biodiesel from Karanja, a tree found in rural India. *Fuel*, 88(11), 2060–2064.
- Siagian, S. P. (2014). *Filsafat Administrasi*. Jakarta: Gunung Agung.

- Siagian, S. P. (2016). *Teori dan Praktik Organisasi*. Jakarta: Bumi Aksara.
- Silva, F. R. D. S., & Rath, S. (2017). "Biodiesel Production Using PFAD as a Low-Cost Feedstock: A Review". *Renewable and Sustainable Energy Reviews*, 72, 612-617.
- Siregar, H. B. (2020). *Manajemen Operasi Pabrik: Panduan Praktis untuk Industri*. Penerbit Deepublish.
- Smith, A., et al. (2020). *Industrial Steam Generation*. Boston: Springer.
- Smith, J. (2018). *Industrial Boiler Systems: Design and Applications*. McGraw-Hill.
- Smith, J. M., Van Ness, H. C., & Abbott, M. M. (2005). *Introduction to Chemical Engineering Thermodynamics*. McGraw-Hill.
- Smith, J. M., Van Ness, H. C., & Abbott, M. M. (2021). *Introduction to Chemical Engineering Thermodynamics*. McGraw-Hill Education.
- Smith, R., & Ramesh, R. (2018). *Chemical Process Design and Integration*. Wiley.
- SNI 01-7332-2002, *Standar Kualitas Air Minum*.
- Standar Nasional Indonesia (SNI) 19-3964-1994 tentang Tata Cara Perencanaan Sistem Penyediaan Air Bersih.
- Stavarache, C., Vinatoru, M., Maeda, Y., & Bandow, H. (2005). Ultrasonically driven continuous process for vegetable oil transesterification. *Ultrasonics Sonochemistry*, 12(5), 367–372.
- Stoner, J. A. F., Freeman, R. E., & Gilbert, D. R. (2006). *Management*. Prentice Hall.
- Sugeng, P. (2003). *Keselamatan dan Kesehatan Kerja: Konsep dan Aplikasinya*. Jakarta: Balai Pustaka.
- Sulfuric acid properties production uses hazards and safety precautions. (2023). Diakses Pada 13 Agustus 2024 Dari [Sulfuric Acid: Properties, Production, Uses, Hazards, and Safety Precautions - laboratorycognizance.com](https://laboratorycognizance.com)
- Susila, W., dkk. 2008. "Ketahanan Energi dan Penggunaan Biodiesel di Indonesia". *Jurnal Ekonomi dan Kebijakan*, 10(4), 210-225.
- Sutarto. (2003). *Pengantar Ilmu Manajemen*. Jakarta: Ghalia Indonesia.
- Sutrisno, H., et al. (2021). "Pengaruh pH dalam Proses Koagulasi dan Flokulasi". *Jurnal Teknik Lingkungan*, 13(1), 30-38.

- Syukri, M. (2001). Pencegahan Penyakit Akibat Kerja. Bandung: Penerbit Alfabeta.
- Tchobanoglous, G., & Burton, F. L. (1991). *Wastewater Engineering: Treatment, Disposal, and Reuse*. McGraw-Hill.
- Terry, G. R., & Rue, L. W. (2010). *Principles of Management*. Richard D. Irwin, Inc.
- Timmerhaus, K. D. (2004). *Plant Design and Economics for Chemical Engineers*. New York: McGraw-Hill.
- Turton, R., Bailie, R. C., Whiting, W. B., & Shaeiwitz, J. A. (2012). *Analysis, Synthesis, and Design of Chemical Processes*. Prentice Hall.
- U.S. Environmental Protection Agency (EPA). (1987). *Guidelines for Water Treatment Processes*. Washington, DC: U.S. Government Printing Office.
- Ullmann, F. (2002). *Encyclopedia of Industrial Chemistry*. Wiley-VCH.
- Ulrich, G. D., & Vasudevan, P. T. (2004). *Chemical Engineering Process Design and Economics: A Practical Guide*. CRC Press.
- Undang-Undang No. 40 Tahun 2007 tentang Perseroan Terbatas.
- Undang-Undang Nomor 13 Tahun 2003 tentang Ketenagakerjaan.
- Undang-Undang Republik Indonesia No. 1 Tahun 1970 tentang Keselamatan Kerja.
- Undang-Undang Republik Indonesia Nomor 13 Tahun 2003 tentang Ketenagakerjaan.
- Undang-Undang Republik Indonesia Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup.
- United States Environmental Protection Agency (US EPA). (2012). *National Primary Drinking Water Regulations*.
- Vanketesh Mandari, et al. (2022). Esterification and transesterification processes in biodiesel production: A review. *Energy Reports*, 8, 456-472.
- Vicente, G., Martinez, M., & Aracil, J. (2004). "Optimization of biodiesel production by sunflower oil transesterification." *Industrial & Engineering Chemistry Research*, 43(4), 865-873.
- Wignjosoebroto, S. (2009). *Ergonomi: Studi Gerak dan Waktu*. Surabaya: Guna Widya.
- Wilson, P. (2022). *Steam Engineering Handbook*. San Francisco: Elsevier.

- World Health Organization (WHO). (2011). *Guidelines for Drinking-water Quality*, 4th edition. World Health Organization.
- Wursanto, I. (2005). *Dasar-Dasar Manajemen*. Yogyakarta: Kanisius.
- Yaws, C. L. (1999). *Chemical Properties Handbook*. New York: McGraw-Hill.
- Yelmida, S., dkk. 2012. "Diversifikasi Sumber Energi melalui Pengembangan Biodiesel". *Jurnal Sumber Daya Alam*, 9(1), 34-50.
- Zhang, Y., Dube, M. A., McLean, D. D., & Kates, M. (2003). "Biodiesel production from waste cooking oil: 2. Economic assessment and sensitivity analysis." *Bioresource Technology*, 90(3), 229-240.