



## DAFTAR PUSTAKA

- Abdel-Shafy, Hussein & Mansour, Mona. (2018). *Phytoremediation for the Elimination of Metals, Pesticides, PAHs, and Other Pollutants from Wastewater and Soil*. 10.1007/978-981-13-1187-1\_5.
- Akcil, A. and Koldas, S. (2006). ‘Acid Mine Drainage (AMD): Causes, Treatment and CaseStudies’, *Journal of Cleaner Production*, 14(12-13 SPEC. ISS.), pp. 1139–1145. doi: 10.1016/j.jclepro.2004.09.006.
- Akvopedia.org. *Horizontal Subsurface Flow Constructed Wetland* [Online]. Available at [https://akvopedia.org/wiki/Horizontal\\_Subsurface\\_Flow\\_Constructed\\_Wetland](https://akvopedia.org/wiki/Horizontal_Subsurface_Flow_Constructed_Wetland) (Accessed: 30 Juli 2021)
- Alfaize, M., Albadran, F., AlJomma, S., Kamal, I. (2020) ‘A new local adsorbent for the removal of toxic metals from industrial wastewater’, *IOP Conf. Ser.: Mater. Sci. Eng.* 928(2) 022049 doi:10.1088/1757-899X/928/2/022049
- Auta, M., and Hameed, B.H. (2012), ‘Modified Mesoporous Clay Adsorbent for Adsorption isotherm and Methylene Blue’, *Chemical Engineering Journal*, 198-199 (219-217).
- Castellan, G.W. (1983) *Physical Chemistry*, Massachusetts, Addison-Wesley Publishing Company.
- Carvalho, M. N., de Abreu, C. A. M., Benachour, M., Sales, D. C. S., Barana, O. S., and Sobrinho, M. A. M. (2012) ‘Applying Combined Langmuir-Freundlich Model to the Multi-Component Adsorption of BTEX and Phenol on Smectite Clay’, *Adsorption Science & Technology* 30(8/9)
- Dharani, R., Sivalingam, A., Thirumarimurugan, M. (2016) ‘Utilization of Light Weight Expanded Clay Aggregate in Waste Water Treatment – A Review’, *International Journal of Emerging Technologies in Engineering Research* 4(4) 26–28.
- Dwityaningsih, R., Pramita, A. and Syarafina, S. (2019) ‘Review Potensi Tanaman Obat Akar Wangi (*Vetiveria Zizanioides*) Sebagai Tanaman Hiperakumulator Dalam Fitoremediasi Pada Lahan Tercemar Logam’, *Jurnal Pengendalian Pencemaran Lingkungan (JPPL)*, 1(01), pp. 51–56. doi: 10.35970/jppl.v1i01.55.
- El-Maghribi, H. H., Mikhail, S. (2016) ‘Removal of heavy metals via adsorption using natural clay material’, *Journal of Environment and Earth Science* 4 38–47.
- Gautama, R. S. (2012). *Pengelolaan Air Asam Tambang*, Bimbingan Teknik Reklamasi dan Pascatambang Pada Kegiatan Pertambangan Mineral dan Batu Bara, Ditjen Mineral dan Batu Bara, KESDM.
- Gibert, O., de Pablo, J., Cortina, J. L., & Ayora, C. (2002). ‘Treatment Of Acid Mine Drainage by Sulphate-Reducing Bacteria Using Permeable Reactive Barriers: A Review From Laboratory To Full-Scale Experiments’, *Reviews in Environmental Science and Biotechnology*, 1(4), 327–333. <https://doi.org/10.1023/A:1023227616422>
- Goldlabel.nl, Hydro Round Pebble, <https://goldlabel.nl/en-us/substrates/hydro-round-pebble>



**REMEDIASI AIR ASAM TAMBANG TIMAH MENGGUNAKAN HIDROTON DAN TANAMAN AKAR WANGI (*Vetiveria zizanioides*)**

**L.) DALAM SISTEM CONSTRUCTED WETLAND**

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Haryani, M. F., FAchrul, M. F., Hadisoebroto, R. (2020) Removal of BOD and COD Concentration in Constructed Wetland, *International Journal of Scientific & Technology Research* 9(1)

Hasan, S. N. M. S., Kusin, F. M., Lee, A. L. S., Ukang, T. A., Yusuff, F. M., and Ibrahim, Z. Z. (2017) Performance of Vetiver Grass (*Vetiveria zizanioides*) for Phytoremediation of Contaminated Water, *MATEC Web of Conferences* 103, DOI: 10.1051/matecconf/201710306003

Henny, C., Satria, G. A., and Susanti, E. (2010) *Pengolahan Air Asam Tambang menggunakan Sistem Passive Treatment*, Prosiding Seminar Nasional Limnologi V.

Hidayati, N. (2005) ‘Fitoremediasi dan Potensi Tumbuhan Hiperakumulator’, *HAYATI Journal of Biosciences*, 12(1), pp. 35–40. doi: 10.1016/S1978-3019(16)30321-7.

Husnabilah, A. (2016). *Perencanaan Constructed Wetland Untuk Pengolahan Greywater Menggunakan Tumbuhan Canna indica (Studi Kasus: Kelurahan Keputih Surabaya)*. Jurusan Teknik Lingkungan, Institut Teknologi Sepuluh Nopember.

Ihekweeme, G. O., Obianyo, I. I., Anosike-Francis, E. N., Anyakora, V. N., Odusanya, O. S., Onwualu, A. P. (2021) ‘Expanded clay aggregates multi-functionality for water purification: Disinfection and adsorption studies’, *Cogent Engineering* 8(1) doi:10.1080/23311916.2021.1883232.

Irhamni, Pandia, S., Purba, E., Hasan, W. (2017), Kajian Akumulator Beberapa Tumbuhan Air Dalam Menyerap Logam Berat Secara Fitoremediasi, *Conference: Jurnal Serambi Engineering Fakultas Teknik USM*

Ismael, I. S., Kharbish, S., Saad, E. M., Maged, A. (2016) ‘Adsorption of Copper from Aqueous Solutions By Using Natural Clay’, *Acta Universitatis Matthiae Belii* 1

Johnson, D. B., and Hallberg, K. B. (2005). ‘Acid Mine Drainage Remediation Options: A Review’. *Science of the Total Environment*, 338(1-2 SPEC. ISS.), 3–14. <https://doi.org/10.1016/j.scitotenv.2004.09.002>

Kalhoria, E. M., Al-Musawib, T. J., Ghahramani, E., Kazemian, H., Zarrabi, M. (2017) ‘Enhancement of the adsorption capacity of the light-weight expanded clay aggregate surface for the metronidazole antibiotic by coating with MgO nanoparticles: Studies on the kinetic, isotherm, and effects of environmental parameters’, *Chemosphere* 175 8-20 doi:10.1016/j.chemosphere.2017.02.043

Kartika, K. dan Fibriyanto, A. (2014) ‘Potensi Alfalfa sebagai Tanaman Hiperakumulator pada Fitoremediasi Tanah Tercemar Logam Berat’, *Prosiding SNPBS (Seminar Nasional Pendidikan Biologi dan Saintek) Ke-2* pp. 726–730.

Khan, M.I., Almesfer, M.K., Danish, M., Ali, I.H., Shoukry, H., Patel, R., Gardy, J., Nizami, A.S., Rehan, M. (2019) ‘Potential of Saudi Natural Clay as An Effective Adsorbent in Heavy Metals Removal from Wastewater’, *Desalination and Water Treatment*, (158) pp. 140-151. doi: 10.5004/dwt.2019.24270

Kiswanto, Wintah, and Rahayu, N. L. (2020). ‘Analisis Logam Berat ( Mn , Fe , Cd ), Sianida dan Nitrit Pada Air Asam Tambang Batu Bara’. *Jurnal Litbang Kota Pekalongan* (18).



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Universitas Gadjah Mada, 2022 | Diunduh dari <http://etd.repository.ugm.ac.id/>

Kurniawan, A., Oedjijono, Tamad, Sulaeman, U., (2019) ‘The Pattern of Heavy Metals Distribution in Time Chronosequence of Ex-Tin Mining Ponds in Bangka Regency, Indonesia’, *Indonesian Journal of Chemistry*, 19(1), pp. 254–261. doi: 10.22146/ijc.33613.

Kusumaningsih, R. (2014), *Analisis Kualitas Air Kolong Bekas Pertambangan Timah Menggunakan Tanaman Akar Wangi Dengan Metode Fitoremediasi (Studi Kasus: Air Kolong Bekas Pertambangan Timah di Provinsi Kepulauan Bangka Belitung)*, FakultasTeknik Universitas Indonesia.

Laily, K. N. (2020) *Studi Treatment Constructed Wetland Pada Air Limbah Domestik Pemukiman Pesisir*, Fakultas Teknis Universitas Tidar.

Lestari, D. E. (2012) *Efektivitas Pengolahan Limbah Cair Domestik Dengan Metode Rawa Buatan (Constructed Wetland)*. Fakultas Ilmu Kesehatan UIN Alauddin Makassar

Longley, K. (2007). *The Feasibility of Poplars For Phytoremediation Of Tce Contaminated Groundwater: A Cost-Effective And Natural Alternative Means Of Groundwater Treatment*. The Evergreen State College. [https://www.researchgate.net/figure/2-Phytoextraction-Process-This-figure-depicts-the-phytoextraction-process-in-plants\\_fig4\\_265191596](https://www.researchgate.net/figure/2-Phytoextraction-Process-This-figure-depicts-the-phytoextraction-process-in-plants_fig4_265191596)

Lukman, S., Essa, M.H., Mu'azu, N. D., Bukhari, A., Basheer, C. (2013) ‘Adsorption and Desorption of Heavy Metals onto Natural Clay Material: Influence of Initial pH’, *Journal of Environmental Science and Technology* 6(1) 1-15. doi: 10.3923/jest.2013.1.15

Malakootian, M., Nouri, J., Hossaini, H. (2009) ‘Removal of heavy metals from paint industry's wastewater using Leca as an available adsorbent’, *International Journal of Environment Science and Technology* 6(2) 183-190

Mundim, H. S. S. L., Canelhas, B. B., Pagan, F. S., Gonçalves, J. C. S. I., da Luz, M. S., Ferreira, D. C. (2022) ‘Optimization of Pb<sup>2+</sup>, Cd<sup>2+</sup>, Ni<sup>2+</sup> and Ba<sup>2+</sup> adsorption onto light expanded clay aggregate (LECA)’, *Ciencia e Natura* 44 doi:10.5902/2179460X68809

Nasir, S., Permatahati, D. S., Musdalipah, O., Ibrahim, E., and Arief, A. T. (1998) ‘Aplikasi Berbagai Jenis Adsorben Pada Pengolahan Air Asam Tambang Sintetik Skala Mini Plant’, *Ethos (Jurnal Penelitian dan Pengabdian Masyarakat)* (4), pp. 249–256.

Nguegang, B., Masindi, V., Msagati, T. A. M., Tekere, M., (2021) ‘The Treatment of Acid Mine Drainage Using Vertically Flowing Wetland: Insights into the Fate of Chemical Species’, *Minerals* 2021; 11(5):477. <https://doi.org/10.3390/min11050477>

Nkansah, M. A., Christy, A. A., Barth, T., Francis, G. W. (2012) The use of lightweight expanded clay aggregate (LECA) as sorbent for PAHs removal from water, *Journal of Hazardous Materials*, 217-218 360-365 doi:10.1016/j.jhazmat.2012.03.038

Nurtjahya, E., Santi, R., Inonu, I. (2020) *Lahan Bekas Tambang Timah Dan Pemanfaatannya*, PT. Kanisius, Yogyakarta.



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Universitas Gadjah Mada, 2022 | Diunduh dari <http://etd.repository.ugm.ac.id/>

Oktafri, Ningsih, Y.A, Novita, D.D (2015), Pembuatan Hidroton Berbagai Ukuran Sebagai Media Tanam Hidroponik dari Campuran Bahan Baku Tanah Liat dan Digestate”, *Jurnal Teknik Pertanian Lampung* 4(4).

Patandungan, A., HS, S. And Aisyah, A. (2016) ‘Fitoremediasi Tanaman Akar Wangi (*Vetiver Zizanioides*) Terhadap Tanah Tercemar Logam Kadmium (Cd) pada Lahan TPA Tamangapa Antang Makassar’, *Al-Kimia*, 4(2), Pp. 8–21. Doi: 10.24252/Al- Kimia.V4i2.1676.

Perry, R. H. (1997), *Perry's Chemical Engineers' Handbook*, 7<sup>th</sup> Ed., McGraw-Hill, New York.

Pierzynski, Gary & Kulakow, Peter & Erickson, L. & Jackson, Lucinda & Pierzynski, G. (2002). ‘Plant System Technologies for Environmental Management of Metals in Soils: Educational Materials’, *Journal of Natural Resources and Life Sciences Education*. 31. 10.2134/jnrlse.2002.0031.

Pouramini, M., Torabian, A., Tehrani, F. M. (2019) ‘Application of lightweight expanded clay aggregate as sorbent for crude oil cleanup’, *Desalination and Water Treatment* 160 (2019) 366-377 doi:10.5004/dwt.2019.24232

Prasetya, A., Prihutami, P., Warisaura, A. D., Fahrurrozi, M., and Petrus, H. T. B. M. (2020), ‘Characteristic of Hg Removal Using Zeolite Adsorption and Echinodorus palaefolius Phytoremediation in Subsurface Flow Constructed Wetland (SSF-CW) model’, *Journal of Environmental Chemical Engineering*, 8(3), p. 103781. doi: 10.1016/j.jece.2020.103781.

Pratama, R. P. (2018) *Fitoremediasi*, Ganeca Environmental Service, <https://www.gesi.co.id/fitoremediasi/> (diakses pada 3 Agustus 2021)

Rachmawardani, A., Sholichin, M., and Wibisono, G. ‘Studi Constructed Wetland Sebagai Solusi Pencemaran Di Sub Das Tukad Badung Hulu Kabupaten Badung Provinsi Bali’, *Repository. Ub. Ac. Id.* <http://repository.ub.ac.id/2371/1/Rachmawardani%2C Anisa.pdf>

Rivashaa Eco Design Solutions (2017) *Expanded Clay Aggregate (ECA) And Its Applications In Wastewater Expanded Clay Aggregate (ECA) Application In Wastewaters*, India (2017)

Robinson, J. W., Frame, E. M. S., and Frame, G. M. (2014) *Undergraduated Instrumental Analysis*, (7), CRC Press, Florida USA.

Rajak, O. P. (2018) *Preparation of synthetic AMD (Acid Mine Drainage) in Laboratory and Its Treatment Using Biochar Material (Adsorption Method)*, Indian Institute of Technology (Indian School of Mines) Dhanbad.

Rukmana, B. T. S., Rauf, A., and Ghafarunnisa, D. (2017). Penanganan Air Asam Tambang Pada Skala Laboratorium Dengan Menggunakan Kapur Tohor Berdasarkan Parameter Ketebalan NAF. *Prosiding Seminar Nasional XII Rekayasa Teknologi Industri Dan Informasi 2017 Sekolah Tinggi Teknologi Nasional Yogyakarta*, 24–29.

Safrodin, A., Mangkoedihardjo, S., and Yuniarto, A. (2016). Desain IPAL Subsurface Flow Constructed Wetland Di Rusunawa Grudo Surabaya. *IPTEK Journal of*



Sahoo, S., Sharma, U., Banerjee, S., Sharma, Y. C. (2013) Application of natural clay as a potential adsorbent for the removal of a toxic dye from aqueous solutions, *Desalination and Water Treatment* 1-9 doi:10.1080/19443994.2013.816872.

Sepehr, M. N., Kazemian, H., Ghahramani, E., Amrane, A., Sivasankar, V., Zarrabi, M. (2014) Defluoridation of water via Light Weight Expanded Clay Aggregate (LECA): Adsorbent characterization, competing ions, chemical regeneration, equilibrium and kinetic modeling, *Journal of the Taiwan Institute of Chemical Engineers* 45(4) 1821–1834 doi:10.1016/j.jtice.2014.02.009.

Sepehr, M. N., Allani, F., Zarrabi, M., Darvishmotevalli, M., Vasheghian, Y., Fadaei, S., Fazli, M. M. (2019) Dataset for adsorptive removal of tetracycline (TC) from aqueous solution via natural light weight expanded clay aggregate (LECA) and LECA coated with manganese oxide nanoparticles in the presence of H<sub>2</sub>O<sub>2</sub>, *Data in Brief*, 22 676–686. doi: 10.1016/j.dib.2018.12.077.

Setianingrum, I., Sintadani, E. D., Viani, V., Uuliyah, D., Faridani, M. F., Putra, R. S. (2017) Metode ERASI (Gabungan Process Electro-Assisted Phytoremediation dan Aerasi) dengan Tanaman Akar Wangi (*Vetiveria zizanioides L*) untuk Remediasi Air Limbah Logam Fe dan Cu, *Chimica et Natura Acta* 5(3) pp. 112-119 DOI: 10.24198/cna.v5.n3.16058

Skousen, J., Rose, A., Geidel, G., Foreman, J., Evans, R., Hellier, W. (1998). ‘A Handbook of Technology for Avoidance and Remediation of Acid Mine Drainage’, The National Mine Land Reclamation Center, West Virginia

Sukarman, Gani, R. A. and Asmarhansyah (2020) ‘Tin Mining Process and Its Effects on Soils in Bangka Belitung Islands Province, Indonesia’, *Sains Tanah*, 17(2), pp. 180– 189. doi: 10.20961/STJSSA.V17I2.37606.

Tarigan, D.M. and Wardana, F.K. (2020) ‘Pertumbuhan Tanaman Akar Wangi (*Vetiveria zizanioides L*) Di Tanah Salin Dengan Perlakuan Asam Salisilat Dan Fungi Mikoriza Arbuskular’, *Agrium*, 22(3).

U.S. Environmental Protection Agency (2005). *What is Acid Mine Drainage, Sources of Non-point Source Pollution*.

Ugwu, I.M., and Igbokwe, O.A., (2019) ‘Sorption of Heavy Metals on Clay Minerals and Oxides: A Review’, *Advanced Sorption Process Applications*, Serpil Edebali, IntechOpen, DOI: 10.5772/intechopen.80989. Available from: <https://www.intechopen.com/chapters/64493>

Ui, L. S., Yulianti, I. M. and Wibowo, A. (2016) ‘Pemanfaatan Tanaman Akar Wangi (*Vetiveria zizanioides L*) Untuk Penyerapan Logam Berat Tembaga (Cu)’, Universitas Atma Jaya Yogyakarta.

Vijayalakshmi, R., and Ramanagopal, S. (2018) ‘Structural concrete using expanded clay aggregate: a review’, *Indian Journal of Science and Technology* 11(16) doi: 10.17485/ijst/2018/v11i16/121888.

Wibowo, P. D., Purnaini, R., and Fitrianingsih, Y. (n.d.). *Penyisihan Logam Pada Lindi Dengan Sistem Sub-Surface Constructed Wetland*, Program Studi Teknik



Widyasari, N. L. (2021) ‘Kajian Tanaman Hiperakumulator Pada Teknik Remediasi Lahan Tercemar Logam Berat’, *Jurnal Ecocentrism*, 1(1), pp. 17–24. Available at: <https://e-journal.unmas.ac.id/index.php/jeco/issue/view/124>.

Wijayanti, I. E. and Kurniawati, E. A. (2019) ‘Studi Kinetika Adsorpsi Isoterm Persamaan Langmuir dan Freundlich pada Abu Gosok sebagai Adsorben’, *EduChemia (Jurnal Kimia dan Pendidikan)*, 4(2), p. 175. doi: 10.30870/educhemia.v4i2.6119.

Yunus, R. and Prihatini, N. S. (2018) ‘Fitoremediasi Fe dan Mn Air Asam Tambang Batubara dengan Eceng Gondok (*Eichornia crassipes*) dan Purun Tikus (*Eleocharis dulcis*) pada Sistem LBB di PT. JBG Kalimantan Selatan”, *Sainsmat: Jurnal Ilmiah Ilmu Pengetahuan Alam*, 7(1), pp. 73–85. Available at: <http://103.76.50.195/sainsmat/article/view/6481>.

Zaini, H. and Sami, M. (2017) ‘Penyisihan Pb(II) Dalam Air Limbah Laboratorium Kimia Sistem Kolom Dengan Bioadsorben Kulit Kacang Tanah’, *ETHOS (Jurnal Penelitian dan Pengabdian)*, (II), p. 8. doi: 10.29313/ethos.v0i0.2220.

Zulfiqar, U., Subhani, T., Husain, S. W. (2016) ‘Synthesis and characterization of silica nanoparticles from clay’, *Journal of Asian Ceramic Societies* 4(1)