

- Abd Mutalib, M., Rahman, M. A., Othman, M. H. D., Ismail, A. F., & Jaafar, J. (2017). Scanning Electron Microscopy (SEM) and Energy-Dispersive X-Ray (EDX) Spectroscopy. In *Membran Characterization* (pp. 161–179). Elsevier. <https://doi.org/10.1016/B978-0-444-63776-5.00009-7>.
- Afikah, Agnes. (2016). *Proses Elektrodialisis di Industri Susu*. ITB Research Gate <https://www.researchgate.net/publication/303922512>.
- Antônio M, Rodrigues S. (2014). *Electrodialysis and Water Reuse*. Springer, Berlin. <https://doi.org/10.1007/978-3-642-40249-4>.
- Barker, J., M.Y. Saidi, J.L. Swoyer. (2003). Lithium Iron(II) Phospho-Olivines Prepared by A Novel Carbothermal Reduction Method. *Electrochem. Solid-State Lett.* 6. A53.
- Baker, R. W. (2004) ‘Ion exchange membrane processes- electrodialysis’.
- Bi, H., H. Zhu, H. Zu, Y. Bai, S. Gao, Y. Gao. (2019). A New Model of Trajectory in Eddy Current Separation for Recovering Spent Lithium Iron Phosphate Batteries. *Waste Manag* 100. 1-9.
- Cahyadi, Deni., Daniel Fajar Puspita. (2022). Urban Mining Baterai Lithium Bekas sebagai Sumber Alternatif Bahan Baku Baterai Lithium. *Jurnal Reksabumi* Vol. 1, No.2, 08-22. [https://jurnal .ut.ac.id/reksabumi](https://jurnal.ut.ac.id/reksabumi).
- Chagnes, A., B.A. Pospiech. (2013). A Brief Review on Hydrometallurgical Technologies for Recycling Spent Lithium-Ion Batteries. *J. Chem. Technol. Biotechnol.* 88. 1191–1199.
- Chen, L., X. Tang, Y. Zhang, L. Li, Z. Zeng, Y. Zhang. (2011). Process for The Recovery of Cobalt Oxalate from Spent Lithium-Ion Batteries. *Hydrometallurgy.* 108. 80–86.
- Chen, V., Li H, Li D. (2006). Cleaning Strategies for Membrane Fouled with Protein Mixtures. *Desalination* 200:198–200. <https://doi.org/10.1016/j.desal.2006.03.294>.
- Chen, X., T. Zhou. (2014). Hydrometallurgical Process for The Recovery of Metal Values from Spent Lithium-Ion Batteries in Citric Acid Media. *Waste Manag. Res.* 32. 1083–1093.
- Djoudi, N., M. Le Page Mostefa, H. Muhr. (2021). Hydrometallurgical Process to Recover Cobalt from Spent Li-Ion Batteries. *Resources* 10. 58.
- Epsztein, R., DuChanois, R. M., Ritt, C. L., Noy, A., & Elimelech, M. (2020). Towards single-species selectivity of membranes with subnanometre pores. *Nature*

- Fang, Jiahu., Zhengping Ding, Yang Ling, Junpeng Li, Xiangqun Zhuge, Zhihong Luo, Yurong Ren, Kun Luo. (2022). Green Recycling and Regeneration of $\text{LiNi}_{0.5}\text{Co}_{0.2}\text{Mn}_{0.3}\text{O}_2$ from Spent Lithium-ion Batteries Assisted by Sodium Sulfate Electrolysis. *Chemical Engineering Journal* 440 (1) 135880. www.elsevier.com/locate/cej.
- Ghosh, S., Prasanna, V. L., Sowjanya, B., Srivani, P., Alagaraja, M., & David, D. (2013). Inductively Coupled Plasma –Optical Emission Spectroscopy: A Review. 3(1), 11.
- Gmar, S. and Chagnes, A. (2019) ‘Recent advances on electro dialysis for the recovery of lithium from primary and secondary resources’, *Hydrometallurgy*, 189(July), p. 105124. doi: 10.1016/j.hydromet.2019.105124.
- Golubenko, D. V., Van der Bruggen, B., & Yaroslavtsev, A. B. (2021). Ion exchange membranes based on radiation-induced grafted functionalized polystyrene for high-performance reverse electro dialysis. *Journal of Power Sources*, 511. <https://doi.org/10.1016/j.jpowsour.2021.230460>
- Hidayat, Muhammad Iman., Suprpto. (2017). Pemisahan Mangan Dioksida (MnO_2) dari Limbah Pasta Baterai dengan Metode Elektrolisis. *Jurnal Sains dan Seni ITS Vol. 6, No.2 (1) 2337-3520 (2301-928X Print) (C37-C40)*.
- Hosseini, SM., Gholami A, Madaeni SS. (2012). Fabrication of (Polyvinyl Chloride/Cellulose Acetate) Electro dialysis Heterogeneous Cation Exchange Membrane: Characterization and Performance in Desalination Process. *Desalination* 306:51–59. <https://doi.org/10.1016/j.desal.2012.07.028>.
- Ji, Y., Choi, Y. J., Fang, Y., Pham, H. S., Nou, A. T., Lee, L. S., Niu, J., & Warsinger, D. M. (2023). Electric Field-Assisted Nanofiltration for PFOA Removal with Exceptional Flux, Selectivity, and Destruction. *Environmental Science & Technology*, 57(47), 18519–18528. <https://doi.org/10.1021/acs.est.2c04874>
- Kariduraganavar MY, Nagarale RK, Kittur AA, Kulkarni SS. (2006). Ion-Exchange Membranes: Preparative Methods for Electro dialysis and Fuel Cell Applications. *Desalination* 197:225–246. <https://doi.org/10.1016/j.desal.2006.01.019> 24.
- Kim, S., J. Bang, J. Yoo, Y. Shin, J. Bae, J. Jeong, K. Kim, P. Dong, K. Kwon. (2021). A Comprehensive Review on The Pretreatment Process in Lithium-Ion Battery Recycling. *J. Clean. Prod.* 294. 126329.
- Krol, J. J., Wessling, M. and Strathmann, H. (1999) ‘Chronopotentiometry and overlimiting ion transport through monopolar ion exchange membranes’, *Journal of Membrane*



- Larouche, F., F. Tedjar, K. Amouzegar, G. Houlachi, P. Bouchard, G.P. Demopoulos, K. Zaghbi. (2020). Progress and Status of Hydrometallurgical and Direct Recycling of Li-Ion Batteries and Beyond. *Materials*. 13. 801.
- Li, C., Meckler, S. M., Smith, Z. P., Bachman, J. E., Maserati, L., Long, J. R., & Helms, B. A. (2018). Engineered Transport in Microporous Materials and Membranes for Clean Energy Technologies. *Advanced Materials*, 30(8), 1704953. <https://doi.org/10.1002/adma.201704953>.
- Lindstrand, V., Sundström, G. and Jönsson, A. S. (2000) 'Fouling of electro dialysis membranes by organic substances', *Desalination*, 128(1), pp. 91–102. doi: 10.1016/S0011-9164(00)00026-6.
- Liu, S., Wang, Z., Wang, D., Guo, H., Yan, G., Li, G., Peng, W., Li, X., & Wang, J. (2023). Simultaneous double membrane electrolysis of sodium sulfate solution and preparation of hydroxide precursor for layered cathode materials. *Journal of Cleaner Production*, 428. <https://doi.org/10.1016/j.jclepro.2023.139272>.
- Lupi, C., M. Pasquali, A.Dell'Era. (2005). Nickel and Cobalt Recycling from Lithium-Ion Batteries by Electrochemical Processes. *Waste Manag.* 25. 215–220.
- Mei, Y. and Tang, C. Y. (2018) 'Recent developments and future perspectives of reverse electro dialysis technology: A review', *Desalination*, 425(October 2017), pp. 156–174. doi: 10.1016/j.desal.2017.10.021.
- Mendieta-George, Daniel., Roberto Perez-Garibay, Ricardo Solis-Rodriguez, Juan C. Fuentes-Aceituno, Anailda Alvarado-Gomez. (2022). Study of The Direct Production of Lithium Phosphate with Pure Synthetic Solutions and Membran Electrolysis. *Minerals Engineering* 185 (1) 107713. www.elsevier.com/locate/mineng.
- Mizuno, T., Akimoto, T. and Ohmori, T. (2002) 'Confirmation of anomalous hydrogen generation by plasma electrolysis', *Proc. 4th meeting JCF ...*, (February), pp. 1–34. Available at: <http://free-energy-info.com/P3.pdf>.
- Mulder, M. (1996). *Basic Principles of Membran Technology*. 2nd Edition, Kluwer Academic Publishers, Dordrecht. <http://dx.doi.org/10.1007/978-94-009-1766-8>.
- Murray P. (1995). *Electrodialysis and Electro dialysis Reversal—Manual of Water Supply Practices*, m38 (1st edition). Am Water Work Assoc, Denver, pp 30–31.
- Mulder, M. (2003) *Basic Principles of Membrane Technology*. seconde ed. Kluwer Academic Publishers, Netherlands.
- Nandiyanto, A. B. D., Oktiani, R., & Ragadhita, R. (2019). How to read and interpret ftir



Spectroscopy of Organic Material, Indonesian Journal of Science and Technology,
4(1), 97–118. <https://doi.org/10.17509/ijost.v4i1.15806>

Nicolini, J. V., Borges, C. P., & Ferraz, H. C. (2016). Selective rejection of ions and correlation with surface properties of nanofiltration membranes. *Separation and Purification Technology*, 171, 238–247. <https://doi.org/10.1016/j.seppur.2016.07.042>.

Nie, X. Y., Sun, S. Y., Sun, Z., Song, X., & Yu, J. G. (2017). Ion-fractionation of lithium ions from magnesium ions by electrodialysis using monovalent selective ion-exchange membranes. *Desalination*, 403, 128–135. <https://doi.org/10.1016/j.desal.2016.05.010>

Or, T., S.W.D.Gourley, K. Kaliyappan, A Yu, Z. Chen. (2020). Recycling of Mixed Cathode Lithium-Ion Batteries for Electric Vehicles: Current Status and Future Outlook. *Carbon Energy*. 2(1) 6-43.

Pandey, A.K., Reji Kumar, R., B, K., Laghari, I.A., Samykano, M., Kothari, R., Abusorrah, A.M., Sharma, K., Tyagi, V.V., 2021. Utilization of solar energy for wastewater treatment: challenges and progressive research trends. *J. Environ. Manag.* 297, 113300 <https://doi.org/10.1016/j.jenvman.2021.113300>.

Prabaharan, G., S.P. Barik, N. Kumar, L. Kumar. (2017). Electrochemical Process for Electrode Material of Spent Lithium Ion Batteries. *Waste Manag.* 68. 527–533.

Pražanová, A., Knap, V., & Stroe, D.-I. (2022). Literature review, recycling of lithium-ion batteries from electric vehicles, part I: recycling technology. *Energies*, 15(3), 1086.

Petrus HB, Li H, Chen V, Norazman N. (2008). Enzymatic Cleaning of Ultrafiltration Membranes Fouled by Protein Mixture Solutions. *J Membr* 325:783–792. <https://doi.org/10.1016/j.memsci.2008.09.004>.

Purkait, M. K., & Singh, R. (2018). *Membrane technology in separation science*. Taylor & Francis. Purnomo, B. J., & Pich.

Rybalkina, O. A., Tsygurina, K. A., Sarapulova, V. V., Mareev, S. A., Nikonenko, V. V., & Pismenskaya, N. D. (2019b). Evolution of Current–Voltage Characteristics and Surface Morphology of Homogeneous Anion-Exchange Membranes during the Electrodialysis Desalination of Alkali Metal Salt Solutions. *Membranes and Membrane Technologies*, 1(2), 107–119. <https://doi.org/10.1134/s2517751619020094>

Sata, T. (1994) ‘Studies on ion exchange membranes with permselectivity for specific ions in electrodialysis’, *Journal of Membrane Science*, 93(2), pp. 117–135. doi:

- Sencanski, J., D. Bajuk-Bogdanovic, D. Majstorovic, E. Tchernychova, J. Papan, M. Vujkovic. (2017). The Synthesis of $\text{Li}(\text{Co}[\text{sbnd}]\text{Mn}[\text{sbnd}]\text{Ni})\text{O}_2$ Cathode Material from Spent-Li ion Batteries and The Proof of Its Functionality in Aqueous Lithium and Sodium Electrolytic Solutions. *J. Power Sources*. 342. 690-703.
- Shin, S. M., N.H. Kim, J.S. Sohn, D.H. Yang, Y.H. Kim. (2005). Development of A Metal Recovery Process from Li-Ion Battery Wastes. *Hydrometallurgy* 79. 172-181.
- Sidiq, R. K. (2015). Rancang Bangun Sistem Pengisi Baterai Mobil Listrik Berbasis Mikrokontroller Atmega16. Universitas Jember: Jember.
- Silveria, A.V.M., M.P. Santana, E.H. Tanabe, D.A. Bertuol. (2017). Recovery of Valuable Materials from Spent Lithium Ion Batteries Using Electrostatic Separation. *Int. J. Miner. Process*. 169. 91-98.
- Song, Y. and Zhao, Z. (2018) 'Recovery of lithium from spent lithium-ion batteries using precipitation and electro dialysis techniques', *Separation and Purification Technology*, 206(May), pp. 335–342. doi: 10.1016/j.seppur.2018.06.022.
- Strathmann, H. (1995). Chapter 6: Electrodialysis and Related Processes. *Membr Sci Technol* 2:213–281. [https://doi.org/10.1016/S0927-5193\(06\)80008-2](https://doi.org/10.1016/S0927-5193(06)80008-2).
- Strathmann, H. (2004) 'Ion-exchange membrane separation processes', *Separation and Purification Technology*, 9(1). doi: 10.1016/j.seppur.2004.05.007.
- Strathmann, H. (2010) 'Electrodialysis, a mature technology with a multitude of new applications', *Desalination*, 264(3), pp. 268–288. doi: 10.1016/j.desal.2010.04.069.
- Sujoto, V. S. H., Sutijan, Astuti, W., Sumardi, S., Louis, I. S. Y., & Petrus, H. T. B. M. (2022). Effect of Operating Conditions on Lithium Recovery from Synthetic Geothermal Brine Using Electrodialysis Method. *Journal of Sustainable Metallurgy*, 8(1), 274–287. <https://doi.org/10.1007/s40831-021-00488-3>.
- Sun Koo, J., Kwak, N. S. and Hwang, T. S. (2012) 'Synthesis and properties of an anion-exchange membrane based on vinylbenzyl chloride-styrene-ethyl methacrylate copolymers', *Journal of Membrane Science*, 423–424, pp. 293–301. doi: 10.1016/j.memsci.2012.08.024.
- Tanaka, Y. (2007) 'Ion Exchange Membranes - Fundamentals and Applications', *Membrane Science and Technology*, 12(07), pp. 293–317. doi: 10.1016/S0927-5193(07)12014-3.
- Tanaka Y. (2015). Electrodialysis. *Prog Filtr Sep*. <https://doi.org/10.1016/B978-0-12-384746-1.00006-9>.



- Valero, F., Barco, A. and Arbo, R. (2017). 'Electrodialysis Technology - Theory and Applications. Desalination, Trends and Technologies', *Mean Field Simulation for Monte Carlo Integration*, pp. 85–124. doi: 10.1201/b14924-7.
- Van der Hoek, J. P., Rijnbende, D. O., Lokin, C. J. A., Bonne, P. A. C., Loonen, M. T., & Hofman, J. (1998). Electrodialysis as an alternative for reverse osmosis in an integrated membrane system. *Desalination*, 117(1–3), 159–172.
- Vermaas, D. A., Guler, E., Saakes, M., & Nijmeijer, K. (2012). Theoretical power density from salinity gradients using reverse electrodialysis. *Energy Procedia*, 20, 170–184. <https://doi.org/10.1016/j.egypro.2012.03.018>
- Vogel. (1979). *Textbook Of Macro And Semimikro Qualitative Inorganic Analysis*. London : Longman Group Limited.
- Wang, Q., Yang, P., & Cong, W. (2011). Cation-exchange membrane fouling and cleaning in bipolar membrane electrodialysis of industrial glutamate production wastewater. *Separation and Purification Technology*, 79(1), 103–113. <https://doi.org/10.1016/j.seppur.2011.03.024>
- Wenten, I.G. (2000). *Teknologi Membran Industrial*. Bandung: Penerbit ITB.
- Xu, P., Hong, J., Xu, Z., Xia, H., & Ni, Q.-Q. (2021). Positively charged nanofiltration membrane based on (MWCNTs-COOK)-engineered substrate for fast and efficient lithium extraction. *Separation and Purification Technology*, 270, 118796. <https://doi.org/10.1016/j.seppur.2021.118796>.
- Xu, S., Song, J., Bi, Q., Chen, Q., Zhang, W.-M., Qian, Z., Zhang, L., Xu, S., Tang, N., & He, T. (2021). Extraction of lithium from Chinese salt-lake brines by membranes: Design and practice. *Journal of Membrane Science*, 635, 119441. <https://doi.org/10.1016/j.memsci.2021.119441>.
- Yan, Z., Chen, L. and Wang, H. (2008) 'Hydrogen generation by glow discharge plasma electrolysis of ethanol solutions', *Journal of Physics D: Applied Physics*, 41(15). doi: 10.1088/0022-3727/41/15/155205.
- Zhang, G., X. Yuab, Y. He, H. Wang, T. Zhang, W. Xie. (2021). Recent Advances in Pretreating Technology for Recycling Valuable Metals from Spent Lithium-Ion Batteries. *J. Hazard. Mater.* 406. 14332.
- Zhang, Y., Wang L, Sun W. (2020). Membrane Technologies for Li⁺/Mg²⁺ Separation from Salt-Lake Brines and Seawater: A Comprehensive Review. *J Ind Eng Chem* 81:7–23. <https://doi.org/10.1016/j.jiec.2019.09.002>
- Zhao, LM., Chen QB, Ji ZY. (2018). Separating and Recovering Lithium from Brines Using



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ELEKTRODIALISIS**

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Selective Electrodialysis: Sensitivity to Temperature. *Chem Eng Res Des* 140:116–

127. <https://doi.org/10.1016/j.cherd.2018.10.009>.

Zhou, Y., Yan, H., Wang, X., Wu, L., Wang, Y., & Xu, T. (2018). Electrodialytic concentrating lithium salt from primary resource. *Desalination*, 425(October 2017), 30–36. <https://doi.org/10.1016/j.desal.2017.10.013>