



DAFTAR PUSTAKA

- Ahmed, A.I., El-Hakam, S.A., Samra, S.E., EL-Khouly, A.A., and Khder, A.S., 2008, Structural Characterization of Sulfated Zirconia and Their Catalytic Activity in Dehydration of Ethanol, *Colloids Surf. A Physicochem. Eng. Asp.*, 317, 62–70, <https://doi.org/10.1016/j.colsurfa.2007.09.043>
- Akçay, M., Yurdakoç, M., Tonbul, Y., Yurdakoç, K., and Hönicke, D., 1998, FTIR Study of the Adsorption of Ammonia and Pyridine on V₂O₅/MgO Catalysts, *Spectrosc. Lett.*, 31(8), 1719-1732, <https://doi.org/10.1080/-00387019808007448>
- Albayati, T. M., dan Doyle, A. M., 2014, SBA-15 Supported Bimetallic Catalysts for Enhancement Isomers Production During n-Heptane Decomposition, *Int. J. Chem. React. Eng.*, 12(1), 345-354, <https://doi.org/10.1016/j.apcatb.2010.10.024>
- Aluyor, E. O. and Oboh, I. O., 2014, Preservatives: Traditional Preservatives-Vegetable Oils, *Encyclopedia of Food Microbiology*, 3, 137–140, <https://doi.org/10.1016/B978-0-12-384730-0.00263-9>
- Aneu, Wijaya, K., and Syoufian, A., 2020, Silica-Based Solid Acid Catalyst with Different Concentration of H₂SO₄ and Calcination Temperature: Preparation and Characterization, *Silicon*, <https://doi.org/10.1007/s12633-020-00741-6>
- Botas J. A., Serrano D. P., Garcia A., de Vicente J., and Ramos R., 2012, Catalytic Conversion of Rapeseed Oil into Raw Chemicals and Fuels Over Ni- and Mo-modified Nanocrystalline ZSM-5 Zeolit, *Catal. Today*, 195, 59-70, <https://doi.org/10.1016/j.cattod.2012.04.061>
- Chen, R.C., and Wang, W. C., 2019, The Production of Renewable Aviation Fuel from Waste Cooking Oil. Part I: Bio-alkane Conversion through Hydroprocessing of Oil, *Renew. Energ.*, 135, 819-835, <https://doi.org/10.1016/j.renene.2018.12.048>
- Christensen, C. H. and Nørskov, J. K., 2008, A Molecular View of Heterogeneous Catalysis, *J. Chem. Phys.*, 128, 182503, <https://doi.org/10.1063/1.4974931>



- Clearfield, A., Serrette, G.P.D. and Khazi-Syed, A.H., 1994, Nature of Hydrous Zirconia and Sulfated Hydrous Zirconia, *Catal. Today.*, 20, 295-312, [https://doi.org/10.1016/0920-5861\(94\)80008-1](https://doi.org/10.1016/0920-5861(94)80008-1)
- Deltcheff, C. R., Amirouche, M., and Fournier, M., 1992, Structure and Catalytic Properties of Silica-Supported Polyoxomolybdates, *J. Catal.*, 125(2), 292-310, [https://doi.org/10.1016/0021-9517\(92\)90296-T](https://doi.org/10.1016/0021-9517(92)90296-T)
- Ding, W., Liang, J., and Anderson, L.L., 1997, Hydrocracking and Hydroisomerization of High-Density Polyethylene and Waste Plastic over Zeolite and Silica-Alumina-Supported Ni and Ni-Mo Sulfides, *Energ. Fuel.*, 11, 1219-1224, <https://doi.org/10.1021/ef970051q>
- Escobar, S., Bernal, C., Mesa, M., 2015, Relationship Between Sol-Gel Conditions and Enzyme Stability: A Case Study with Beta-Galactosidase/Silica Biocatalyst for Whey Hydrolysis, *J. Biomater. Sci.*, 26, 1126-1138, <https://doi.org/10.1080/09205063.2015.1078929>
- Fu, B., Gao, L., Nia, L., Wei, R., and Xiao, G., 2009, Biodiesel from Waste Cooking Oil via Heterogeneous Superacid Catalyst $\text{SO}_4^{2-}/\text{ZrO}_2$, *Energ. Fuel.*, 23, 569-572, <https://doi.org/10.1021/ef800751z>
- Gates, B.C., Katzer, I.R. dan Schuit, G.C.A., 1979, *Chemistry Catalytic Processes*, New York, <https://doi.org/10.1002/aic.690250427>
- Ghoreishi, K. B., Asim, N., Yarno, M. A., Samsudin, M. W., 2014, Mesoporous Phosphated and Sulphated Silica as Solid Acid Catalyst for Glycerol Acetylation, *Chem. Pap.*, 68 (9), 1195-1204, <https://doi.org/10.2478/s11696-014-0550-x>
- Ghoreishi, K. B., dan Yarmo, M. A., 2010, Sol-gel Sulfated Silica as a Catalyst for Glycerol Acetylation with Acetic Acid, *J. Sci. Technol.*, 65-78, <https://doi.org/10.14710/jksa.23.12.414-423>
- Guevara-Lara, A., Bacaud, R., and Vrinat, M., 2007, Highly Active NiMo/TiO₂-Al₂O₃ Catalysts: Influence of The Preparation and The Activation Conditions on The Catalytic Activity, *Appl. Catal. A-Gen.*, 328(2), 99–108, <https://doi.org/10.1016/j.apcata.2007.05.028>



- Guzman, A., Torres, J. E., Prada, L. P. and Nuñez, M. L., 2010, Hydroprocessing of Crude Palm Oil at Pilot Plant Scale, *Catal. Today.*, 156(1–2), 38–43, <https://doi.org/10.1016/j.cattod.2009.11.015>
- He, T., Liu, X., Ge, Y., Han, D., Li, J., Wang, Z. and Wu, J., 2017, Gas Phase Hydrodeoxygenation of Anisole and Guaiacol to Aromatics with a High Selectivity over Ni-Mo/SiO₂, *Catal. Commun.*, 102, 127-130, <https://doi.org/10.1016/j.catcom.2017.09.011>
- He, F., Zhao, H., Qu, X., Zhang, C., and Qiu, W., 2009, Modified Aging Process for Silica Aerogel, *J. Mater. Process. Technol.*, 209, 1621-1626
- Hello, K. M., and Hlial, E. K., 2019, Modification of Silica with Sulfuric Acid and Phosphoric Acid for Cellulose Hydrolysis, *J. Phys. Conf. Ser.*, 1-10, <https://doi.org/10.1021/ie990690j>
- Herdiansyah, H., Negoro, H. A., Rusdayanti, N., and Shara, S., 2020, Palm Oil Plantation and Cultivation: Prosperity and Productivity of Smallholders, *Open Agric.*, 5, 617-630, <https://doi.org/10.1515/opag-2020-0063>
- Iplik, E., Aslanidou, I. and Kyprianidis, K., 2020, Hydrocracking: A Prespective Towards Digilization, *Sustain.*, 12, 1-26, <https://doi.org/10.3390/su12-177058>
- Jafarzadeh, M., Rahman, I. A., and Sipaut, C.S., 2009, Synthesis of Silica Nanoparticles by Modified Sol-Gel Process: The Effect of Mixing Modes of The Reactants and Drying Techniques, *J. Sol-Gel Sci. Technol.*, 50, 328-336, <https://doi.org/10.1007/s10971-009-1958-6>
- Jeon, H.J., Yi, S.C., Oh, S.G., 2003, Preparation and Antibacterial Effects of Ag-SiO₂ Thin Films by Sol–Gel Method, *Biomaterials*, 24, 4921-4928, [https://doi.org/10.1016/S0142-9612\(03\)00415-0](https://doi.org/10.1016/S0142-9612(03)00415-0)
- Keller, T. C., Arras, J., Haus, M. O., Hauert, R., Kevin, A., Kevin, J., and Ramierez, J. P., 2016, Synthesis-Propretiy-Performance Relationships of Amorphous Silica Alumina Catalysts for The Production of Methylene dianiline And Higher Homologues, *J. Catal.*, 344, 757-767, <https://doi.org/10.1016/j.jcat.2016.08.016>



- Khowatimy, F.A., Priastomo, Y., Febriyanti, E., Riyantoko, H. and Trisunaryanti, W., 2014, Study of Waste Lubricant Hydrocracking into Fuel Fraction Over Combination of Y-Zeolite and ZnO Catalyst, *Proc. Environ. Sci.*, 20, 225-234, <https://doi.org/10.1016/j.proenv.2014.03.029>
- Koçar, G. and Civaş, N., 2013, An Overview of Biofuels From Energy Crops: Current Status and Future Prospects, *Renew. Sustain. Energy Rev.*, 28, 900-916, <http://dx.doi.org/10.1016/j.rser.2013.08.022>
- Kusuma, R.I., Hadinoto, J.P., Ayucitra, A., Soataredjo, F.E., and Ismadji, S., 2013, Natural Zeolite from Pacitan Indonesia, as a Catalyst Support for Transesterification of Palm Oil, *Appl. Clay Sci.*, 74, 121-126, <https://doi.org/10.1016/j.clay.2012.04.021>
- Mohanty, S., Kunzru, D., dan Saraf, D.N., 1999, Hydrocracking: A Review, *Fuel*, 69(12), 1467-1473, [https://doi.org/10.1016/0016-2361\(90\)90192-S](https://doi.org/10.1016/0016-2361(90)90192-S)
- Nugrahaningtyas, K. D., Rahmawati, N., Rahmawati, F. and Hidayat, Y., 2019, Synthesis and Characterization of CoMo/Mordenite Catalyst for Hydrotreatment of Lignin Compound Models, *Open Chem. J.*, 17(1), 1061-1070, <https://doi.org/10.1515/chem-2019-0120>
- Nugroho, A. P. P. N., Fitriyanto, D. dan Roesyadi, A., Pembuatan Biofuel dari Minyak Kelapa Sawit melalui Proses Hydrocracking dengan Katalis Ni-Mg/ γ -Al₂O₃, *Jurnal Teknik POMITS*, 3(2), 117-121.
- Nurjannah, Roesyadi, A., dan Prajitno, D. H., 2012, Konversi Katalitik Minyak Sawit Untuk Menghasilkan Biofuel Menggunakan Silika Alumina Dan HZSM-5 Sintesis, *Reaktor*, 13(1), 37-43, <https://doi.org/10.14710/reaktor.-13.1.37-43>
- Ore, M.S, L., Wijaya, K., Trisunaryanti, W., Saputri, W.D., Heraldy E., Yuwana, M.W., Hariani, P.L., Budiman, A., and Sudiono, S., 2020, The Synthesis of SO₄/ZrO₂ and Zr/CaO Catalysts Via Hydrothermal Treatment and Their Application for Conversion of Low-grade Coconut Oil into Biodiesel, *J. Environ. Chem. Eng.*, 8, 104-205, <https://doi.org/10.1016/j.jece.2020.-104205>



- Patel, A., Brahmkhatri, V., and Singh, N., 2013, Biodiesel Production by Esterification of Free Fatty Acid over Sulfated Zirconia, *Renew. Energ.*, 51, 227-233.
- Pambudi, D. R. S. dan Zainuri, M., 2016, Pengaruh Waktu Tahan Proses Kalsinasi *Precursor Silika Sebagai Material Pelapis Hidrofobik*, *Jurnal Sains dan Seni ITS*, 5(2), 2337-3520, <http://dx.doi.org/10.12962/j23373520.v5i2-17913>
- Purwanto, A.S., Taslimah, dan Sriatun, 2012, Sintesis dan Karakterisasi Silica Gel dari Tetraethylortosilikat (TEOS) Menggunakan Surfaktan Polyethylene Glycol (PEG) 6000 dalam Kondisi Basa, *Jurnal Kimia Sains dan Aplikasi*, 15(1), 1-6, <https://doi.org/10.14710/jksa.15.1.1-6>
- Rad, M. R., Rashidi, M. A., and Vafajoo, L., 2012, The Effect of Support in NiMo Catalyzed Hydrocracking of Extra Heavy Oil, *4th Int. Conf. Nanostructures*, Kish Island, I. R. Iran.
- Radwan, N., Hagar, M., Afifi, T., Al-wadaani Fahd, and Okasha, R., 2018, Catalytic Activity of Sulfated and Phosphate Catalysts Towards the Synthesis of Substituted Coumarin, *Catalyst*, 8(1), 1-18, <https://doi.org/10.3390/catal-8010036>
- Rasheed, S., Rao, D. N., Reddy, A. S., Shankar, R., dan Das, P., 2015, Sulphuric Acid Immobilized on Silica Gel ($H_2SO_4-SiO_2$) as an Eco-friendly Catalyst for Transamidation, *RSC Adv.*, 5(14), 10567-10574, <https://doi.org/10.1039/C4RA16571C>
- Ren, J., Wang, A., Li, X., Chen, Y., Liu, H., and Hu, Y., 2008, Hydrodesulfurization of Dibenzothiophene Catalyzed by Ni-Mo Sulfides Supported on a Mixture of MCM-41 and HY Zeolite, *Appl. Catal. A-Gen.*, 344, 175-182, <http://dx.doi.org/10.1016/j.apcata.2008.04.017>
- Ristianingsih, Y., Hidayah, N. dan Sari, F. W., 2016, Pembuatan Biodiesel Dari Crude Palm Oil (CPO) Sebagai Bahan Bakar Alternatif Melalui Proses Transesterifikasi Langsung, *J. Teknol. Agro Industri.*, 2(1), 38, <http://doi.org/10.34128/jtai.v2i1.23>.



- Rohmah, R. and Zainuri, M., 2016, Pengaruh Variasi Temperatur Kalsinasi SiO₂ terhadap Sifat Kebasahan pada Permukaan, *Jurnal Sains dan Seni ITS*, 5(2), 3–6, <http://dx.doi.org/10.12962/j23373520.v5i2.17243>
- Salman, M. N., Krisdiyanto, D., Khamidinal, K. and Arsanti, P., 2015, Preparasi Katalis Silika Sulfat dari Abu Sekam Padi dan Uji Katalitik Pada Reaksi Esterifikasi Gliserol Dengan Anhidrida Asam Asetat, *Reaktor*, 15, 231–240, <https://doi.org/10.14710/reaktor.15.4.231-240>
- Santos, R. C. R., Braga, D. M. V., Pinheiro, A. N., Leite, E. R., Freire, V. N., Longhinotti, E. and Valentini, A., 2016, Role of Cu, Ni and Co Metals in The Acidic and Redox Properties of Mo Catalyst Supported on Al₂O₃ Spheres for Glycerol Conversion, *Catal. Sci. Technol.*, 6(13), 4986-5002, <https://doi.org/10.1039/C6CY00096G>
- Said, A. E. A., El-Wahab, M. M. A., and El-Aal, M. A., 2014, The Catalytic Performance of Sulfated Zirconia in The Dehydration of Methanol to Dimethyl Ether, *J. Mol. Catal. Chem.*, 394, 40-47, <https://doi.org/10.1016/j.jmocata.2014.06.041>
- Shah, S., Marin, F. O. G., Chinnathambi, K., Norton, M.G., and Ha, S., 2016, Partial Oxidation of Surrogate Jet-A Fuel Over SiO₂ Supported MoO₃, *Appl. Catal. Environ.*, 193, <http://dx.doi.org/10.1016/j.apcatb.2016.03.064>
- Sihombing, J. L., Trisunaryanti, W., Purwono, S., Syoufyan, A., dan Triyono, 2008, Sintesis dan Karakterisasi Katalis NiO-CoO-MoO₃/Zeolit Alam dan NiO-MoO₃-CoO/Zeolit Alam dan Uji Katalisasi pada Proses Hidrorengkah Pelumas Bekas, *Bmipa*, 18 (2), 90-101.
- Sitorus, B., Hidayat, R. D. R. dan Prasetya, O., 2014, Pengelolaan Penggunaan Bahan Bakar Minyak yang Efektif pada Transportasi Darat, *J. Manaj. Transp. Logist.*, 1(2), 117-126.
- Speight, J. G., 2013, *Heavy and Extra-heavy Oil Upgrading Technologies*, Gulf Professional Publishing, United Kingdom, <https://doi.org/10.1016/B978-0-12-404570-5.00002-8>.
- Sugianto, D. J., Wijaya, K. dan Tahir, I., 2014, Karakterisasi dan Aplikasi Katalis Nickel-Molibdenum Teremban pada Zeolit Alam Aktif untuk Hidrorengkah



Tir Batubara, *Jurnal Natur Indonesia*, 16(1), 10-22, <http://doi.org/10.3125-8/jnat.16.1.10-22>

Sunajadevi, K., and Sugunan, S., 2004, Synthesis, Characterization and Benzylation Activity of Nanocrystalline Chromia Loaded Sulfated Titania Prepared Via Sol-Gel Route, *Catal. Commun.*, 5, 575–581, <http://dx.doi.org/10.1016/j.catcom.2004.07.006>

Suseno, A., Wijaya, K., Trisunaryanti, W. and Roto, 2018, Synthesis and Characterization of Ni-Cu Doped Zirconia-pillared Bentonite, *Orient. J. Chem.*, 34(3), 1427-1431, <http://dx.doi.org/10.13005/ojc/340332>

Stanitski, C. L., Eubanks, L. P., Middlecamp, C. H., and Pienta, N. J., 2003, *Chemistry in Context Applying Chemistry to Society 4 ^th ed.*, Mc-Graw-Hill, New York.

Twaiq, F. A., Zabidi, N. A. M., and Bhatia, S., 1999, Catalytic Conversion of Palm Oil to Hydrocarbons: Performance of Various Zeolite Catalysts, *Ind. Eng. Chem. Res.*, 38(9), 3230-3237, <https://doi.org/10.1021/ie980758f>

Wang, D., Romer, F., Connell, L., Walter, C., Saiz, E., Yue, S., Lee, P. D., McPhail, D. S., Hanna, J. V. and Jones, J. R., 2015, Highly Flexible Silica/Chitosan Hybrid Scaffolds with Oriented Pores for Tissue Regeneration, *J. Mater. Chem. B.*, 3, 7560-7576, <https://doi.org/10.1039/C5TB00767D>

Wijaya, K., Kurniawan, M. A., Saputri, W. D., Trisunaryanti, W., Mirzan, M., Hariani, P. dan Tikoalu, A., 2021, Synthesis of Nickel Catalyst Supported on ZrO₂/SO₄ Pillared Bentonite and Its Application for Conversion of Coconut Oil into Gasoline via Hydrocracking Process, *J. Environ. Chem. Eng.*, 9(1), 1-11, <http://dx.doi.org/10.1016/j.jece.2021.105399>

Wijaya, K., Ariyanti, A. D., Tahir, I., Syoufian, A., Rachmat, A. and Hasanudin, 2018, Synthesis of Cr/Al₂O₃-Bentonite Nanocomposite as the Hydrocracking Catalyst of Castor oil, *NHC.*, 19, 46–54, <http://dx.doi.org/10.4028/www.scientific.net/NHC.19.46>

Wiratmaja, I., 2010, Pengujian Karakteristik Fisika Biogasoline Sebagai Bahan Bakar Alternatif Pengganti Bensin Murni, *Jurnal Energi Dan Manufaktur*, 4(2), 145-154.



UNIVERSITAS
GADJAH MADA

SINTESIS KATALIS SILIKA TERSULFATASI TEREMBAN LOGAM NiMo UNTUK HIDRORENGKAH
MINYAK SAWIT SEGAR
MENJADI BIOGASOLIN
AMALIA FEBIA PRATIWI, Prof. Dr.rer.nat. Karna Wijaya, M.Eng. ; Akhmad Syoufian, Ph.D.
Universitas Gadjah Mada, 2021 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- Xiao, T., Shirvani, T., Inderwildi, O., Gonzalez-Cortes, S., AlMegren, H., King, D. dan Edward, P. P., 2015, The Catalyst Selectivity Index (CSI): A Framework and Metric to Assess the Impact of Catalyst Efficiency Enhancements upon Energy and CO₂ Footprints, *Top. Catal.*, 58, 682-695, <http://doi.org/10.1007/s11244-015-0401-1>
- Yusoff, S., 2004, Renewable Energy from Palm Oil Innovation on Effective Utilization of Waste, *J. Clean. Prod.*, 14, 87-93, <https://doi.org/10.1016/j.jclepro.2004.07.005>
- Zarei, A., Khazdooz, L., Aghaei, H., Gheisari, M.M., Alizadeh, S. and Golestanifar, L., 2017, Synthesis of Phenols by Using Aryldiazonium Silica Sulfate Nanocomposites, *Tetrahedron*, 73, 6954–6961, <https://doi.org/10.1016/j.tet.2017.10.057>
- Zhang, J., Zhang, B., Zhou, J., Li, J., Shi, C., Huang, T., Shi, C., Huang, T., Wang, Z., and Tang, J., 2011, H₂SO₄-SiO₂: Highly Efficient and Reusable Catalyst for per-O-Acetylation of Carbohydrates Under Solvent-Free Conditions, *J. Carbohydr. Chem.*, 30(3), 165-177, <https://doi.org/10.1080/07328303.2011.621042>