

DAFTAR PUSTAKA

- Abatyough, M.T., Ajibola, V.O., Agbaji, E.B., & Yashim, Z.K. (2022). Properties of Upgraded Bio-oil from Pyrolysis of Waste Corn Cobs. *Journal of Sustainability and Environmental Management (JOSEM)*, 1(2): 120-128. <https://doi.org/10.3126/josem.v1i2.45348>
- Abbas, Q., Liu, G., Yousaf, B., Ali, M.U., Ullah, H., Munir, M.A.M., & Liu, R. (2018). Contrasting effects of operating conditions and biomass particle size on bulk characteristics and surface chemistry of rice husk derived biochars. *Journal of Analytical and Applied Pyrolysis*, 134 :281-292. <https://doi.org/10.1016/j.jaap.2018.06.018>
- Abdullah, N., Gerhauser, H., & Sulaiman, F. (2010). Fast pyrolysis of empty fruit bunches. *Fuel*, 89 (8): 2166–2169. doi.org/10.1016/j.fuel.2009.12.019
- Abnisa, F., Arami A.N, Wan Daud W.M.A., Sahu, J.N., & Noor, M. (2013). Utilization of oil palm tree residues to produce bio-oil and bio-char via pyrolysis. *Energy Convers. Manag.*, 76: 1073–1082. [doi:10.1016/j.enconman.2013.08.038](https://doi.org/10.1016/j.enconman.2013.08.038)
- Ahmadian, M., Anbia, M., & Rezaie, M. (2020). Sulfur Dioxide Removal from Flue Gas by Supported CuO Nanoparticle Adsorbents. *Industrial & Engineering Chemistry Research*, 59 (50): 21642-21653. <https://doi.org/10.1021/acs.iecr.0c05629>
- Ahmadi, S., Reyhanitash, E., Yuan, Z., Rohani, S., & Xu, C. (Charles). (2017). Upgrading of fast pyrolysis oil via catalytic hydrodeoxygenation: Effects of type of solvents. *Renewable Energy*, 114, 376–382. <https://doi.org/10.1016/j.renene.2017.07.041>
- Ansari, K. B., Arora, J. S., Chew, J. W., Dauenhauer, P. J., & Mushrif, S. H. (2019). Fast pyrolysis of cellulose, hemicellulose, and lignin: effect of operating temperature on bio-oil yield and composition and insights into the intrinsic pyrolysis chemistry. *Industrial & Engineering Chemistry Research*, 58(35): 15838-15852. doi.org/10.1021/acs.iecr.9b00920
- Arvela, P.M., & Murzin, D.Y. (2017). Hydrodeoxygenation of Lignin-Derived Phenols: From Fundamental Studies towards Industrial Applications. *Catalysts*, 7 (9) : 1-40. <https://doi.org/10.3390/catal7090265>

- Aziz, I., Nurbayti, S., & Hakim, A.R. (2012). Uji Karakteristik Biodiesel yang dihasilkan dari Minyak Goreng Bekas Menggunakan Katalis Zeolit Alam (H-Zeolit) dan KOH. *Jurnal Kimia VALENSI*, 2(5): 541-547. <https://doi.org/10.15408/jkv.v2i5.296>
- Aziz, S.M.A., Wahi, R., Ngaini, Z., Hamdan, S., Yahaya, S.A. (2017). Esterification of Microwave Pyrolytic Oil from Palm Oil Kernel Shell. *J Chem*, 2017: 1-9. <https://doi.org/10.1155/2017/8359238>
- Azri, R., Bahri, S., & Aman. (2014). Pirolisis Biomassa Pelepah Sawit Menjadi Bio-Oil Dengan Katalis Natural Zeolit Dealuminated (Nza). *Jom FTEKNIK*, 1(2): 1-11. Diakses dari <https://jom.unri.ac.id/index.php/JOMFTEKNIK/article/view/6648/6345>
- Badan Pusat Statistik. (2021). *Statistik Ekspor dan Impor MIGAS Indonesia*. BPS: Jakarta.
- Bartholomew, C.H., Farrauto, R.J., (2005). *Fundamentals Of Industrial Catalytic Processes, Second Edition*. John Wiley & Sons, Inc, New Jersey.
- Bhoi, P.R., Ouedraogo, A.S., Soloiu, V., & Quirino, R. (2020). Recent advances on catalysts for improving hydrocarbon compounds in bio-oil of biomass catalytic pyrolysis. *Renewable and Sustainable Energy Reviews*, 121: 1-13. <https://doi.org/10.1016/j.rser.2019.109676>
- Bridgewater, A. V. (2012). Review of fast pyrolysis of biomass and product upgrading. *Biomass Bioenergy*, 3: 68-94. <https://doi.org/10.1016/j.biombioe.2011.01.048>
- Chen, D., Cen, K., Zhuang, X., Gan, Z., Zhou, J., Zhang, Y., & Zhang, H. (2022). Insight into biomass pyrolysis mechanism based on cellulose, hemicellulose, and lignin: Evolution of volatiles and kinetics, elucidation of reaction pathways, and characterization of gas, biochar and bio-oil. *Combustion and Flame*, 242(112142): 1-17. <https://doi.org/10.1016/j.combustflame.2022.112142>
- Cheng, S., Wei, L., Julson, J., Muthukumarappan, K., & Kharel, P.R. (2017a). Upgrading pyrolysis bio-oil to biofuel over bifunctional Co-Zn/HZSM-5 catalyst in supercritical methanol. *Energy Conversion and Management*. 147: 19-28. doi.org/10.1016/j.enconman.2017.05.044

- Cheng, S., Wei, L., Julson, J., Muthukumarappan, K., Kharel, P.R., & Boakye, E. (2017). Hydrocarbon bio-oil production from pyrolysis bio-oil using non sulfide Ni-Zn/Al₂O₃ catalyst. *Fuel Processing Technology*, 162 :78-86. <https://doi.org/10.1016/j.fuproc.2017.04.001>
- Cheng, S., Wei, L., Julson, J., Muthukumarappan, K., Kharel, P.R., Cao, Y., Boakye, E., Raynie, D., & Gu, Z. (2017c). Hydrodeoxygenation upgrading of pine sawdust bio-oil using zinc metal with zero valency. *Journal of the Taiwan Institute of Chemical Engineers*, 74: 146-153. <https://doi.org/10.1016/j.jtice.2017.02.011>
- Cheng, S., Wei, L., Julson, J., Rabnawazb, M. (2017 b). Upgrading pyrolysis bio-oil through hydrodeoxygenation (HDO) using non-sulfided Fe-Co/SiO₂ catalyst. *Energy Conversion and Management*, 150: 331-342. <https://doi.org/10.1016/j.enconman.2017.08.024>
- Cheng, S., Wei, L., Zhao, X., & Julson, J. (2016). Application, Deactivation, and Regeneration of Heterogeneous Catalysts in Bio-Oil Upgrading. *Catalysts*, 6 (195) : 1-24. <https://doi.org/10.3390/catal6120195>
- Choi, J. H., Woob, H. C., & Suha, D. J. (2014). Pyrolysis of Seaweeds for Bio-oil and Bio-char Production. *Chemical Engineering Transactions*, 37 : 121-126. DOI: 10.3303/CET1437021
- Cychosz, K.A., & Thommes, M. (2018). Review Progress in the Physisorption Characterization of Nanoporous Gas Storage Materials. *Engineering*, 4 (4): 559-566. <https://doi.org/10.1016/j.eng.2018.06.001>
- Czernik, S., & Bridgwater, A.V. (2004). Overview of Applications of Biomass Fast Pyrolysis Oil. *Energy & Fuels*, 18: 590-598. <https://doi.org/10.1021/ef034067u>
- Dasari, K.K., Gumtapure, V., & Dutta, S. (2020). Upgrading of coconut shell derived pyrolytic bio-oil by thermal and catalytic deoxygenation. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, 43(24): 1-10. <https://doi.org/10.1080/15567036.2019.1711465>
- Dickerson, T., & Soria, J. (2013). Catalytic Fast Pyrolysis: A Review. *Energies*, 6: 514-538. <https://doi.org/10.3390/en6010514>

- Direktorat Jenderal Perkebunan. (2021). *Statistik Perkebunan Kelapa Sawit Indonesia*. Jakarta: Kementrian Pertanian.
- Dhyani, V., & Bhaskar, T. (2018). A comprehensive review on the pyrolysis of lignocellulosic biomass. *Renewable Energy*, 129: 695-716. <https://doi.org/10.1016/j.renene.2017.04.035>
- Dolah, R., Karnik, R., & Hamdan, H. (2021). Review: A Comprehensive Review on Biofuels from Oil Palm Empty Bunch (EFB): Current Status, Potential, Barriers and Way Forward. *Sustainability*, 13(10210): 1-29. <https://doi.org/10.3390/su131810210>
- Fekhar, B., Zsinka, V., & Miskolczi, N. (2020). Thermo-catalytic co-pyrolysis of waste plastic and paper in batch and tubular reactors for in-situ product improvement. *Journal of Environmental management*, 269: 1-9. <https://doi.org/10.1016/j.jenvman.2020.110741>
- Gea, S., Hutapea, Y.A., Piliang, A.F.R., Pulungan, A.N., Rahayu, Layla, J., Tikoalu, A.D., Wijaya, K., Saputri, W.D. (2022). A Comprehensive Review of Experimental Parameters in Bio-oil Upgrading from Pyrolysis of Biomass to Biofuel Through Catalytic Hydrodeoxygenation. *BioEnergy Research*, 1-23. <https://doi.org/10.1007/s12155-022-10438-w>
- Gea, S., Irvan, Wijaya, K., Nadia, A., Pulungan, A.N., Sihombing, J.L., & Rahayu. (2022a). Bio-oil hydrodeoxygenation over zeolite-based catalyst: the effect of zeolite activation and nickel loading on product characteristics. *International Journal of Energy and Environmental Engineering*, 13: 541-553. <https://doi.org/10.1007/s40095-021-00467-0>
- Gea, S., Irvan, I., Wijaya, K., Nadia, A., Pulungan, A. N., Sihombing, J. L., & Rahayu, (2022b). Bio-oil hydrodeoxygenation over acid activated-zeolite with different Si/Al ratio. *Biofuel Research Journal*, 9(2), 1630–1639. <https://doi.org/10.18331/brj2022.9.2.4>
- Guo, K., Ding, Y., Luo, J., Gu, M., & Yu, Z. (2019). NiCu Bimetallic Nanoparticles on Silica Support for Catalytic Hydrolysis of Ammonia Borane: Composition-Dependent Activity and Support Size Effect. *ACS Appl. Energy Mater*, 2(8): 5851-5861. <https://doi.org/10.1021/acsaem.9b00997>

- Haerudin H. (2005). *Katalis dan Bahan Penyusunnya dalam Penyediaan Sumber Energi*. Pusat Penelitian Kimia Lembaga Ilmu Pengetahuan Indonesia. Puspiptek, 1-3.
- Hambali, E., & Rivai, M. (2017). The Potential of Palm Oil Waste Biomass in Indonesia in 2020 and 2030. *IOP Conf. Series: Earth and Environmental Science*, 65: 1-9. doi:10.1088/1755-1315/65/1/012050
- Han, Y., Gholizadeh, M., Tran, C.C., Kaliaguine, S., Li, C.Z., Olarte, M., & Perez, M.G. (2019). Hydrotreatment of pyrolysis bio-oil: A review. *Fuel Processing Technology*, 195: 1-29. <https://doi.org/10.1016/j.fuproc.2019.106140>
- Hellinger, M., Carvalho, H.W.P., Baier, S., Wang, D., Kleist, W., & Grunwaldt, J.D. (2015). Catalytic hydrodeoxygenation of guaiacol over platinum supported on metal oxides and zeolites. *Applied Catalysis A: General*, 490: 181–192. <https://doi.org/10.1016/j.apcata.2014.10.043>
- Hilten, R.N., Bibens, B.P., Kastner, J.R., & Das, K.C. (2010). In-Line Esterification of Pyrolysis Vapor with Ethanol Improves Bio-oil Quality. *Energy Fuels*, 24: 673-682. DOI:10.1021/ef900838g
- Hu, L., Wei, X.Y., Kang, Y.H., Guo, X.H., Xu, M.L., & Zong, Z.M. (2021). Mordenite supported ruthenium catalyst for selective hydrodeoxygenation of lignin model compounds and lignin-derived bio-oil to produce cycloalkanes. *Journal of the Energy Institute*, 96: 269-279. <https://doi.org/10.1016/j.apcatb.2018.03.041>
- Hu, X., & Gholizadeh, M. (2019b). Biomass pyrolysis: A review of the process development and challenges from initial researches up to the commercialisation stage. *Journal of Energy Chemistry*, 39: 109-143. <https://doi.org/10.1016/j.jechem.2019.01.024>
- Hu, Y., Wang, H., Lakshmikandan, M., Wang, S., Wang, Q., He, Z., & Abomohra, A.E.F.(2020c). Catalytic co-pyrolysis of seaweeds and cellulose using mixed ZSM-5 and MCM-41 for enhanced crude bio-oil production. *Journal of Thermal Analysis and Calorimetry*, 143: 827–842. <https://doi.org/10.1007/s10973-020-09291-w>

- Hita, I., Lanzac, T.C., Bonura, G., Cannilla, C., Arandes, J.M., Frusteri, F., & Bilbao, J. (2019). Hydrodeoxygenation of raw bio-oil towards platform chemicals over FeMoP/zeolite catalysts. *Journal of industrial and engineering chemistry*, 80: 392- 400.
<https://doi.org/10.1016/j.jiec.2019.08.019>
<https://www.cnbcindonesia.com/market/20220102155348-17-303902/ekonomi-bangkit-di-2021-harga-minyak-mentah-mendidih> diakses tanggal 26 Januari 2022
<https://www.cnbcindonesia.com/news/20211117155827-4-292297/bukan-cuma-harta-karun-ri-punya-lambung-devisa-rp-500-t> diakses tanggal 26 Januari 2022
- Ismail, Y., Nurwidyawati, A.D., & Rahayu, A.D. (2019). Estimation of Vehicles Carbon Dioxide (CO₂) Emission. *Journal of Industrial Engineering*, 4 (2): 94-99. <http://repository.president.ac.id/xmlui/handle/123456789/3474>
- Istadi, I., Prasetyo, S.A., & Nugroho, T.S. (2015). Characterization of K₂O/CaO ZnO Catalyst for Transesterification of Soybean Oil to Biodiesel. *Procedia Environmental Sciences*, 23: 394-399.
<https://doi.org/10.1016/j.proenv.2015.01.056>
- Istady. (2011). *Fundamental dan Aplikasi : Teknologi Katalis untuk Konversi Energi*. Semarang: Badan Penerbit Undip.
- Jalani, B.S., Kushairi, A., & Cheah, S.C. (2003). *Production Systems And Agronomy/ Oil Palm And Coconut*. Elsevier Ltd. All Rights Reserved.
- Ji, K., Xun, J., Liu, P., Song, Q., Gao, J., Zhang, K., & Li, J. (2018). The study of methanol aromatization on transition metal modified ZSM-5 catalyst. *Chinese journal of chemical engineering*, 26 (9): 1949-1953.
<https://doi.org/10.1016/j.cjche.2018.03.024>
- Jin, W., Perez, L. P., Shen, D., Escibano, A. S., Gu, S., & Reina, T. R. (2019). Catalytic Upgrading of Biomass Model Compounds: Novel Approaches and Lessons Learnt from Traditional Hydrodeoxygenation a Review. *ChemCatChem*, 11: 924–960. DOI: 10.1002/cctc.201801722
- Kadarwati, S., Apriliani, E., Annisa, R.N., Jumaeri, J., Cahyono, E., & Wahyuni, S. (2021). Esterification of Bio-Oil Produced from Sengon (*Paraserianthes falcataria*) Wood Using Indonesian Natural Zeolites. *Int. Journal of Renewable Energy Development (IJRED)*, 10 (4): 747-

754. <https://doi.org/10.14710/ijred.2021.35970>

- Kalvachev, Y., Todorova, T., & Popov, C. (2021). Recent Progress in Synthesis and Application of Nanosized and Hierarchical Mordenite—A Short Review. *Catalysts*, 11 (308) :1-16. <https://doi.org/10.3390/catal11030308>
- Kumar, M., Berkson, Z.J., Clark, R.J., Shen, Y., Prisco, N.A., Zheng, Q., Zeng, Z., Zheng, H., McCusker, L.B., Palmer, J.C., Chmelka, B.F., & Rimer, J.D. (2019). Crystallization of Mordenite Platelets using Cooperative Organic Structure-Directing Agents. *J. Am. Chem. Soc.*, 141: 20155–20165. DOI: 10.1021/jacs.9b09697
- Kurnia, I., Karnjanakom, S., Bayu, A., Yoshida, A., Rizkiana, J., Prakoso, T., Abudula, A., & Guan, G. (2017). In-situ catalytic upgrading of bio-oil derived from fast pyrolysis of lignin over high aluminum zeolites. *Fuel Processing Technology*, 167, 730-737. <https://doi.org/10.1016/j.fuproc.2017.08.026>
- Lee, H., Kim, H., Yu, M.J., Ko, C.H., Jeon, J.K., Jae, J., Park, S.H., Jung, S.C., & Park, Y.K. (2016). Catalytic Hydrodeoxygenation of Bio-oil Model Compounds over Pt/HY Catalyst. *Scientific Reports*, 6 (28765): 1-8. <https://doi.org/10.1038/srep28765>
- Lian, X., Xue, Y., Zhao, Z., Xu, G., Han, S., & Yu, H. (2017). Progress on upgrading methods of bio-oil: A review. *International Journal Of Energy Research*, 41 (13): 1798-1816. <https://doi.org/10.1002/er.3726>
- Li, C., Ma, J., Xiao, Z., Hector, S.B., Liu, R., Zuo, S., Xie, X., Zhang, A., Wu, H., & Liu, Q. (2018b). Catalytic cracking of Swida wilsoniana oil for hydrocarbon biofuel over Cu- modified ZSM-5 zeolite. *Fuel*, 218: 59-66. <https://doi.org/10.1016/j.fuel.2018.01.026>
- Li, F., Ding, S., Wang, Z., Li, Z., Li, L., Gao, C., Zhong, Z., Lin, H., & Chen, C. (2018a). Production of light olefins from catalytic cracking bio-oil model compounds over La₂O₃-modified ZSM-5 zeolite. *Energy Fuels*, 32(5): 5910-5922. <https://doi.org/10.1021/acs.energyfuels.7b04150>
- Li, S., Lu, Y., Guo, L., & Zhang, X. (2011). Hydrogen production by biomass gasification in supercritical water with bimetallic Ni-M/ γ -Al₂O₃ catalysts (M: Cu, Co dan Sn). *International Journal of Hydrogen Energy*, 36: 14391

- 14400. <https://doi.org/10.1016/j.ijhydene.2011.07.14>
- Li, X., Chen, G., Liu, C., Ma, W., Yan, B., Zhang, J. (2017). Hydrodeoxygenation of lignin-derived bio-oil using molecular sieves supported metal catalysts: A critical review. *Renewable and Sustainable Energy Reviews*, 71:296-308. <https://doi.org/10.1016/j.rser.2016.12.057>
- Li, Y., Zhang, C., Liu, Y., Tang, S., Chen, G., Zhang, R., & Tang, X. (2017). Coke formation on the surface of Ni/HZSM-5 and Ni-Cu/HZSM-5 catalysts during bio-oil hydrodeoxygenation. *Fuel*, 189: 23-31. <https://doi.org/10.1016/j.fuel.2016.10.047>
- Lin, Y.Y., Chen, W.H., & Liu, H.C. (2020). Aging and emulsification analyses of hydrothermal liquefaction bio-oil derived from sewage sludge and swine leather residue. *Journal of Cleaner Production*, 266: 1-13. <https://doi.org/10.1016/j.jclepro.2020.122050>
- Liu, C., Chen, D., Ashok, J., Hongmanorom, P., Wang, W., Li, T., Wang, Z., & Kawi, S. (2020a). Chemical looping steam reforming of bio-oil for hydrogen-rich syngas production: Effect of doping on $\text{LaNi}_{0.8}\text{Fe}_{0.2}\text{O}_3$ perovskite. *International Journal of Hydrogen Energy*, 45(41): 21123-21137. <https://doi.org/10.1016/j.ijhydene.2020.05.186>
- Liu, M., Jia, W., Li, J., Wang, Y., Ma, S., Chen, H., & Zhu, Z. (2015b). Catalytic Properties of Hierarchical Mordenite Nanosheets Synthesized by Self Assembly Between Subnanocrystals and Organic Templates. *Catalysis Letters*, 146: 249-254. <https://doi.org/10.1007/s10562-015-1632-2>
- Liu, Y., Li, Z., Leahy, J.J. & Kwapinski, W. (2015a). Catalytically Upgrading Bio-oil via Esterification. *Energy Fuels*, 29 (6): 3691-3698. <https://doi.org/10.1021/acs.energyfuels.5b00163>
- Lucarelli, C., Bonincontro, D., Zhang, Y., Grazia, L., Carrasco, M.R., Thieuleux, C., Quadrelli, E.A., Dimitratos, N., Cavani, F., Albonetti, S. (2019). Tandem hydrogenation/ hydrogenolysis of furfural to 2-methylfuran over a Fe/Mg/O catalyst: Structure–activity relationship. *Catalysts*, 9: 1-16. <https://doi.org/10.3390/catal9110895>

- Luo, Z., Wang, S., & Cen, K. (2005). A model of wood flash pyrolysis in fluidized bed reactor. *Renewable Energy*, 30: 377–392. <https://doi.org/10.1016/j.renene.2004.03.019>
- Lup, A.N.K., Abnisa, F., Daud, W.M.A.W., & Aroua, M.K. (2017). A Review on Reactivity and Stability of Heterogeneous Metal Catalysts for Deoxygenation of Bio-Oil Model Compounds. *Journal of Industrial and Engineering Chemistry*, 56: 1-34. <https://doi.org/10.1016/j.jiec.2017.06.049>
- Ly, H.V., Kim, J., Hwang, H.T., Choi, J.H., Woo, H.C., & Kim, S.S. (2019). Catalytic Hydrodeoxygenation of Fast Pyrolysis Bio-Oil from *Saccharina japonica* Alga for Bio-Oil Upgrading. *Catalysts*, 9 (12): 1-15. <https://doi.org/10.3390/catal9121043>
- Ma, C., Geng, J., Zhang, D., & Ning, X. (2020). Non-catalytic and catalytic pyrolysis of *Ulva prolifera* macroalgae for production of quality bio-oil. *Journal of the Energy Institute*, 93 (1) : 303-311. <https://doi.org/10.1016/j.joei.2019.03.001>
- Martinez, M. (2010). Sebuah Pemahaman Dasar *Scanning Electron Microscopy* (SEM) dan *Energy Dispersive X-Ray Spectroscopy* (EDX). http://karya_ilmiah.um.ac.id (diakses Kamis, 14 Oktober 2021).
- Martínez, N., García, R., Fierro, J.L.G., Wheeler, C., Austin, R.N., Gallagher, J.R., Miller, J.T., Krause, T.R., Escalona, N., & Sepúlveda, C. (2016). Effect of Cu addition as a promoter on Re/SiO₂ catalysts in the hydrodeoxygenation of 2-methoxyphenol as a model bio oil compound. *Fuel*, 186: 112-121. <https://doi.org/10.1016/j.fuel.2016.08.065>
- Maulina, S., Nurtahara, & Fakhradila (2018). Pirolisis Pelepah Kelapa Sawit Untuk Menghasilkan Fenol Pada Asap Cair. *Jurnal Teknik Kimia USU*, 7(2): 12-16. <https://doi.org/10.32734/jtk.v7i2.1641>
- Mohammad, M., Hari, T.K., Yaakob, Z., Sharma, Y.C., & Sopian, K. (2013). Overview on the production of paraffin based-biofuels via catalytic hydrodeoxygenation. *Renewable and Sustainable Energy Reviews*, 22 : 121-132. <https://doi.org/10.1016/j.rser.2013.01.026>
- Montoya, J.I., Valdes, C., Chejne, F., Gomez, C.A., Blanco, A., Marrugo, G.,

- Osorio, J., Castillo, E., Aristobulo, J., & Acero, J. (2014). Bio-oil production from Colombian bagasse by fast pyrolysis in a fluidized bed: An experimental study. *J. Anal. Appl. Pyrolysis*, 112: 379-387. <https://doi.org/10.1016/j.jaap.2014.11.007>
- Mortensen, P.M., Grunwaldt, J.D., Jensen, P.A., & Jensen, A.D. (2013). Screening of Catalysts for Hydrodeoxygenation of Phenol as Model Compound for Bio-oil. *ACS Catalysis*, 3(8): 1774–1785. <https://doi.org/10.1021/cs400266e>
- Mortensen, P.M., Grunwaldt, J.-D., Jensen, P.A., Knudsen, K.G., & Jensen, A.D. (2011). A review of catalytic upgrading of bio-oil to engine fuels. *Applied Catalysis A: General*, 407: 1-19. <https://doi.org/10.1016/j.apcata.2011.08.046>
- Muangsuwan, C., Kriprasertkul, W., Ratchahat, S., Liu, C.G., Posoknistakul, P., Laosiripojana, N., & Sakdaronnarong, C. (2021). Upgrading of Light Bio-oil from Solvothermal Liquefaction of an Oil Palm Empty Fruit Bunch in Glycerol by Catalytic Hydrodeoxygenation Using NiMo/Al₂O₃ or CoMo/Al₂O₃ Catalysts. *ACS Omega*, 6(4): 2999-3016. <https://doi.org/10.1021/acsomega.0c05387>
- Murphy, D.J. (2014). The future of oil palm as a major global crop: opportunities and challenges. *Journal of Oil Palm Research*, 26 (1): 1-24.
- Narayanan, S., Tamizhdurai, P., Mangesh, V.L., Ragupathi, C., Santhana, P., Krishnan, & Ramesh, A. (2021). Recent advances in the synthesis and applications of mordenite zeolite – review. *RSC Adv.*, 11: 250-267. DOI: 10.1039/D0RA09434J
- Nasikin M, & Susanto H. B. (2010). *Katalis Heterogen*. Jakarta: UI-Press.
- Neimark, A.V., Sing, K.S.W., & Thommes, M. (2008). Characterization of solid catalysts. In *Handbook of Heterogeneous Catalysis*, 2, 721-738.
- Niemantsverdriet, J. W. (2007). *Spectroscopy in Catalysis An Introduction*. 2nd Edition. New York: Wiley-VCH.
- Oh, S., Ahn, S.H., & Choi, J.W. (2019). Effect of Different Zeolite Supported Bifunctional Catalysts for Hydrodeoxygenation of Waste Wood Bio-oil. *J. Korean Wood Sci. Technol*, 47(3): 344-359.

<https://doi.org/10.5658/WOOD.2019.47.3.344>

- Pang, Y.X., Yan, Y., Foo, D.C.Y., Sharmin, N., Zhao, H., Lester, E., Wu, T., & Pang, C.H. (2021). The influence of lignocellulose on biomass pyrolysis product distribution and economics via steady state process simulation. *Journal of Analytical and Applied Pyrolysis*, 158 : 1-10. <https://doi.org/10.1016/j.jaap.2020.104968>
- Paraschiv, S., & Paraschiv, L.S. (2020). Trends of carbon dioxide (CO₂) emissions from fossil fuels combustion (coal, gas and oil) in the EU member states from 1960 to 2018. *Energy Reports*, 6 : 237-242. <https://doi.org/10.1016/j.egyr.2020.11.116>
- Parsell, T.H., Owen, B.C., Klein, I., Jarrell, T.M., Marcum, C.L., Hauptert, L.J., Amundson, L.M., Kenttamaa, H.I., Ribeiro, F., Miller, J.T., & Omar, M.M.A. (2013). Cleavage and hydrodeoxygenation (HDO) of C–O bonds relevant to lignin conversion using Pd/Zn synergistic catalysis. *Chem. Sci.*, 4: 806-813. <https://doi.org/10.1039/C2SC21657D>
- Patel, M., & Kumar, A. (2016). Production of renewable diesel through the hydroprocessing of lignocellulosic biomass-derived bio-oil: A review. *Renewable and Sustainable Energy Reviews*, 58: 1293–1307. <http://dx.doi.org/10.1016/j.rser.2015.12.146>
- Pirmoradi, M., & Kastner, J.R. (2021). A kinetic model of multi-step furfural hydrogenation over a Pd-TiO₂ supported activated carbon catalyst. *Chemical Engineering Journal*, 414: 1-11. <https://doi.org/10.1016/j.cej.2021.128693>
- Pourzolfaghar, H., Abnisa, F., Daud, W.M.A.W., Aroua, M.K., & Mahlia, T.M.I. (2020). Catalyst Characteristics and Performance of Silica-Supported Zinc for Hydrodeoxygenation of Phenol. *Energies*, 13 (2802) : 1-13. <https://doi.org/10.3390/en13112802>
- Prasertpong, P., Jaroenkhasemmesuk, C., Tippayawong, N., & Thanmongkhon, Y. (2017). Characterization of Bio-oils from Jatropha Residues and Mixtures of Model Compounds. *Journal of Natural Sciences*, 16(2): 135-144. DOI:10.12982/cmujns.2017.0011

- Primadita, D.S., Kumara, I.N.S., & Ariastina, W.G. (2020). A Review on Biomass For Electricity Generation In Indonesia. *Journal of Electrical, Electronics and Informatics*, 4 (1): 1-9.
- Pulungan, A. N., Kembaren, A., Nurfajriani, Syuhada, F.A., Sihombing, J.L., Yusuf, M., & Rahayu (2021). Biodiesel produvtion from rubbr seed oil using natural zeolite supported metal oxide catalyst. *Polish Journal Of Evironmental Studies*, 30(6) : 1-9. <https://doi.org/10.15244/pjoes/135615>
- Pulungan, A.N., Nurfajriani, Kembaren, A., Sihombing, J.L., Ginting, C. V., Nurhamidah, A., & Hasibuan, R. (2022). The stabilization of bio-oil as an alternative energy source through hydrodeoxygenation using Co and Co Mo supported on active natural zeolite. *Journal of Physics: Conference Series*, 2193: 1-9. doi:10.1088/1742 6596/2193/1/012084
- Purnami, Wardana, I.N.G., & Veronika K. (2015). Pengaruh Penggunaan Katalis Terhadap Laju dan Efisiensi Pembentukan Hidrogen. *Jurnal Rekayasa Mesin*, 6(1), 51-59. <https://doi.org/10.21776/ub.jrm.2015.006.01.8>
- Qureshi, K.H., Lup, A.N.K., Khan, S., Abnisa, F., & Daud, W.M.A.W. (2021). Optimization of palm shell pyrolysis parameters in helical screw fluidized bed reactor: Effect of particle size, pyrolysis time and vapor residence time. *Cleaner Engineering and Technology*, 4: 1-11. <https://doi.org/10.1016/j.clet.2021.100174>
- Ranaware, V., Verma, D., Insyani, R., Riaz, A., Kim, S.M., & Kim, J. (2019). Highly efficient and magnetically-separable ZnO/Co@N-CNTs catalyst for hydrodeoxygenation of lignin and its derived species under mild conditions. *Green Chemistry*, 21 (5): 1021-1042. <https://doi.org/10.1039/C8GC03623C>
- Resende, K.A., Teles, C.A., Jacobs, G., Davis, B.H., Cronauer, D.C., Kropf, A.J., Marshall, C.L., Hori, C.E., & Noronha, F.B. (2018). Hydrodeoxygenation of phenol over zirconia supported Pd bimetallic catalysts. The effect of second metal on catalyst performance. *Applied Catalysis B: Environmental*, 232: 213-231. <https://doi.org/10.1016/j.apcatb.2018.03.041>
- Robert, R.W, Soegijono, B., & Rinaldi, N. (2012). Characterization of Cr/Bentonite and HZSM-5 Zeolite as Catalysts for Ethanol Conversion to

- Biogasolin. *Makara Journal of Science*, 16(1):65-70. <http://dx.doi.org/10.7454/mss.v16i1.1283>
- Rusli, N.D., Ghani, A.A.A., Mat, K., Yusof, M.T., Saad, M.Z., Hassim, H.A. (2021). The Potential of Pretreated Oil Palm Frond in Enhancing Rumen Degradability and Growth Performance: A Review. *Advances in Animal and Veterinary Sciences*, 9 (6): 811-822. <https://doi.org/10.17582/journal.aavs/2021/9.6.811.822>
- Sakulkit, P., Palamanit, A., Dejchanchaiwong, R., & Reubroycharoen, P. (2020). Characteristics of pyrolysis products from pyrolysis and co-pyrolysis of rubber wood and oil palm trunk biomass for biofuel and value-added applications. *Journal of Environmental Chemical Engineering*, 8(6): 1-15. <https://doi.org/10.1016/j.jece.2020.104561>
- Salema, A.A., & Ani, F.N. (2012). Microwave-assisted pyrolysis of oil palm shell biomass using an overhead stirrer. *Journal of Analytical and Applied Pyrolysis*, 96:162–172. <http://dx.doi.org/10.1016/j.jaap.2012.03.018>
- Sankar, G.U., Yuvakkumar, R., Ravi, G., Rajkumar, G., & Moorthy, C.G. (2021). Preparation of $\text{CuO}_{1-x}\text{Mn}_x$ ($x= 0.03, 0.05, 0.07$) and MATLAB modelling for sustainable energy harvesting applications. *Journal of Physics: Conference Series*, 1850: 1-9. doi:10.1088/1742-6596/1850/1/012025
- Sembiring, K.C., Rinaldi, N., & Simanungkalit, S.P. (2015). Bio-oil from Fast Pyrolysis of Empty Fruit Bunch at Various Temperature. *Energy Procedia*, 65: 162-169. <https://doi.org/10.1016/j.egypro.2015.01.052>
- Schweitzer, P. A. (2014). *“Handbook of Separation Techniques for Chemical Engineers.”* McGraw-Hill Book Company.
- Shamsabadi, M.K., & Behpour, M. (2021). Fabricated CuO–ZnO/nanozeolite X heterostructure with enhanced photocatalytic performance: mechanism investigation and degradation pathway. *Materials Science & Engineering*, 269: 1-19. <https://doi.org/10.1016/j.mseb.2021.115170>
- Sihombing, J.L, Gea, S., Wirjosentono, B., Agusnar, H., Pulungan, A.N., Herlinawati, Yusuf, M., Hutapea, Y.A. (2020). Characteristic and Catalytic Performance of Co and Co-Mo Metal Impregnated in Sarulla Natural Zeolite Catalyst for Hydrocracking of MEFA Rubber Seed Oil

- into Biogasoline Fraction. *Catalysts*, **10** (121): 1-14
<https://doi.org/10.3390/catal10010121>
- Sitthisa, S, & Resasco, D. E. (2011). Hydrodeoxygenation of Furfural Over Supported Metal, Catalysts: A Comparative Study of Cu, Pd and Ni. *Catalyst letter*, 141:784–791. <http://dx.doi.org/10.1007/s10562-011-0581-7>
- Si, Z., Zhang, X., Wang, C., Ma, L., & Dong, R. (2017). An Overview on Catalytic Hydrodeoxygenation of Pyrolysis Oil and Its Model Compounds. *Catalysts*, 7 (6): 1-22. <https://doi.org/10.3390/catal7060169>
- Sondakh, R.C., Hambali, E., Indrasti, N.S. (2019). Improving characteristic of bio-oil by esterification method. *IOP Conf Ser Earth Environ Sci*, 230: 1-7. <https://doi.org/10.1088/1755-1315/230/1/012071>
- Sparkman, O.D., Penton, Z. E., & Kitson, F. G. (2011). *Gas Chromatography and Mass Spectrometry: A Practical Guide*. USA: Academic Press.
- Tang, B., Song, W.C., Li, S.Y., Yang, E.C., & Zhao, X.J. (2018). Post-synthesis of Zr-MOR as robust solid acid catalyst for the ring-opening aminolysis of epoxides. *New Journal of Chemistry*, 42 (16): 13503-13511. <https://doi.org/10.1039/C8NJ02449A>
- Vasconcelos, S.C., Pinhel, L.F.C., Madriaga, V.G.C., Rossa, V., Batinga, L.G.S., Silva, D.S.A., Santos, R.D.D., Soares, A.V.H., González, E.A.U. Passos, F.B., Varma, R.S., & Lima, T.M. (2022). Selective Synthesis of Levulinic Ester from Furfural Catalyzed by Hierarchical Zeolites. *Catalysts*, 12 (7): 1-18. <https://doi.org/10.3390/catal12070783>
- Wang, S., Wang, Q., Jiang, X., Han, X., & Ji, H. (2013b). Compositional analysis of bio-oil derived from pyrolysis of seaweed. *Energy Conversion and Management*, 68: 273-280. doi.org/10.1016/j.enconman.2013.01.014
- Xu, Y., Zhang, L., Lv, W., Wang, C., Wang, C., Zhang, X., Zhang, Q., & Ma, L. (2021). Two-Step Esterification–Hydrogenation of Bio-Oil to Alcohols and Esters over Raney Ni Catalysts. *Catalyst*, 11(7): 1-10. <https://doi.org/10.3390/catal11070818>
- Zhang, B., Zhang, J., & Zhong, Z. (2018). Low-Energy Mild Electrocatalytic Hydrogenation of Bio-oil Using Ruthenium Anchored in Ordered

- Mesoporous Carbon. *ACS Appl. Energy Mater.*, 1(12): 6758-6763. <https://doi.org/10.1021/acsaem.8b01718>
- Zhang, C.H., Yang, Y., Teng, B.T., Li, T.Z., Zheng, H.Y., Xiang, H.W., & Li, Y. W. (2006). Study of an iron-manganese Fischer-Tropsch synthesis catalyst promoted with copper. *Journal of Catalysis*, 237(2), 405–415. <https://doi.org/10.1016/j.jcat.2005.11.004>
- Zhao, F.W., Zhang, Q., Hui, F., Yuan, J., Mei, S.N., Yu, Q.W., Yang, J.M., Mao, W., Liu, Z.W., Liu, Z.T., & Lu, J. (2020). Catalytic Behavior of Alkali Treated H-MOR in Selective Synthesis of Ethylenediamine via Condensation Amination of Monoethanolamine. *Catalysts*, 10 (4) :1-15. <https://doi.org/10.3390/catal10040386>
- Zhao, X., Wei, L., Cheng, S., Kadis, E., Cao Y., Boakye, E., Gua, Z., & Julson, J. (2016). Hydroprocessing of carinata oil for hydrocarbon biofuel over Mo Zn/Al₂O₃. *Applied Catalysis B: Environmental*, 196 :41-49. <https://doi.org/10.1016/j.apcatb.2016.05.020>
- Zheng, Y., Wang, J., Li, D., Liu, C., Lu, Y., Lin, X., & Zheng, Z. (2021). Activity and selectivity of Ni-Cu bimetallic zeolites catalysts on biomass conversion for bio-aromatic and bio-phenols. *Journal of the Energy Institute*, 97: 58-72. <https://doi.org/10.1016/j.joei.2021.04.008>