



DAFTAR PUSTAKA

- Abdullah, Rahmawati Sianipar, R.N., Ariyani, D., and Nata, I.F., 2017, Conversion of palm oil sludge to biodiesel using alum and KOH as catalysts, *Sustainable Environment Research*, 27, 291–295.
- Agustin, N.C., Prasdiantika, R., dan Subekti, S., 2022, Sintesis Biodiesel Minyak Ampas Tahu Terkatalisis Lempung Termodifikasi Kalsium Oksida dengan Pemanasan Microwave, *METANA*, 18, 14–22.
- Ali, C.H., Asif, A.H., Iqbal, T., Qureshi, A.S., Kazmi, M.A., Yasin, S., Danish, M., and Mu, B.Z., 2018, Improved transesterification of waste cooking oil into biodiesel using calcined goat bone as a catalyst, *Energy Sources, Part A: Recovery, Utilization and Environmental Effects*, 40, 1076–1083.
- Andalia, W., dan Pratiwi, I., 2018, Kinerja Katalis NaOH dan KOH ditinjau dari Kualitas Produk Biodiesel yang dihasilkan dari Minyak Goreng Bekas, *Jurnal Tekno Global*, 7, 66–73.
- Anisah, P.M., Suwandi, and Agustian, E., 2019, Effect of transesterification on the result of waste cooking oil conversion to biodiesel,. In, *Journal of Physics: Conference Series*. Institute of Physics Publishing, pp. 1–9.
- Anwaristiawan, D., Harjito, dan Widiarti, N., 2018, Modifikasi Katalis BaO/Zeolit Y pada Reaksi Transesterifikasi Minyak Biji Jarak (*Jatropha Curcas L.*) menjadi Biodiesel, *Indo. J. Chem. Sci*, 7, 292–298.
- Asri, N.P., Yuniati, Y., Hindarso, H., Hidayat, N., Siswa, I., Puspitasari, D.A., and Suprapto, S., 2020, Transesterification of Kesambi Oil (*Schleichera oleosa l.*) using Nano ZnO-CuO/ γ -alumina Solid Catalyst,. In, *IOP Conference Series: Earth and Environmental Science*. Institute of Physics Publishing, pp. 1–11.
- Azman, A.N., 2018, EKSTRAKSI DAN KARAKTERISTIK MINYAK IKAN SEMBILANG (*Paraplotosus albilabris*) DENGAN BAHAN PELARUT YANG BEBEDA, *Berkala Perikanan Terubuk*, 46, 19–27.
- Benitha, V.S., Prabhahar, R.S.S., and Nagarajan, J., 2021, Enhanced yield of biodiesel through nano catalytic transesterification of palm oil, *Mater Today Proc*, 47, 3088–3094.
- Bunaciu, A.A., Udriștioiu, E. gabriela, and Aboul-Enein, H.Y., 2015, X-Ray Diffraction: Instrumentation and Applications, *Crit Rev Anal Chem*, 45, 289–299.
- Chen, L. and Yuan, Z.Y., 2022, Design strategies of supported metal-based catalysts for efficient oxidative desulfurization of fuel, *Journal of Industrial and Engineering Chemistry*, 108, 1–14.
- Coniwanti, P., Surliadji, L., and Triandini, D., 2019, The effects of catalysts type, molar ratio, and transesterification time in producing biodiesel from beef



- tallow,. In, *IOP Conference Series: Materials Science and Engineering*. Institute of Physics Publishing, pp. 1–7.
- Damayanti, F., dan Supriyatn, T., 2020, Pemanfaatan Limbah Minyak Jelantah Sebagai Upaya Peningkatan Kepedulian Masyarakat Terhadap Lingkungan, *Dinamisia : Jurnal Pengabdian Kepada Masyarakat*, 5, .
- Degirmenbasi, N., Boz, N., and Kalyon, D.M., 2014, Biofuel production via transesterification using sepiolite-supported alkaline catalysts, *Appl Catal B*, 150–151, 147–156.
- Dewanti, A.T., Fitrah, M., Setiawan, B., Suryanto, A., dan Rasyid, R., 2021, Uji Aktifitas Katalis NaOH/Ni/gamma Al₂O₃ pada Proses Transesterifikasi Minyak Kelapa Sawit, *Journal of Chemical Process Engineering*, 6, 53–58.
- Dey, S. and Mehta, N.S., 2020, Oxidation of Carbon Monoxide Over Various Nickel Oxide Catalysts in Different Conditions: A Review, *Chemical Engineering Journal Advances*, 1, .
- Efendi, R., Aulia, H., Faiz, N., dan Firdaus, E.R., 2018, Pembuatan Biodiesel Minyak Jelantah Menggunakan Metode Esterifikasi-Transesterifikasi Berdasarkan Jumlah Pemakaian Minyak Jelantah,. In, *Industrial Research Workshop and National Seminar*. Bandung, pp. 402–409.
- Erchamo, Y.S., Mamo, T.T., Workneh, G.A., and Mekonnen, Y.S., 2021, Improved biodiesel production from waste cooking oil with mixed methanol–ethanol using enhanced eggshell-derived CaO nano-catalyst, *Sci Rep*, 11, .
- Ewbank, J.L., Kovarik, L., Diallo, F.Z., and Sievers, C., 2015, Effect of Metal-Support Interactions in Ni/Al₂O₃ Catalysts with Low Metal Loading for Methane Dry Reforming, *Appl Catal A Gen*, 494, 57–67.
- Fakruldin, A., Raml, A., and Abdul Mutalib, M.I., 2018, Effect of Preparation Method on Physicochemical Properties of Fe/Zeolite Catalyst,. In, *Journal of Physics: Conference Series*. Institute of Physics Publishing, pp. 1–6.
- Fanny, W.A., Subagjo, S., dan Prakoso, T., 2018, Pengembangan katalis Kalsium Oksida untuk sintesis biodiesel, *Jurnal Teknik Kimia Indonesia*, 11, 66.
- Fatimah, I., Fadillah, G., Sagadevan, S., Oh, W.C., and Ameta, K.L., 2023, Mesoporous Silica-Based Catalysts for Biodiesel Production: A Review, *ChemEngineering*, 7, .
- Febriana, N.A., Zamhari, M., dan Purnamasari, I., 2023, Pembuatan Katalis CaO/γ-Al₂O₃ Bentuk Kristal dengan Metode Impregnasi Pada Reaksi Transesterifikasi Minyak Kelapa Sawit, *Jurnal Pendidikan Tambusai*, 7, 23070–23075.
- Gnanaprakasam, A., Sivakumar, V.M., Surendhar, A., Thirumurugan, M., and Kannadasan, T., 2013, Recent Strategy of Biodiesel Production from Waste



Cooking Oil and Process Influencing Parameters: A Review, *Journal of Energy*, 2013, 1–10.

Hartanto, D., Purbaningtias, T.E., Fansuri, H., Prasetyoko, D., Kimia, J., Matematika, F., Ilmu, D., dan Alam, P., 2011, Karakterisasi Struktur Pori dan Morfologi ZSM-2 Mesopori yang Disintesis dengan Variasi Waktu Aging Pore Structure and Morphology Characterizations of Mesoporous ZSM-5 Synthesized at Various Aging Time, *Jurnal Ilmu Dasar*, 12, 80–90.

Hartono, R., Denny, Y.R., Ramdhani, D.S., Assaat, L.D., Priakbar, A.W., dan Ribawa, W.H., 2023, Pembuatan Biodiesel Dengan Reaktor Bersirkulasi Sederhana Menggunakan Katalis KOH, *J Teknol*, 15, 123–132.

Haryanto, A., Silviana, U., Triyono, S., dan Prabawa, S., 2015, PRODUKSI BIODIESEL DARI TRANSESTERIFIKASI MINYAK JELANTAH DENGAN BANTUAN GELOMBANG MIKRO: PENGARUH INTENSITAS DAYA DAN WAKTU REAKSI TERHADAP RENDEMEN DAN KARAKTERISTIK BIODIESEL Reaction Time on the Yield and Biodiesel Characteristic, *AGRITECH*, 35, 234–240.

Hidayanti, N., Arifah, N., Jazilah, R., Suryanto, A., dan Mahfud, D., 2015, PRODUKSI BIODIESEL DARI MINYAK KELAPA DENGAN KATALIS BASA MELALUI PROSES TRANSESTERIFIKASI MENGGUNAKAN GELOMBANG MIKRO (MICROWAVE),.

Ifah, A. Al, Trisunaryanti, W., Triyono, and Dewi, K., 2016, Synthesis of MCM-41-NH₂ Catalyst by Sonochemical Method for Transesterification of Waste Palm Oil, *Int J Chemtech Res*, 9, 382–387.

Iliade, P., Miletto, I., Coluccia, S., and Berlier, G., 2012, Functionalization of mesoporous MCM-41 with aminopropyl groups by co-condensation and grafting: A physico-chemical characterization, *Research on Chemical Intermediates*, 38, 785–794.

Jabbar, M.F.A., Affat, A.D., and Hamad, L.B., 2023, Transesterification of Waste Cooking Oil Using Natural and Chemical Materials as Catalyst, *Engineering Chemistry*, 4, 33–39.

Jenness, G.R., Christiansen, M.A., Caratzoulas, S., Vlachos, D.G., and Gorte, R.J., 2014, Site-Dependent Lewis Acidity of γ -Al₂O₃ and Its Impact on Ethanol Dehydration and Etherification, *Journal of Physical Chemistry C*, 118, 12899–12907.

Jumah, M.N.B., Ibrahim, S.M., AL-Huqail, A.A., Bin-Murdhi, N.S., Allam, A.A., Abu-Tawee, G.M., Altoom, N., Al-Anazi, K.M., and Abukhadra, M.R., 2021, Enhancing the Catalytic Performance of NiO During the Transesterification of Waste Cooking Oil Using A Diatomite Carrier and An Integrated Ni0 Metal: Response Surface Studies, *ACS Omega*, 6, 12318–12330.



- Jung, H.S., Moon, D.S., and Lee, J.K., 2012, Quantitative Analysis and Efficient Surface Modification of Silica Nanoparticles, *J Nanomater*, 2012, 1–8.
- Kalariya, A. and Vyas, A., 2020, Biodiesel production by transesterification of soybean oil using NiO-CaO based mixed oxide catalyst, *Industrial Engineering Journal*, 13, .
- Kim, D.H., Celedonio, J., and Ko, Y.S., 2017, A Study on Grafting Efficiency of Amine and CO₂ Sorption Behavior Inside Amorphous Silica, *Top Catal*, 60, 706–713.
- Kosim, M. dan Munasir, 2014, Studi Pengaruh Penambahan SiO₂ Terhadap Porositas γAl₂O₃, *Jurnal Fisika*, 3, 37–40.
- Kumar, S., Thakur, N., Abida, K., Kumar, A., Gupta, R.K., and Ali, A., 2019, Transesterification of triglyceride over Ni impregnated Zn/CaO nanocatalysts,. In, *Materials Today: Proceedings*. Elsevier Ltd, pp. A1–A8.
- Lestari, A.S. dan Sartika, D., 2018, PREPARASI DAN KARAKTERISASI NANOPARTIKEL Fe₃O₄ MENGGUNAKAN METODE KOPRESIPITASI, *Jurnal Teknologi Technoscientia*, 11, 7–10.
- Li, Z., Pan, Z., and Wang, Y., 2019, Enhanced adsorption of cationic Pb(II) and anionic Cr(VI) ions in aqueous solution by amino-modified nano-sized illite-smectite clay, *Environmental Science and Pollution Research*, 26, 11126–11139.
- Megawati, M. dan Muhartono, 2019, Konsumsi Minyak Jelantah dan Pengaruhnya terhadap Kesehatan,.
- Mirzayanti, Y.W., Asri, N.P., Marlinda, L., and Muttaqii, M.A.L., 2021, Transesterification of Jatropha Curcas Oil for Biodiesel Production Over NiO Catalyst,. In, *Journal of Physics: Conference Series*. IOP Publishing Ltd.
- Mohiuddin, E., Mdleleni, M.M., and Key, D., 2018, Catalytic cracking of naphtha: The effect of Fe and Cr impregnated ZSM-5 on olefin selectivity, *Appl Petrochem Res*, 8, 119–129.
- Mokaizh, A.A. bin, Shariffuddin, J.H., Baarimah, A.O., Al-Fakih, A., Mohamed, A., Baarimah, S.O., Al-Mekhlafi, A.B.A., Alenezi, H., Olalere, O.A., and Saeed, A.A.H., 2022, Elucidating the Effects of Reaction Time on the Physicochemical Characterization of Valorized Synthesized Alumina, *Materials*, 15, .
- Monika, Banga, S., and Pathak, V. V., 2023, Biodiesel production from waste cooking oil: A comprehensive review on the application of heterogenous catalysts, *Energy Nexus*, 10, 1–20.
- Nandiyanto, A.B.D., Ragadhita, R., and Fiandini, M., 2023, Interpretation of Fourier Transform Infrared Spectra (FTIR): A Practical Approach in the



- Polymer/Plastic Thermal Decomposition, *Indonesian Journal of Science and Technology*, 8, 113–126.
- Ningsih, S.K.W. and Khair, M., 2017, Synthesis and Characterization of NiO Nanocrystals by using Sol-Gel Method with Various Precursors, *Makara J Sci*, 21, .
- Nurhayati, Anita, S., Amri, T.A., and Linggawati, A., 2017, Esterification of crude palm oil using H₂SO₄ and transesterification using CaO catalyst derived from Anadara granosa, *Indonesian Journal of Chemistry*, 17, 309–315.
- Olugbenga, A., Mohammed, A., and Garba, M.U., 2013, The Potential of Potassium Loaded Gamma Alumina from Kaolin as a Solid Base Catalyst for Biodiesel Production, *International Journal of Advanced Scientific and Technical Research Issue*, 3, 398–403.
- Ortiz, H.I.M., Mercado, Y.M., Silva, J.A.M., Maldonado, Y.O., Castruita, G., and Cerdá, L.A.G., 2014, Functionalization with Amine-Containing Organosilane of Mesoporous Silica MCM-41 and MCM-48 Obtained at Room Temperature, *Ceram Int*, 2014, 9701–9707.
- Pakpahan, J.F., Tambunan, T., Harimby, A., dan Ritonga, M.Y., 2013, PENGURANGAN FFA DAN WARNA DARI MINYAK JELANTAH DENGAN ADSORBEN SERABUT KELAPA DAN JERAMI, *Jurnal Teknik Kimia USU*, 2, 31–36.
- Paranjpe, K.Y., 2017, Alpha, Beta and Gamma Alumina as A Catalyst-A Review, *The Pharma Innovation Journal*, 6, 236–238.
- Permana, E., Cristine, I., Sumbogo Murti, S.D., dan Yanti, F.M., 2020, Preparasi dan Karakterisasi Katalis Cu/ZnO dengan Support Karbon Aktif Menggunakan Aktivator H₃PO₄ dan ZnCl₂, *J Teknol*, 13, 6–15.
- Permana, E., Naswir, M., Ekawati Sinaga, M.T., Alfairuz, H., dan Sumbogo Murti, S., 2020, Kualitas Biodiesel dari Minyak Jelantah Berdasarkan Proses Saponifikasi dan Tanpa Saponifikasi, *Jurnal Teknologi Terapan* /, 6, 26–31.
- Prins, R., 2020, On the structure of γ-Al₂O₃, *J Catal*, 392, 336–346.
- Rachmadona, N., Aznury, M., Ogino, C., Teknik Kimia, J., Negeri Sriwijaya, P., Ward, N., dan Prefecture, H., 2017, Produksi Biodiesel dari Limbah Kelapa Sawit Dengan Menggunakan Lipase Thermomyces Lanuginosus Sebagai Katalis, *Kinetika*, 29–33.
- Ruhul, A.M., Kalam, M.A., Masjuki, H.H., Fattah, I.M.R., Reham, S.S., and Rashed, M.M., 2015, State of The Art of Biodiesel Production Processes: A Review of The Heterogeneous Catalyst, *RSC Adv*, 5, 101023–101044.
- Sádaba, I., López Granados, M., Riisager, A., and Taarning, E., 2015, Deactivation of Solid Catalysts in Liquid Media: The Case of Leaching of Active Sites in Biomass Conversion Reactions, *Green Chemistry*, 17, 4133–4145.



- Sarandon, K.A., Leksi Siregar, A., dan Rahardja, I.B., 2019, Pembentukan Biodiesel Melalui Proses Transesterifikasi Dengan Katalis Abu Tandan Kosong Kelapa Sawit (ATKKS),.
- Selpiana, S., Bahrin, D., Habibie, M.R., and Samara, F.S., 2023, Preparation and Characterization of Catalyst Zn/Al₂O₃ Catalyst Using Dry and Wet Impregnation Method, *Indonesian Journal of Fundamental and Applied Chemistry*, 8, 25–33.
- Selpiana, S., Bahrin, D., Ningsih, R.Y.B., Akbar, A.H., and Permatasari, A., 2022, Synthesis and Characterization Catalyst γ -Al₂O₃ and Al/ γ -Al₂O₃ Using XRD Analysis, *Indonesian Journal of Fundamental and Applied Chemistry*, 7, 26–31.
- Shaik, M.R., Khan, Mujeeb, Kumar, J.V.S., Ashraf, M., Khan, Majad, Kuniyil, M., Assal, M.E., Al-Warthan, A., Siddiqui, M.R.H., Khan, A., Tahir, M.N., and Adil, S.F., 2023, Nano Nickel-Zirconia: An Effective Catalyst for the Production of Biodiesel from Waste Cooking Oil, *Crystals (Basel)*, 13, .
- Sihotang, A., Is Heriyanti, S., Djangkung Sumbogo Murti, S., Mirda Yanti, F., Riski Gusti, D., Farizt Ichsan, A., and Adiningtyas Putri, A., 2022, The Effect of Metal Impregnation of Fe, Cu, and Co on Surface Area of Zsm-5 Catalyst Analyzed Using Surface Area Analyzer (SAA), *Al-Kimia*, 10, 170–179.
- Simpel, I.N., Negara, I.M.S., dan Ratnayani, O., 2021, Karakteristik Fisiko-Kimia Katalis Heterogen CaO-Base dan Pemanfaatannya Untuk Konversi Minyak Goreng Bekas Secara Sinambung Menjadi Biodiesel, *Jurnal Kimia*, 188.
- Simpel, I.N., Suprapta Winaya, I.N., Subagia, I.G.A., and Budiarso Suyasa, I.W., 2020, Solid Catalyst in Esterification and Transesterification Reactions for Biodiesel Production: A Review, *International Journal of Engineering and Emerging Technology*, 5, 168–174.
- Sopianti, D.S., Herlina, H., dan Saputra, H.T., 2017, Penetapan Kadar Asam Lemak Bebas Pada Minyak Goreng, *Jurnal Katalisator*, 2, 100–105.
- Sotomayor, F., Quantatec, A.P., Thommes, M., Sotomayor, F.J., and Cychosz, K.A., 2018, Characterization of Micro/Mesoporous Materials by Physisorption: Concepts and Case Studies, *Acc. Mater. Surf. Res*, 3, 34–50.
- Sulaiman, N.F., Leong, Y.W., Lee, S.L., Toemen, S., and Bakar, W.A.W.A., 2023, Enhanced transesterification reaction using chromium-doped calcium oxide-based catalyst supported on alumina and its specification of biodiesel, *Energy Convers Manag*, 293, .
- Sulaiman, N.F., Ramly, N.I., Abd Mubin, M.H., and Lee, S.L., 2021, Transition metal oxide (NiO, CuO, ZnO)-doped calcium oxide catalysts derived from eggshells for the transesterification of refined waste cooking oil, *RSC Adv*, 11, 21781–21795.



- Suseno, A., Wijaya, K., Trisunaryanti, W., and Roto, 2018, Synthesis and Characterization of Ni-Cu Doped Zirconia-Pillared Bentonite, *Oriental Journal of Chemistry*, 34, 1427–1431.
- Sutianingsih, Y., 2022, A Review: Antibacterial Activity of Metal Impregnated Zeolite in Water Treatment Process, *Jurnal Kartika Kimia*, 5, .
- Syahdarani, E., Ramelan, A.H., Wahyuningsih, S., Subagio, A., Kartini, I., and Kawuri, K.R., 2022, ZnO/NiO synthesis and its characterization using solvothermal method,. In, *Journal of Physics: Conference Series*. IOP Publishing Ltd.
- Tarigan, J.B., Perangin-Angin, S., Simanungkalit, S.R., Zega, N.P., and Sitepu, E.K., 2023, Utilization of waste banana peels as heterogeneous catalysts in room-temperature biodiesel production using a homogenizer, *RSC Adv*, 13, 6217–6224.
- Taufik, M. dan Seftiono, H., 2018, Karakteristik Fisik dan Kimia Minyak Goreng Sawit Hasil Proses Penggorengan dengan Metode Deep-Fat Frying, *J Teknol*, 10, 123–130.
- Tavakolian, S., Ahari, H., Givianrad, M.H., and Hosseini, H., 2021, Improving the Barrier Properties of Food Packaging by Al₂O₃@TiO₂ & Al₂O₃@SiO₂ Nanoparticles, *Food Bioproc Tech*, 14, 1287–1300.
- Trisunaryanti, W., Azizah, S.N., Fatmawati, D.A., Triyono, T., and Ningrum, N.C., 2022, Performance of a Hybrid Catalyst from Amine Groups and Nickel Nanoparticles Immobilized on Lapindo Mud in Selective Production of Bio-hydrocarbons, *Indonesian Journal of Chemistry*, 22, 896–912.
- Triyono, 2002, Effect of Impregnation Procedure of Pt/γ-Al₂O₃ Catalysts Upon Catalytic Oxidation of Co, *Indonesian Journal of Chemistry*, 2, 8–11.
- Untari, B., Mikusanti, and Ainna, A., 2020, Penentuan Kadar Asam Lemak Bebas dan Kandungan Jenis Asam Lemak dalam Minyak yang Dipanaskan dengan Metode Titrasi Asam Basa dan Kromatografi Gas, *Jurnal Ilmiah Bakti Farmasi*, 5, 1–10.
- Wahyudin, W., Tambunan, A.H., Purwanti, N., Joelianingsih, J., dan Nabetani, H., 2018, Tinjauan Perkembangan Proses Katalitik Heterogen dan Non-Katalitik untuk Produksi Biodiesel, *Jurnal Keteknikan Pertanian*, 6, 123–130.
- Yazdani, F., Akia, M., Khanbolouk, F., Hamze, H., and Arandiyan, H., 2021, Novel heterogeneous base nanocatalysts supported on a spray dried gamma alumina applying optimized production of biodiesel from waste cooking oil, *Biofuels*, 12, 1275–1281.
- Yustira, Y., Alimuddin, A.H., Prawaty, Y., dan Wahyuni, N., 2016, Esterifikasi Asam Lemak dari Limbah Minyak Kelapa Sawit (Palm Sludge Oil) Dengan Katalis Sn/Zeolit,. In, *Seminar Nasional II Penerapan Ilmu Pengetahuan dan Teknologi.*, pp. 35–44.



Zhang, L. and Shu, X., 2013, Influence of Ni Loading on Catalytic Activity of NiO/g-Al₂O₃ for Hydrogenation of Coal Pyrolysis, *Asian Journal of Chemistry*, 25, 5071–5075.