

REFERENCES

- Ackley, M.W., Rege, S.U., and Saxena, H., 2003, Application of natural zeolites in the purification and separation of gases, *Microporous Mesoporous Mater.*, 61, 25–42.
- Adri, N.C., Laak, V., Sophia, L., Sagala, Jovana, Zečević, Friedrich, H., Petra, E., Jongh, D., and Krijn P., 2010, Mesoporous mordenites obtained by sequential acid and alkaline treatments catalysts for cumene production with enhanced accessibility, *J. Catal.*, 276, 170-180.
- Ahmad, M., Farhana, R., Raman, A.A.A., and Bhargava, S.K., 2016, Synthesis and activity evaluation of heterometallic nano oxides integrated ZSM-5 catalysts for palm oil cracking to produce biogasoline, *Energy Convers. Manag.*, 119, 352–360.
- Ahmad, M.H., Ibrahim, W.A., Sazali, J., Izhah, I., and Zulkafli, H., 2020, Thermal process of castor and plant-based oil, *Indones. J. Chem.*, 20, 237-247
- Ajala, O.E., Aberuagba, F., and Odetoye, T. E., 2015, Biodiesel: sustainable energy replacement to petroleum-based diesel fuel, *Chem. Bio Eng.*, 2, 145 – 156.
- Alver, B. F., and Esenl, F., 2017, Acid treated mordenites as adsorbents of C₂H₄ and H₂ gases, *Microporous Mesoporous Mater.*, 244, 67–73.
- Andrei, V.A., Tatiana Y.O., Dmitrii, A., Prozorov, and Lukin, M.V., 2016, Selective blockage of the catalyst active sites for the hydrogenation of various functional nickel groups over raney nickel and nickel supported on silica, *Green Chem.*, 2, 2471 -2476.
- Anuar, M.Z., and Abdullah, A.Z., 2016, Challenges in biodiesel industry with regards to feedstock, environmental, social and sustainability issues: a critical review, *Renew. Sustain. Energy Rev.*, 58, 208 -223.
- Atbani, A E., Silitonga As., Ong, H.C., Mahlia , T.M.L., Masjuki , H.H., Badruddin, I.A., and Fayaz, H., 2013, Non-edible vegetable oils; a critical evaluation of oil extraction fatty acid compositions, biodiesel productions, characteristic, engine performance, and emissions production and refining technologies, *Renew. Sustain. Energy Rev.*, 16, 3470-4356.
- Ates, A., 2018, Effect of alkali-treatment on the characteristics of natural zeolites with different compositions, *J. Colloid Interface Sci.*, 523, 266–281.
- Bao, J., Yang, G., Okada, C., Yoneyama, Y., and Tsubaki, N., 2011, H-type zeolite coated iron-based multiple-functional catalyst for direct synthesis of middle isoparaffins from syngas, *J. Appl. Catal. A Gen.*, 394, 195–200.

- Barczyk, K., Mozgawa, W., and Król, M., 2014, Studies of anions sorption on natural zeolites, *Spectrochim. Acta Part A Mol. Biomol. Spectrosc.*, 133, 876–882.
- Bernard, P., Stelmachowski, P., Broś, P., Makowski, W., and Kotarba, A., 2021, Demonstration of the influence of specific surface area on reaction rate in heterogeneous catalysis, *J. Chem. Educ.*, 98, 935-940.
- Bertrand-Drira, C., Cheng X. W., Cacciaguerra, T., Trens, P., Melinte, G., Ersen, O., Minoux, D., Finiels, A., Fajula, F., and Gerardin, C., 2015, Mesoporous mordenites obtained by desilication: mechanistic considerations and evaluation in catalytic oligomerization of pentene, *Microporous Mesoporous Mater.*, 213, 142-149.
- Bezergianni, S., Dimitriadis, A., and Meletidis, G., 2014, Effectiveness of CoMo and NiMo catalysts on co-hydroprocessing of heavy atmospheric gas oil-waste cooking oil mixtures, *Fuel*, 125, 129-136.
- Borges, L. D., and Macedo, J. L., 2016, Solid State Dealumination of zeolite Y: structural characterization and 242 acidity analysis by calorimetric measurements, *Microporous Mesoporous Mater.*, 236, 85 - 93.
- Cedilnik, J., and Pražnikar, J., 2016, Particulate matter (PM10) patterns in Europe: an exploratory data analysis using non-negative matrix factorization, *Atmos. Environ.*, 132, 217–228.
- Gea, S., Haryono, A., Andriyani, Sihombing, J.L., Pulungan, A.N., Nasution, T., Rahayu, and Hutapea, A.Y., 2020, The effect of chemical activation using base solution with various concentrations towards sarulla natural zeolite, *J. Environ. Earth. Sci.*, 6, 85-95.
- Hew, K. L., Tamidi, A.M S., Yusup, K.T., Lee, M.M., and Ahmad, 2010, Catalytic cracking of bio-oil to organic liquid product, *Bioresour Technol.*, 101, 8855-8858.
- Horáček, J., Tišler, Z., Rubáš, V., and Kubička D., 2014, HDO catalyst for triglycerides conversion into pyrolysis and isomerization feedstock, *Fuel*, 121, 57-64.
- Kamel, D.A., Farag, H.A., Amin, N.K., Zatout, A.A., and Ali, R.M., 2018, Smart utilization of jatropha (*jatropha curcas linnaeus*) seeds for biodiesel production: optimization and mechanism, *Ind. Crops Prod*, 111, 407–413.
- Korkuna, O., Lebeda, R., Skubiszewska-Zieba, T., Vrublevs'ka, Gun'ko, V.M., and Ryzkowski, J., 2006, Structural and physicochemical properties of natural zeolites: clinoptilolite and mordenite, *Microporous Mesoporous Mater.*, 87, 234-254.

- Kosinov, N., Liu, C., Emiel, J.M., Hensen, Evgeny, A., and Pidko., 2018, Engineering of transition metal catalysts confined in zeolites, *Chem. Mater.*, 30, 3177-3198
- Krause, J., and Špicka, J, 2013, Economic analysis of chemical industry, *Chelsea mag.*, 107, 573–578.
- Krisnandi, Y.K., Mahmuda, I., Rahayu D.U.C., and Sihombing, R., 2018, Synthesis and characterization of ZSM-5 zeolite from dealuminated and fragmented Bayat-Klaten natural zeolite, *J. Phys. Chem. Solids*, 109, 120-125
- Kristiani, A., Sudiyarmanto, Fauzan, A., and Hidayati., 2017, Metal supported on natural zeolite as catalysts for conversion of ethanol to gasoline, *Matec Web Conf.*, 101, 51-56.
- Kustovska, A.D., 2017, Adsorption methanol and water vapor on modified forms of mordenite-clinoptilolite rocks, *Adsorp Sci Technol.*, 5, 1-9.
- Luque R., and De S., 2014, Upgrading of waste oils into transportation fuels using hydrotreating technologies, *Biofuel Res J.*, 4, 107-109.
- Long, C., Chen, X., Jiang, L., Zhi, L., and Fan, Z., 2015, Porous layer-stacking carbon derived from in-built template in biomass for high volumetric performance supercapacitors, *Nano Energy*, 12, 141.
- Lopez, S., Inayat, A., Schwab, A., Selvam, T., and Schwieger, W., 2011, Zeolitic materials with hierarchical porous structures, *Adv. Mater.*, 23, 260.
- Luo, W., Cao, W., Bruijninx, P. C. A., Lin, L., Wang, A., and Zhang, T., 2019, Zeolite-supported metal catalysts for selective hydrodeoxygenation of biomass-derived platform molecules, *Green Chem*, 21, 3744–3768.
- Madankar, G., Pradhan, S., and Naik, S.N P., 2013, Parametric study of reactive extraction of castor seeds for methyl ester production and its potential use as bio lubricant, *Green Chem*, 43, 283-290.
- Mahardiani, L., Trisunaryanti, W., and Triyono, 2010, Preparation and characterization of natural zeolite catalyst for hydrocracking of palm oil, *Int. J. Chem. Sci.*, 20, 345-348.
- Martinez, C., and Corma, A., 2011, Inorganic molecular sieves: preparation, modification and industrial application in catalytic processes, *Coord. Chem. Rev.*, 25, 1558-1580.
- Moshoeshoe, M., Tabbiruka, M.S.N., and Obuseng, V., 2017, A review of the chemistry, structure properties and applications of zeolites, *Am.J.Mater.Sci*, 5, 196-221.

- Nurliati, T. G., Krisnandi, Y. K., Sihombing, R., and Salimin, Z., 2015, Studies of modification of zeolite by tandem acid-base treatments and its adsorptions performance towards thorium, *Atom Indones*, 41, 87 – 95.
- Orozco, L. M., Echeverri, D. A., Sánchez, L., and Rios, L. A., 2017. Second generation green diesel from castor oil: development of a new and efficient continuous-production process. *J. Chem. Eng*, 322, 149–156.
- Oseke, G.G., Atta, A.Y., Mukhtar, B., Yakubu, and Aderemi, B.O., 2020, Increasing the catalytic stability of Zn/ZSM-5 with copper for enhanced propane aromatization, *J. King Saud Univ. Sci.*, 20, 1018-1039.
- Pimerzin, A.A., Nikulshin, A.V., and Mozhaves, 2013, Effect of surface modification of the support of hydrotreating catalysts with transition metal oxides (sulfides) on their catalytic properties, *Pet Chem*, 53, 245-254.
- Procházka, and P., Hönl, V., 2018, Economic analysis of diesel-fuel replacement by crude palm oil in Indonesian power plants, *Energies*, 11, 504-513.
- Purba, S. E., Wijaya, K., Trisunaryanti, W., and Pratika, R. A., 2021, Dealuminated and desilicated natural zeolite as a catalyst for hydrotreatment of used cooking oil into biogasoline, *Mediterr. J. Chem.*, 11, 75-83.
- Rabie, A. M., Shaban, M., Abukhadra, M.R., Hosny, R., Ahmed, S.A., Negm, and M.A., 2019, Diatomite supported by CaO/MgO nanocomposite as heterogeneous catalyst for biodiesel production from waste cooking oil, *J. Mol. Liq.* 279, 224 -231.
- Ramesh, K., Reddy, S., Rashmi, I., and Biswas, A.K., 2014, Porosity distribution, surface area and morphology of synthetic potassium zeolites: A SEM and N₂ adsorption study, *Commun Soil Sci Anal.*, 16, 37-41.
- Reule, A.A.C., Sawada, J.S., and Semagina, N., 2017, Effect of selective 4-membered ring dealumination on mordenite-catalyzed dimethyl ether carbonylation., *J. Catal.*, 2017, 349, 98–109.
- Schwieger. W., 2016, Hierarchy concepts: classification and preparation strategies for zeolite containing materials with hierarchical porosity, *Chem. Soc. Rev*, 45, 3353–3376.
- Sihombing J.L, Pulungan, A.N., Herlinawati, Yusuf, Gea, Agusnar, and Hutapea, 2020, Characteristic and catalytic performance of co and co-mo metal impregnated in sarulla natural zeolite catalyst for hydrotreatment of mefa rubber seed oil into biogasoline fraction, *J. Catal.*, 10, 121-129.
- SooYoung, N., 2014, Application of hydrotreated vegetable oil from triglyceride-based biomass to CI engines – a review, *Fuel*, 115, 88–96.

- Song, Y. Q., 2009, Effect of variations in pore structure and acidity of alkali treated ZSM-5 on the isomerization performance, *J. Mol. Catal. A. Chem.*, 310, 130–137.
- Sousa, L. V., Silva, A. O. S., and Silva, B. J. B., 2018, Preparation of zeolite P by desilication and recrystallization of zeolites ZSM22 and ZSM-35, *Mater. Lett.*, 217, 259–262.
- Sun, H., Peng, P., Wang, Y., Li, C., Subhan, F., Bai, P., Xing, W., Zhang, Z., Liu, Z., and Yan, Z., 2017, Preparation, scale-up and application of meso-ZSM-5 zeolite by sequential desilication–dealumination, *J. Porous Mater.*, 24, 1513–1525.
- Trisunaryanti, W., Triyono, Rizki, N.C., Saptoadi, H., Zainal, A., Syamsiro, M., and Yoshikawa, K., 2013, Characteristic of metal supported-zeolite catalysts for hydrocracking of polyethylene terephthalate, *JAC*, 3, 29-34.
- Tugsuu, T., Sugimoto, Y., and Enkhsaruul, B., 2017, Preparation of the natural zeolite-based catalyst for hydrotreatment process of petroleum derived atmospheric residue, *J. Mater. Sci.*, 5, 14-22.
- Tye, C.T., 2019, Catalysts for hydrotreatment of heavy oils and petroleum residues, *Intech*, 10, 436-450.
- Vorontsov, A. V., Valdés, H., and Smirniotis, P. G., 2019, Design of active sites in zeolite catalysts using modern semiempirical methods: The case of mordenite, *Comput. Theor. Chem.*, 1166, 112572.
- Wijaya, K., Baobalabuana, G., Trisunaryanti, W., and Syoufian, A., 2013, Hydrotreatment of palm oil into biogasoline catalyzed by Cr/natural zeolite, *Asian J. Chem.*, 16, 8981-8986.
- Wu, Y., Tian, F., Liu, J., Song, D., Jia, C., and Chen, Y., 2012, Enhanced catalytic isomerization of α -pinene over mesoporous zeolite beta of low Si/Al ratio by NaOH treatment, *Microporous Mesoporous Mater.*, 162, 168–174.
- Ying, W., Tanja, E., and Zecevic, J., 2015, tailoring and visualizing the pore architecture of hierarchical zeolites, *Chem. Soc. Rev.*, 44, 7234–7235.
- Zarchin, R., Rabaev, M., Vidruk-Nehemya, R., Landau, M.V., and Herskowitz, M., 2015, Hydroprocessing of soybean oil on nickel-phosphide supported catalysts, *Fuel*, 139, 684–691.
- Zhang, Q., Wang, T., Xu, T., and Zhang, L., 2014, Production of liquid alkanes by controlling reactivity of sorbitol hydrogenation with a Ni/HZSM -5 catalyst in water, *Energy Conv. Manag.*, 77, 226 -268.



THE EFFECT OF ACETIC ACID AND SODIUM HYDROXIDE TREATMENT TOWARDS THE CHARACTER OF WONOSARI NATURAL ZEOLITE AS Cu, Ni AND Zn METAL SUPPORT FOR HYDROTREATMENT CATALYST OF CASTOR OIL INTO BIOFUEL

LAILATUL RAHMI, Prof. Dr. Iip Izul Falah; Prof. Dra. Wega Trisunaryanti, M.S., Ph.D.Eng

Universitas Gadjah Mada, 2021 | Diunduh dari <http://etd.repository.ugm.ac.id/>

Zhao, X., Wei, L., Julson, J., Gu, Z., and Cao, Y., 2015, Catalytic cracking of inedible camelina oils to hydrocarbon fuels over bifunctional Zn/ZSM-5 catalysts, *Korean J. Chem. Eng.*, 32, 1528–1541.