

BAB V

KESIMPULAN DAN SARAN

5.1. Kesimpulan

Pada penelitian *leaching* ion logam dari *spent catalyst* Co-Mo/ γ -Al₂O₃, dapat disimpulkan bahwa :

1. Temperatur operasi *leaching* memiliki pengaruh terhadap persentase *recovery* ion logam aluminium, molibdenum, dan *kobalt*, waktu yang semakin meningkat akan membuat *recovery* ion logam aluminium dan kobalt semakin tinggi, sedangkan *recovery* ion logam molibdenum akan semakin menurun.
2. Derajat keasaman dari suatu jenis pelarut berpengaruh terhadap persentase *recovery* ion logam aluminium, molibdenum, dan *kobalt*, jenis pelarut terbaik dalam proses *leaching* logam aluminium, molibdenum, dan *kobalt* adalah media pelarut asam sulfat 1 M.
3. Metode subkritik dapat digunakan untuk *leaching* ion logam aluminium, molibdenum, dan *kobalt*, tetapi persentase yang dihasilkan tidak lebih baik dibandingkan dengan menggunakan pelarut asam sulfat.

5.2. Saran

Dari hasil penelitian yang telah dilakukan terdapat beberapa saran yang dapat diberikan untuk penelitian selanjutnya dengan topik serupa, diantaranya :

1. Pada penelitian selanjutnya apabila ingin *me-leaching* terkhusus untuk mendapatkan konsentrasi ion molibdenum dibutuhkan adanya perlakuan khusus terlebih dahulu yaitu melakukan *roasting* pada sampel *spent catalyst* agar perolehan ion logam molibdenum dapat lebih dari 40%.
2. Untuk mendapatkan perolehan ion Mo⁶⁺ yang optimum dibutuhkannya penambahan H₂O₂ guna memecah ikatan MoS dalam bahan baku *spent catalyst* sehingga dapat memperoleh konsentrasi molibdenum yang *leaching* lebih besar.
3. Apabila akan membuat larutan asam sulfat pH cukup tinggi, jangan meneteskan langsung dari asam sulfat pekat 98%, ada baiknya lakukan pengenceran terlebih dahulu untuk larutan pekat 98% kemudian diencerkan kembali sesuai pH yang diinginkan.

4. Penggunaan media pelarut H_2SO_4 pH=5 ternyata kurang dapat mewakili *subcritical fluid*.

DAFTAR PUSTAKA

- Akimov, A. S., N. N. Sviridenko, and Al S. Akimov. 2020. "Synthesis and Application of Cobalt and Polyoxomolybdate-Containing Alumina Systems." in *Journal of Physics: Conference Series*. Vol. 1611. Institute of Physics Publishing.
- Andriani, Meiriza. 2020. *KINETIKA PROSES LEACHING ION LOGAM ALUMINIUM (III) DARI SPENT CATALYST Co-Mo-Al₂O₃ DENGAN LARUTAN ASAM SULFAT (H₂SO₄)*. Laporan Penelitian. Universitas Katolik Parahyangan. Bandung. Indonesia
- Arslanoğlu, Hasan, and Ali Yaraş. 2019. "Recovery of Precious Metals from Spent Mo–Co–Ni/Al₂O₃ Catalyst in Organic Acid Medium: Process Optimization and Kinetic Studies." *Petroleum Science and Technology* 37(19):2081–93.
- Barik, S. P., Kyung Ho Park, P. K. Parhi, and J. T. Park. 2012. "Direct Leaching of Molybdenum and Cobalt from Spent Hydrodesulphurization Catalyst with Sulphuric Acid." *Hydrometallurgy* 111–112(1):46–51.
- Boukerche, Ikram, Naima Habbache, Nadia Alane, Souad Djerad, and Lakhdar Tifouti. 2010. "Dissolution of Cobalt from CoO/Al₂O₃ Catalyst with Mineral Acids." *Industrial and Engineering Chemistry Research* 49(14):6514–20.
- Chang, R. (2010). "Chemistry 10th edition." Edisi ke-10. New York: McGraw-Hill Education.
- Febrian, Muhamad Basit, Titin Sri Mulyati, Ade Suherman, Natalia Adventini, Yanuar Setiadi, Duyeh Setiawan, and Azmairit Aziz. 2018. "SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM CONTENT IN ^{99m}Tc SOLUTION VIA Mo-TGA-KSCN COMPLEXES FORMATION." *Jurnal Sains Dan Teknologi Nuklir Indonesia* 19(2):71.
- Floriano, Wely Brasil, Marco Antonio, and Chaer Nascimento. 2004. *Dielectric Constant and Density of Water as a Function of Pressure at Constant Temperature*. Vol. 34.
- Fogler, H. Scott. 2006. *Elements of Chemical Reaction Engineering*. Edisi ke-5. Prentice Hall International Series.
- Gavhane. 2008. "Mass Transfer II Revised Edition." Revisi Edisi ke-6. Nirali Prakashan.
- Christie J. Geankoplis. 1993. "Transport Processes and Unit Operations" Edisi ke-3. Prentice Hall.

- Hakim, Luqman, and Dan Muhammad Nawir. 2019. *Karakterisasi Struktur Material Pasir Bongkahan Galian Golongan C Dengan Menggunakan X-Ray Diffraction (X-RD) Di Kota Palangkaraya*. Vol. 1.
- Handoko, Tony, ST Henky Muljana, and MEng Jurusan Teknik Kimia. 2009. *Pengaruh Laju Alir Gas Karbondioksida Dan Lama Pembakaran Dalam Pemurnian Alumina Dari Spent Catalyst*. Laporan Penelitian. Universitas Katolik Parahyangan. Bandung. Indonesia.
- Hart, Abarasi, Mohamed Adam, John P. Robinson, Sean P. Rigby, and Joseph Wood. 2020. "Hydrogenation and Dehydrogenation of Tetralin and Naphthalene to Explore Heavy Oil Upgrading Using Ni₂O₃ and Co₂O₃ Catalysts Heated with Steel Balls via Induction." *Catalysts* 10(5).
- Havlik, Tomas. 2008. "*Hydrometallurgy Principles and Applications*. Cambridge." Edisi ke-1. Woodhead Publishing Series in Metals and Surface Engineering.
- Hilmi, Irfan, and Tony Handoko. 2011. *Pengolahan Rafinat Hasil Ekstraksi Spent Catalyst Sebagai Bahan Baku Pembuatan Semen*. Prosiding Seminar Nasional Teknik Kimia "Kejuangan". Bandung. Indonesia
- Huang, J. H., C. Kargl-Simard, M. Oliazadeh, and A. M. Alfantazi. 2004. "PH-Controlled Precipitation of Cobalt and Molybdenum from Industrial Waste Effluents of a Cobalt Electrodeposition Process." *Hydrometallurgy* 75(1–4):77–90.
- Karbalaei Saleh, Danyal, Hadi Abdollahi, Mohammad Noaparast, and Alireza Fallah Nosratabad. 2019. "Dissolution of Aluminium from Metakaolin with Oxalic, Citric and Lactic Acids." *Clay Minerals* 54(2):209–17.
- Kevin, Alexander. 2021. *PENGARUH PENAMBAHAN ZAT ADITIF TERHADAP PROSES EKSTRAKSI NIKEL DAN ALUMINIUM DARI SPENT CATALYST Ni/Al₂O₃*. Laporan Penelitian. Universitas Katolik Parahyangan. Bandung. Indonesia
- Khajenoori, M., A. Haghghi Asl, and F. Hormozi. 2009. "Proposed Models for Subcritical Water Extraction of Essential Oils." *Chinese Journal of Chemical Engineering* 17(3):359–65.
- Kim, Hong In, Kyung Ho Park, and Devabrata Mishra. 2009. "Sulfuric Acid Baking and Leaching of Spent Co-Mo/Al₂O₃ Catalyst." *Journal of Hazardous Materials* 166(2–3):1540–44.
- Kurniati, Elly. 2009. "PEMBUATAN KONSENTRAT PROTEIN DARI BIJI KECIPIR DENGAN PENAMBAHAN HCl." *Jurnal Penelitian Ilmu-Ilmu Teknik*, 9 (2) 115–22.

- Lie, Jenni, Stefani Tanda, and Jhy Chern Liu. 2020. "Subcritical Water Extraction of Valuable Metals from Spent Lithium-Ion Batteries." *Molecules* 25(9).
- Luknanto. 1992. "Angkutan Limbah Universitas Gadjah Mada Pusat Antar Universitas Ilmu Teknik." Laporan Penelitian. Universitas Gadjah Mada. Yogyakarta. Indonesia
- Luong, Duy, Mark A. Sephton, and Jonathan S. Watson. 2015. "Subcritical Water Extraction of Organic Matter from Sedimentary Rocks." *Analytica Chimica Acta* 879:48–57.
- Margarella, Alexandria M., Kathryn A. Perrine, Tanza Lewis, Manfred Faubel, Bernd Winter, and John C. Hemminger. 2013. "Dissociation of Sulfuric Acid in Aqueous Solution: Determination of the Photoelectron Spectral Fingerprints of H₂SO₄, HSO₄⁻, and SO₄²⁻ in Water." *Journal of Physical Chemistry C* 117(16):8131–37.
- Möller, Maria, Peter Nilges, Falk Harnisch, and Uwe Schröder. 2011. "Subcritical Water as Reaction Environment: Fundamentals of Hydrothermal Biomass Transformation." *ChemSusChem* 4(5):566–79.
- Munasir, Triwikantoro, M. Zainuri, and Darminto. 2012. "UJI XRD DAN XRF PADA BAHAN MENERAL(BATUAN DAN PASIR) SEBAGAI SUMBER MATERIAL CERDAS (CaCO₃ DAN SiO₂)."
Jurnal Penelitian Fisika Dan Aplikasinya (JPFA) Vol 2 No 1, Juni 2012 ISSN: 2087-9946 2.
- Nakajima. 2013. *Mass Transfer - Advances in Sustainable Energy and Environment Oriented Numerical Modeling*. Edisi ke-1. InTech.
- Pavan Kumar, G. V. S. R., and Kondrotu Srinivasa Rao. 2017. "Aluminium-Eriochrome Cyanin R, a Novel Chromogen for the Spectrophotometric Determination of Pentoprazole Sodium." *Indian Journal of Pharmaceutical Education and Research* 51(2):S34–39.
- Prayudo, Ayndri, Novian Okky, Setyadi, and Anteresi. 2015. "Jurnal Ilmiah Widya Teknik Volume 14 Nomor 01 Mei 2015 ISSN."
- Riyan Wahyudi, Oleh. 2018. *STUDI PENGGUNAAN METODE ANALISIS BERBASIS UV-Vis SPECTROSCOPY DAN METODE REGRESI PLS UNTUK PENENTUAN KONSENTRASI KOPI CAMPURAN LANANG-BIASA (PEABERRY DAN NORMAL).*
- Rouessac, Francis, Annick Rouessac, and Steve Brooks. 2007. *Chemical Analysis Modern Instrumentation Methods and Techniques Second Edition*.
- Ruiz, Vincent, Eric Meux, Sébastien Diliberto, and Michel Schneider. 2011. "Hydrometallurgical Treatment for Valuable Metals Recovery from Spent

- CoMo/Al₂O₃ Catalyst. 1. Improvement of Soda Leaching of an Industrially Roasted Catalyst.” *Industrial and Engineering Chemistry Research* 50(9):5295–5306.
- Senanayake, Gamini. 2007. “Review of Theory and Practice of Measuring Proton Activity and PH in Concentrated Chloride Solutions and Application to Oxide Leaching.” *Minerals Engineering* 20(7):634–45.
- Sharp, Kim A., and E. R. Johnson. 2001. “*Water: Structure and Properties.*” Encyclopedia of Life Sciences. University of Pennsylvania : Philadelphia
- Shriver, D. F., and P. W. Atkins. 2009. “*Inorganic Chemistry*”. Edisi ke-5. OXFORD
- Skoog. 2014. “Fundamentals of Analytical Chemistry” Edisi ke-9. Belmont : Brooks/Cole : Cengage Learning, cop.
- Susanti, Frida, Sartika Garini, S. T. Ignatius, Jeremy Renaldo, Rachel Ananda, and St Ashanty Stenny. 2013. *LAPORAN PENELITIAN Ekstraksi Batang Physalis Angulata Dengan Air Subkritis.*
- Todd, David B. 2014. “Solvent Extraction.” Pp. 225–38 in *Fermentation and Biochemical Engineering Handbook: Principles, Process Design, and Equipment: Third Edition.* Elsevier Inc.
- Treyball R.E. 1981. “MASS-TRANSFER OPERATIONS” Edisi ke-3. McGrawHill Education.
- Valverde, Ivam Macedo, Jéssica Frontino Paulino, and Julio Carlos Afonso. 2008. “Hydrometallurgical Route to Recover Molybdenum, Nickel, Cobalt and Aluminum from Spent Hydrotreating Catalysts in Sulphuric Acid Medium.” *Journal of Hazardous Materials* 160(2–3):310–17
- Verma, Mahendra P. 2003. *A THERMODYNAMIC ASSESSMENT OF DISSOCIATION CONSTANT OF WATER.*
- Wahyuni, Dyah Tri, and Simon Bambang Widjanarko. 2015. *PENGARUH JENIS PELARUT DAN LAMA EKSTRAKSI TERHADAP EKSTRAK KAROTENOID LABU KUNING DENGAN METODE GELOMBANG ULTRASONIK The Effect of Different Solvent and Extraction Time of Carotenoids Extract From Pumpkin with Ultrasonic Method.* Vol. 3.
- Wanta, Kevin, MEng Ratna Frida Susanti, and William Teja Gunawan. 2019. *PROSES EKSTRAKSI SPENT CATALYST DENGAN MENGGUNAKAN METODE SUBCRITICAL WATER EXTRACTION.* Laporan Penelitian. Universitas Katolik Parahyangan. Bandung. Indonesia

- Weingärtner, Hermann, and Ernst Ulrich Franck. 2005. "Supercritical Water as a Solvent." *Angewandte Chemie - International Edition* 44(18):2672–92.
- Wibisono. 2019. *PENGARUH TEMPERATUR, WAKTU EKSTRAKSI, DAN PENAMBAHAN ZAT ADITIF TERHADAP PROSES EKSTRAKSI NIKEL DAN ALUMINIUM DARI SPENT CATALYST Ni/Al₂O₃ DENGAN METODE SUBCRITICAL WATER EXTRACTION*. Laporan Penelitian. Universitas Katolik Parahyangan. Bandung. Indonesia
- Wiecka, Zuzanna, Martyna Rzelewska-Piekut, Ryszard Cierpiszewski, Katarzyna Staszak, and Magdalena Regel-Rosocka. 2020. "Hydrometallurgical Recovery of Cobalt(II) from Spent Industrial Catalysts." *Catalysts* 10(1).
- Yabalak, Erdal, and Ahmet Murat Gizir. 2013. "Subcritical and Supercritical Fluid Extraction of Heavy Metals from Sand and Sewage Sludge." *Journal of the Serbian Chemical Society* 78(7):1013–22.