

DAFTAR PUSTAKA

- Abbasian F., Lockington, R., Mallavarapu, M., Naidu, R. (2015). A Pyrosequencing-Based Analysis of Microbial Diversity Governed by Ecological Conditions in The Winogradsky Column. *World J Microbiol Biotechnol*, 1115-1126.
- Abidin, N., Wahdaniar., Febrianti, N., Syarifah, S.M. (2023). Pengurai Sampah Plastik Ramah Lingkungan. *Bincang Sains dan Teknologi (BST)*, 31(7), 63-71.
- Adzami, N. S., Ghazali, M. F., Ramli, A. H., Tajarudin, H. A., Daud, Z. (2018). A New Potential of Calcium Carbonate Production Include by *Bacillus sphaericus* in Batch Fermentation. *International Journal of Integrated Engineering*. 10(9): 130-134.
- Afriyanto, B., Indriyanti, E.W., Hardini, P. (2019). Pengaruh Limbah Plastik Low Density Polyethylene Terhadap Karakteristik Dasar Aspal. *Jurnal Transportasi*, 19(1), 59-66.
- Albertsson, A.-C., Andersson, S. O., & Karlsson, S. (1994). The mechanism of biodegradation of polyethylene. *Polymer Degradation and Stability*, 45(1), 121-135.
- Alizadeh, H., & Pawlik, M. (2024). The Effect of Anionicity On Mechanical Degradation Of Polyacrylamide-type Flocculants. *Polymer Degradation and Stability*, 223(7), 1-10.
- American Society for Testing Material International (2021). *Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis* (Standard No. ASTM E1252-98). 1-7.
- American Society for Testing Material International (2021). *Standard Test Method for Compositional Analysis by Thermogravimetry* (Standard No. ASTM E1131). 1-3.
- Andrady, A. L. (2011). Microplastics In the Marine Environment. *Marine Pollution Bulletin*, 62(8), 1596-1605.
- Arakawa, C., & DeForest, C. 2017. Polymer Design and Development. *Biology and Engineering of Stem Cell Niches*. 295-314.
- Asmi, N., Baharuddin, M., Febryanti. (2022). Skrining Mikroba Pendegradasi Plastik Dari Tanah Dan Uji Biodegradasi Menggunakan Fourier Transform Infrared (FTIR). *Al-Kauniyah: Jurnal Biologi*, 15(1), 151-163.

- Auta, H. S., Emenike, C. U., & Fauziah, S. H. (2017). Distribution and importance of microplastics in the marine environment: A review of the sources, fate, effects, and potential solutions. *Environment International*, 102, 165–176.
- Aziz, I. R., & Hafsan (2019). Biodegradasi Plastik LDPE Hitam dan Putih Pada Sampah TPA Antang Dalam Kolom Winogradsky. *Al-Kauniyah*, 166-172.
- Azizah. (2009). Polimer Berdasarkan Sifat Thermalnya. *Chem-is-Try.Org*.
- Badriyah, L., & Shovitri, M. (2015). Biodegradasi Plastik Putih dalam Kolom Winogradsky. *Jurnal Sains dan Seni ITS*, 50-54.
- Bahri, S., Zulkifli, L., Rasmi, D.A.C., Sedijani, P. (2021). Isolation, Purification, and Toxicity Test of *Bacillus thuringiensis* from Cows Cage Soil Againsts *Drosophila melanogaster*. *Jurnal Biologi Tropis*. 21 (30): 1106-1114.
- Bando, Y., Kato, T., Yasuda, K., Sakurai, Y., Nakamura, M. (1999). Wastewater Treatment by Anaerobic-Aerobic Activated Sludge Method in Bubble Column with Draft Tube. *Journal of Chemical Engineering of Japan*. 32(6): 770-775.
- Brito, M, J. L., Rivero, J. C. S., Rodriguez, S. B. (2018). Effects of Medium Composition and Gas Superficial Velocity on Mass Transfer during Microalgae Culturing in a Bubble Column Photobioreactor. *Industrial & Engineering Chemistry Research*. 57(50):17058-17063.
- Celina M. C., Linde, E., & Martinez, E. (2021). Carbonyl Identification and Quantification Uncertainties for Oxidative Polymer Degradation. *Polymer Degradation and Stability*, 183, 109423.
- Clarinsa, R.M., & Sutoyo, S. (2021). Pembuatan dan Karakterisasi Plastik Biodegradable dari komposit HDPE (High Density Polyethylene) dan Pati Umbi Suweg (*Amorphophallus campanulatus*). *UNESA Journal of Chemistry*, 10(1), 85-95.
- Crawford, C.B., & Quinn, B. (2017). Microplastic Pollutants. *Elsevier*.
- Damayanti, N., Sulaiman, N., & Ibrahim, N. (2020). Plastic Biodegradation by *Pseudomonas aeruginosa* UKMCC1011 Using A Modified Winogradsky Coloumb. *Science and Engineering*, 7(2), 43-49.
- Faridawfilati, D., & Sudarti. (2021). Pengetahuan Masyarakat Tentang Dampak Pembakaran Terhadap Lingkungan Kabupaten Jember. *Jurnal Sanitasi Lingkungan*, 1(2), 50-55.
- Farnholz, A.F., Schweighuber, A., Klampfl, C.W., Fischl, J. (2023). Comparative study on the degradation of HDPE, LLDPE and LDPE during Multiple Extrusions. *Polymer Degradation and Stability*, 216, 1-8.

- Fibriarti, B. L., Feliatra., Amin, B., Darwis. (2021). Biodegradation of LDPE Plastic By Local Strain Of *Bacillus* sp. Isolated from Dump Soil of Pekanbaru, Indonesia. *Biodiversitas*. 22(12): 5484-5490.
- Fuente, E., Marrakchi, F., Cadena, E. M., García, J. C., & Tamayo, A. (2020). Thermogravimetric Analysis For Characterizing Polymer Degradation During Biodegradation Processes. *Polymers*, 12(3), 657.
- Gajendiran, A., Krishnamoorthy, S., & Abraham, J. (2016). Microbial degradation of low-density polyethylene (LDPE) by *Bacillus cereus*. *3 Biotech*, 6, 52.
- Gewert, B., Plassmann, M. M., & MacLeod, M. (2015). Pathways for degradation of plastic polymers floating in the marine environment. *Environmental Science: Processes & Impacts*, 17(9), 1513–1521
- Hanafiah, M. H., Husin, M. A., & Amran, R. (2003). Populasi Mikroorganisme Tanah dan Peranannya Dalam Proses Degradasi Polimer. *Soil Microbiology Journal*, 12(4), 45–56.
- Haque, E., Rahman, M. M., & Islam, M. S. (2020). Biodegradation of Synthetic Plastics by *Bacillus* Species Isolated From Landfill Soil. *Environmental Technology & Innovation*, 19, 100879.
- Hidayat, T. R., Indrawati, I., Herlina, T. (2020). Isolasi dan Identifikasi Bakteri Pendegradasi *Styrofoam* Asal Tanah Tempat Pembuangan Akhir Sarimukti Bandung. *Jurnal Pendidikan dan Biologi*, 110-116.
- Humaira, T., Kurniawan, B., Hsanah, S., Christina, E., At-Tsaqib. (2022). Modifikasi Struktur Polistirena Menggunakan Maleat Anhidrida sebagai Pengikat Silang dan Benzoil Peroksida sebagai Inisiator. *Asian Journal of Mechatronics, and Electrical Engineering (AJMEE)*, 1(1), 25-34.
- Irdawati., Azizah, D.F., Amanda, N.R., Putri, A., Pebryeni. S., Azhara, S., Efandri, V, C., Suherman, D., Yeriska, F. (2023). Identifikasi dan Karakterisasi Isolat Bakteri LFP di Laboratorium Fisika, Universitas Negeri Padang. *Prosiding Semnas Bio*. 242-252.
- Islam, Z. F., Cherepanov, P., Xu, W., Hayden, H., Colombi, E., Lin, Z., Mazaheri, O., Caruso, F., Chen, D. (2025). Native Polymer Degradation Capacity of Microorganisms In Agricultural Soils. *Science of the Total Environment*. 968:1-12.
- Jain, R., Tiwari, A., & Verma, A. (2017). Microbial Degradation of Plastics: A Review. *Environmental Chemistry Letters*, 15(3), 345–365.
- Jakubowicz, I. (2003). Evaluation of Degradability of Biodegradable Polyethylene (PE). *Polymer Degradation and Stability*, 80(1), 39–43.

- Jamaludin, A., Afghani, F.A., Dwiyantri, H., Saputri, A. (2020). Identifikasi Kerusakan Thermo Gravimetry Analysis Di Hotcell 108 IRM. *PIN Pengelolaan Instalasi Nuklir*, 19-28.
- Juliana, S., Parhusip, M., Simanullang, A., Tita, E., Irawati, W. (2022). Potential of *Ideonella sakaiensis* bacteria in Degrading Plastic Waste Type Polyethylene Terephthalate. *Jurnal Biologi Tropis*, 22(2), 381-389.
- Kale, G., Auras, R., Singh, S. P., & Narayan, R. (2015). Biodegradability of Polylactide Bottles in Real and Simulated Composting Conditions. *Polymer Testing*, 27(8), 1026–1033.
- Kale, S. K., Deshmukh, A. G., Dudhare, M. S., & Patil, V. B. (2015). Microbial Degradation of Plastic: A review. *Journal of Biochemical Technology*, 6(2), 952–961.
- Kawagoe, M., Nagaoka, Y., Yamagaki, K., Naoe, K., Noda, H. 2004. Submerged Culture of *Agaricus blazei* Mycelium in a Bubble Column Fermentor. *Journal of Chemical Engineering of Japan*. 37 (8): 1056-1061.
- Kepel, B., Bodhi, W., Fatimawali. (2021). Pengaruh pH dan Suhu terhadap Aktivitas Pereduksi Merkuri Bakteri Resisten Merkuri Tinggi *Bacillus cereus* yang Diisolasi dari Urin Pasien dengan Amalgam Gigi. *e-GiGi*. 8(1): 15-21.
- Khan, S., Nadir, S., Shah, Z., & Ahmad, M. (2021). Biodegradation of polyethylene using *Bacillus* Species in Winogradsky Column Setup: An Innovative Approach for Plastic Waste Management. *Journal of Environmental Chemical Engineering*, 9(5), 105512.
- Kumar, S., Panda, A. K., & Singh, R.K. 2011. Review on Tertiary Recycling of High Density Polyethylene to Fuel. *Resources, Conservation and Recycling*, 893-910.
- Laycock, B., Nikolic, M., Colwell, J.M., Gauthier, E., Halley, P., Bottle, S., George, G. (2017). Lifetime Prediction Of Biodegradable Polymers. *Progres in Polymer Sains*, 144-189.
- Li, J., Zhang, J., Zhao, L., & Wang, L. (2019). Safety assessment and biotechnological potential of *Bacillus* species in environmental applications. *Applied Microbiology and Biotechnology*, 103(7), 2961–2973.
- Maisyaroh, D., Mayasari, U., Nasution, R.A. (2024). Potensi Bakteri *Bacillus subtilis* Sebagai Agen Biodegradasi Limbah Styrofoam. *Biogenerasi*, 9(1), 700-705.
- Marjayandari, L., & Shovitri, M. (2015). Potensi Bakteri *Bacillus* sp. dalam Mendegradasi Plastik. *Jurnal Sains dan Seni ITS*, E59-E62.

- Marlina, R., Sumantri, Y., Kusumah, S.S., Syarbini, A., Cahyaningtyas, a.A., Ismadi. (2021). Karakterisasi Komposit Biodegradable Foam dari Limbah serat Kertas dan Kulit Jeruk Untuk Aplikasi Kemasan Pangan. *Jurnal Kimia dan Kemasan*, 1-11.
- Masyuroh, A., & Rahmawati, I. (2021). Pembuatan Recycle Plastik HDPE Sederhana Menjadi Asbak. *Jurnal Abdikarya*, 3(1), 53-63.
- McKenney, P.T., Driks, a., Eichenberger, P. (2013). The Bacillus subtilis endospore: Assembly and Function of The Multilayered Coat. *Nat Rev Microbiol.* 11(1): 33-34.
- Misgiyarta and Widowati, S. (2007) 'Seleksi dan Karakterisasi Bakteri Asam Laktat (BAL) Indigenus'. *Prosiding Seminar Hasil Penelitian Rintisan dan Bioteknologi Tanaman*, 24(4), 38–57.
- Muharam, Y., Suryanto, D., & Prasetyo, B. (2018). Pengaruh Gelembung Udara terhadap Pertumbuhan Bakteri Aerobik dalam Proses Biodegradasi. *Jurnal Teknik Lingkungan*, 24(1), 45–52.
- Mokhtar, A., Jufri, M., Budiono, & Rahmandika, A (2019). Rancang bangun tungku pirolisis untuk membuat bahan bakar cair dari limbah plastik. *Seminar Nasional Teknologi dan Rekayasa (SENTRA)*, 22(2), 1-24.
- Muharam, Y., Dianursanti, D., Naufal, R. (2018). Study of Carbon Dioxide Mass Transfer in an Annular Bubble Column. *Proceedings of the 4th International Symposium on Applied Chemistry*. 020048-1–020048-5.
- Nurhanifa., Suryani., Fitria (2019). Termodifikasi Alkali Untuk Aplikasi Elemen Industri Otomotif. *Proceeding Seminar Nasional Politeknik Negeri Lhokseumawe*, A333-A337.
- Nurhayati, Chasri. (2020). Degradasi Paving Block Plastik Dari Limbah Plastik Low Density Polyethylene (LDPE) Selama Penyimpanan. *Jurnal Dinamika Penelitian Industri*, 31(2), 125-132.
- Ocana, E. R., Paz, J., Torres, V. S. Effect of the Addition of the Bacillus sp., Paenibacillus sp. Bacterial Strains on the Co-composting of Green and Food Waste. *Journal of Environmental Chemical Engineering*. 10(3).
- Ojha, N., Pradhan, N., Singh, R., & Madamwar, D. (2017). Evaluation of HDPE and LDPE degradation by fungus *Aspergillus terreus* strain NCFT4269.10 using FTIR and GC-MS analysis. *Polymer Degradation and Stability*, 134, 332–340.
- Pargaputri, A. F., Andriani, D., Mulawarmanti, D., Amaliah, I. R. (2023). Pengaruh Nystatin Topikal dan Terapi Oksigen Hiperbarik terhadap Jumlah Makrofag Pada Tikus Kandidiasis Oral Kondisi Imunosupresi: Studi Eksperimental Laboratoris. *Jurnal Kedokteran Gigi Universitas Padjajaran*. 35(2): 147-151.

- Peter, H., Müller, R., & Schmidt, W. (2020). Microbial Stress Response to pH: Mechanisms and Implications for Bioremediation Processes. *Frontiers in Microbiology*, 11, 556140.
- Priyanka, D., & Archana, D. (2012). Biodegradation of polystyrene and polyethylene by microorganisms: A review. *Biodegradation*, 23(1), 31-49.
- Purwaningrum, P. (2016). Upaya Mengurangi Timbulan Sampah Plastik. *Urban And Environmental Technology*, 8(2), 141-147.
- Puspitaningrum, R., & Adhiyanto, C. (2016). *Enzim dan Pemanfaatannya*. Jakarta: Ghalia Indonesia.
- Rathour, R., Singh, A., & Pandey, P. (2022). Biodegradation of xenobiotic compounds using Bacillus species: Current Status and Future Perspectives. *Bioresource Technology Reports*, 17, 100894.
- Restrepo-Flórez, J. -M., Bassi, A., & Thompson, M. R. (2014). Microbial Degradation and Deterioration of Polyethylene – A review. *International Biodeterioration & Biodegradation*, 88, 83–90.
- Restu, R., Suryadi, R., & Putra, W. (2019). Biodegradation of Polyethylene by Bacillus cereus: Effect on Weight Reduction. *Journal of Applied Environmental Sciences*, 15(2), 78-85.
- Riandi, M. I., Kawuri, R., & Sudirga, S. K. (2017). Potensi Bakteri Pseudomonas sp. dan Ochrobactrum sp. yang di Isolasi dari Berbagai Sampel Tanah dalam Mendegradasi Limbah Polimer Plastik Berbahan Dasar High Density Polyethylene (HDPE) dan Low Density Polyethylene (LDPE). *Symbiosis Journal of Biological Sciences*, 5(2), 58.
- Rohde, M. (2019). The Gram-Positive Bacterial Cell Wall. *Microbiol Spectrum*. 7(3): 1-21.
- Roy, P. K., Hakkarainen, M., Varma, I. K., & Albertsson, A.-C. (2011). Degradable polyethylene: Fantasy or reality. *Environmental Science & Technology*, 45(10), 4217–4227.
- Ruggero, F., Carretti, E., Gori, R., Lotti, T.(2020). Monitoring of Degradation of Starch-based Biopolymer Film Under Different Composting Conditions, Using TGA, FTIR and SEM Analysis. *Chemosphere*, 1-9.
- Safaat, Muhammad. (2020). Potensi Logam Oksida Sebagai Fotokatalis Degradasi Plastik Di Air Laut. *Oseana*, 40-58.
- Sanjaya, N., Suryawati, L., & Wulandari, D. (2022). Characterization of Bacillus Subtilis S2-3 in the Biodegradation of Polyethylene Under Different pH Conditions. *Journal of Environmental Biotechnology*, 40(4), 220-232.

- Sejati, K. (2009). *Pengolahan Limbah Terpadu Dengan Sistem Node, Sub Point, dan Center Point*. Yogyakarta: Kasinus.
- Shah, A. A., Hasan, F., Hameed, A., & Ahmed, S. (2008). Biological Degradation of Plastics: A comprehensive review. *Biotechnology Advances*, 26(3), 246–265.
- Sharma, S., Kumar, V., & Ghosh, P. (2021). Enzymatic Degradation of Plastics: Role of Bacillus Species in Depolymerization of Polyethylene and Polystyrene. *International Journal of Environmental Science and Technology*, 18(10), 3049–3060.
- Shen, C., & Zhang, Y. 2021. *Introductory Microbiology Lab Skills and Techniques in Food Science*. London: Akademik Press.
- Sihotang, R. H., Zulfita, D., Surojul. (2013). Pengaruh Pupuk Organik Cair Terhadap Pertumbuhan dan Hasil Kacang Hujau Pada Tanah Aluvial. *Jurnal Sains Mahasiswa Pertanian*, 2(1): 1-10.
- Skoneczny, S., & Skoneczny, M. C. (2021). Determination of Steady-states of a Bubble Column bioreactor with Biofilm for Aerobic Processes. *Chemical Engineering Research and Design*. 168: 25-36.
- Sridharan, S., Kumar, M., Singh, L., Bolan, N.S., Saha, M. (2021). Microplastics as an Emerging Source Of Particulate Air Pollution: A Critical Review. *Journal Of Hazardous Materials*, 1-5.
- Sudhakar, M., Doble, M., Murthy, P. S., & Venkatesan, R. (2007). Marine microbe-mediated Biodegradation of low- and high-density polyethylenes. *International Biodeterioration & Biodegradation*, 61(3), 203–213.
- Tokiwa, Y., Calabia, B. P., Ugwu, C. U., & Aiba, S. (2009). Biodegradability of Plastics. *International Journal of Molecular Sciences*, 10(9), 3722–3742.
- Umamaheswari, P., & Murani, K. (2013). Surface Modification of Polystyrene by Bacillus sp. for Enhanced Biodegradation: A study on polar group formation. *International Journal of Environmental Science and Technology*, 10(5), 1153-1161.
- Wang, Y., Chen, Y., Liu, Z., & Ma, X. (2023). Genomic Insights Into Plastic Degradation Pathways in Bacillus Species: Opportunities for Genetic Engineering. *Frontiers in Microbiology*, 14, 1159023.
- Welle, F. (2011). Twenty Years of PET Bottle to Bottle Recycling . *An overview. Resources, Conservation and Recycling*, 55(11), 865-875.
- Wiasih, H.F., & Suyatmo, R.I.D. (2024). Degradasi Kantong Plastik Oxo-Degradable dan Limbah Polietilena Menggunakan Metode Kolom Winogradsky. *Journal of Polymer Chemical Engineering and Technology*, 23-32.

- Widiyatmoko, H., Purwaningrum, P., arum,, F.P. (2015). Analisis Karakteristik Sampah Plastik di Permukiman Kecamatan Tebet dan Alternatif. *JTL*, 7(1): 24-33.
- Yamada-Onodera, K., Mukumoto, H., Katsuyaya, Y., Saiganji, A., & Tani, Y. (2001). Degradation of polyethylene by a fungus, *Penicillium simplicissimum* YK. *Polymer Degradation and Stability*, 72(2), 323–327.
- Yan, H., Lu, C., Jing, D., Hou, X. (2013). Chemical degradation of TGDDM/DDS epoxy resin in supercritical 1-propanol: Promotion effect of hydrogenation on thermolysis. *Polymer Degradation and Stability*, 2571-2582.
- Yang, L., Liu, Ying., Zhuang, G., Peng, X., Wu, W., Zhuang, X. (2021). Biodegradation of Expanded Polystyrene and Low-Density Polyethylene Foams in Larvae of *Tenebrio Molitor* Linnaeus (Coleoptera: Tenebrionidae): Broad Versus Limited Extent Depolymerization and Microbe-dependence Versus Independence. *Chemosphere*, 262, 1-9.
- Yao, Z., Seong, H. J., Jang, Y. (2022). Degradation of Low Density Polyethylene by *Bacillus* Species. *Applied Biological Chemistry*. 65: 2-9.
- Yue, W., Yao, P., Wei, Y., Mo, H. (2008). Synergetic Effect Of Ozone And Ultrasonic Radiation On Degradation Of Chitosan. *Polymer Degradation And Stability*, 13(1), 1814-1821.
- Yulma, A. H., Widodo, B., & Rahmawati, H. (2018). Thermal Stability and Microbial Degradation of Polystyrene and Polyethylene: Role of Temperature in Microbial Activity. *Biodegradation*, 29(6), 503-510.