

## **BAB V**

### **KESIMPULAN DAN SARAN**

#### **5.1 Kesimpulan**

Berdasarkan percobaan yang telah dilakukan, dapat disimpulkan bahwa:

1. Hubungan antara variasi jumlah kebutuhan air bersih dan *service time* adsorben yang disajikan pada **Tabel 4.7**, dapat digunakan untuk memperkirakan waktu penggantian adsorben dalam kolom adsorpsi yang telah terdapat di sebuah rumah tangga, dan sebaliknya.
2. Semakin lama *service time*, maka semakin besar tinggi unggun, diameter kolom, dan panjang kolom yang dibutuhkan.
3. Semakin besar jumlah kebutuhan air bersih, maka semakin besar tinggi unggun, diameter kolom, dan panjang kolom yang dibutuhkan.

#### **5.2 Saran**

Adapun saran untuk penelitian kedepannya:

1. Perlu dilakukan percobaan karakterisasi adsorben terlebih dahulu untuk adsorben yang akan digunakan, agar hasil yang didapatkan lebih akurat.
2. Perlu dilakukan percobaan adsorpsi kontinu skala laboratorium terlebih dahulu menggunakan air yang akan diolah, agar hasil yang didapatkan lebih akurat.
3. Perlu dilakukan penelitian lebih lanjut dengan variasi variabel percobaan lainnya seperti penggunaan air yang mengandung konsentrasi lebih tinggi.

## DAFTAR PUSTAKA

- Abbaspour, N., Hurrell, R., & Kelishadi, R. (2014). *Review on Iron and its Importance for Human Health*. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences, 19(2), 164–174.
- Abidin, H. Z., Andreas, H., Gumilar, I., Wangsaatmaja, S., Fukuda, Y., & Deguchi, T. (2009). *Land subsidence and groundwater extraction in Bandung Basin, Indonesia*. IAHS-AISH Publication. 329.
- Ainun, S., Sururi, M. R., Pharmawati, K. & Suryana, I. (2015). Penyisihan Fe-Organik Pada Air Tanah Dengan AOP (*Advanced Oxidation Process*). Reaktor, 15(4), 218-223.
- Algamar, K. (1989). *Activated Dry Sand Filter as an Alternatif to Reduce the Concentration of Fe and Mn in Water Treatment*. Australia: International Reference Centre for Community Water Supply and Sanitation (IRC) Library.
- Al-Anber, M. & Al-Anber, Z. A. (2008). *Utilization of Natural Zeolite as Ion-Exchange and Sorbent Material in the Removal of Iron*. Desalination 225, 70-81.
- Badan Pusat Statistik. (2016). Rata-rata Banyaknya Anggota Rumah Tangga menurut Provinsi, 2000-2015. <https://www.bps.go.id/dynamictable/2015/09/07/849/rata-rata-banyaknya-anggota-rumah-tangga-menurut-provinsi-2000-2015.html>, diakses 15 Juni 2020.
- Bothwell, T. H. (1979). *Iron metabolism in man*. Oxford: Blackwell Scientific.
- Brezonik, P.L. (1974). *Analysis and speciation of the trace metals in water supply, in: Aqueous–Environmental Chemistry of the Metals*. Ann Arbor Science Publishers.
- Castillo D. I., Petriciolet, A. B. & Avila, H. E. (2017). *Adsorption Process for Water Treatment and Purification*. Aguascalientes: Springer International Publishing.
- Cheremisinoff, P. N. (2019). *Handbook of Water and Wastewater Treatment Technology*. Boca Raton: CRC Press
- Chowdhury, Z., Zain, S., Rashid, A., Rafique, R., & Khalid, K. (2013). *Breakthrough Curve Analysis For Column Dynamics Sorption of Mn (II) Ions From Wastewater by Using Mangostana Garcinia Peel-Based Granular Activated Carbon*. Journal of Chemistry, volume 2013.
- Crini, G., Lichtfouse, E., Wilson, L. & Morin-Crini, N. (2019). *Adsorption-Oriented Processes Using Conventional and Non-conventional Adsorbents for Wastewater Treatment*. Green Adsorbents for Pollutant Removal, 18, Springer Nature, 23-71.

- Crittenden, B. & Thomas, W. J. (1998). *Adsorption Technology & Design*. Elsevier Science & Technology Books.
- Das, B., Mondal, N. K., Bhaumik, R. & Roy, P. (2014). *Insight into Adsorption Equilibrium, Kinetics and Thermodynamics of Lead onto Alluvial Soil*. Int. J. Environ. Sci. Technol, 11: 1101-1114
- De Zuane, J. (1930). *Handbook of Drinking Water Quality: Standards and Control*. New York: Van Nostrand Reinhold.
- Dong, L., Liu, W., Jiang, R. & Wang, Z. (2015). *Study on the Adsorption Mechanism of Activated Carbon Removing Low Concentrations of Heavy Metals*. Desalination and Water Treatment.
- Effendi, H. (2003). *Telaah Kualitas Air Bagi Pengelolaan Sumber Daya dan Lingkungan Perairan*. Yogyakarta: Kanisius.
- Faust, S. D., & Aly, O. M. (1987). *Adsorption Processes for Water Treatment*. Stoneham: Butterworth.
- Fetter, C. (1994). *Applied Hydrogeology*, 3<sup>rd</sup> edition. New York: Macmillan College Publishing, inc.
- Gabelman, A. (2017). *Adsorptions Basics: Part 1*. American Institute of Chemical Engineering (AIChE).
- Hasanzadeh, M., Ansari, R., & Ostovar, F. (2016). *Synthesis and Application of CeO<sub>2</sub>/Sawdust Nanocomposite for Removal of As(III) Ions from Aqueous Solutions Using a Fixed Bed Column System*. Global NEST J., 19 (1), 7-16.
- Helmy, Q. & Notodarmojo, S. (2019). *Improvement of the Raw Drinking Water Quality From Shallow Well Ozone Treatment*. IOP Conf. Series: Materials Science and Engineering, 620.
- Hudaya, T. & Rachmat, V. (2018). *Activated Carbon Fixed-Bed Adsorber Design for Treating Chromium Hexavalent Wastewater*. Makara J. Technol, 22/3, 135-141.
- Kementrian Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia. (2007). **PEMAKAIAN AIR RUMAH TANGGA PERKOTAAN 144 LITER PERHARI**. <https://www.pu.go.id/berita/view/4175/pemakaian-air-rumah-tangga-perkotaan-144literperhari#:~:text=Pemakaian%20air%20rata%2Drata%20rumah,setiap%20orang%20144%20liter%20perharinya.&text=Kebutuhan%20pokok%20minimal%20pemakaian%20air,bersih%20rumah%2C%20se>, diakses 15 Juni 2020.

- Kirk & Othmer. (2004). *Volume 04: Bearing Materials to Carbon*. Encyclopedia of Chemical Technology, (4), 578.
- Kulkarni, S. J. & Kaware, J. P. (2014). *Fixed Bed Removal of Heavy Metal: a Review*. International Journal of Research, 1(6), 861-871.
- Kundari, N. A. & Wiyuniati, S. (2008). Tinjauan Kesetimbangan Adsorpsi Tembaga dalam Limbah Pencuci PCB dengan Zeolit. Seminar Nasional IV SDM Teknologi Nuklir Yogyakarta, 489-496.
- Lakherwal, D. (2014). *Adsorption of Heavy Metals*. Chandigarh: International Journal of Environmental Research and Development.
- Larasati, A. I., Susanawati, L. D. & Suharto B. (2015). Efektivitas Adsorpsi Logam Berat pada Air Lindi Menggunakan Media Karbon Aktif, Zeolit dan Silika Gel di TPA Tlekung, Batu. Jurnal Sumberdaya Alam dan Lingkungan.
- Malkoc, Emine, Nuhoglu, Yasar, Abali & Yuksel. (2006). *Cr(IV) Adsorption by Waste Acorn of Quercus Ithaburensis in Fixed Beds: Prediction of Breakthrough Curves*.
- Maryati, S. & Humaira, A. N. S. (2016). *Spatial Variation of Water Supply Provision in Bandung Metropolitan Area*. International Conference on Engineering and Science for Research and Development, 73-78.
- McCabe, W. L., Smith, J. C. & Harriott, P. (1993). *Unit Operations of Chemical Engineering*. Singapore: McGraw-Hill Book Co.
- Nastiti, A., Muntalif, B. S., Roosmini, D., Sudradjat, A., Meijernik, S.V. & Smits, A. J. M. (2017). *Coping with Poor Water Supply in Peri-Urban Bandung, Indonesia: Towards a Framework for Understanding Risks and Aversion Behaviours*. Environment and Urbanization, 29(1), 69-88.
- Notodarmojo, S. (2005). *Ground and Groundwater Pollution (In Indonesia)*. Bandung: ITB Press.
- Noureddine, M. E., Mohammed, E. K., Abdellah, D., Safae, B., Abdellah, L., & Bachine, B. (2016). *Biosorption of Congo Red in a Fixed-Bed Column From Aqueous Solution Using Jujube Shell : Experimental and Mathematical Modelling*.
- O'Connell, D. W., Birkinshaw, C. & O'Dwyer, T.F. (2008). Heavy Metal Adsorbents Prepared from the Modification of Cellulose: a Review. *Bioresource Technology*, 99(15), 6709-6724.
- Patel, H. (2019). Fixed - bed column adsorption study : a comprehensive review. *Applied Water Science*, 9(3), 1-17.

- Peraturan Menteri Kesehatan Republik Indonesia Nomor 32 Tahun 2017. *Standar Baku Mutu Kesehatan Lingkungan dan Persyaratan Kesehatan Air untuk Keperluan Higiene Sanitasi, Kolam Renang, SPA dan Pemandian Umum*. 20 Juni 2017. Berita Negara Republik Indonesia Tahun 2017 Nomor 864. Jakarta.
- Pirajan, J. C. M., Rangel, D., Amaya, B., Vargas, E. M. & Giraldo, L. (2008). *Design and Construction of Equipment to Make Adsorption at Pilot Plant Scale of Heavy Metals*. Z. Naturforsch, 63a, 453-461.
- Rene, E. R., Sahinkaya, E., Lewis, A & Lens, P. N. L. (2017). *Sustainable Heavy Metal Remediation Volume 1: Principles and Processes*. Switzerland: Springer.
- Richardson, J.F., Harker, J. H. & Backhurst, J. R. (2002). *Coulson and Richardson's Chemical Engineering, Volume 2, 5<sup>th</sup> Edition: Particle Technology and Separation Processes*. Oxford: Butterworth-Heinemann.
- Roquerol, F., Roquerol, J., Llewellyn, Sing, K., & Maurin, G. (2012). *Adsorption by Powders and Porous Solids*. Elsevier. Ltd.
- Seader, J. & Henley, E. (2005). *Separation Process Principles*. Chichester: John Wiley.
- Shafeeyan, M., Daud, W. & Shamiri, A. (2014). *A Review of Mathematical Modeling Fixed Bed Column for Carbon Dioxide Adsorption*.
- Sidabutar, & Marpuria, Y. (2018). *Studi Adsorpsi Fe dan Mn pada Air Sumur Menggunakan Karbon Aktif Pelepah Kelapa Sawit Sebagai Adsorben*. Medan: Universitas Sumatera Utara.
- Suhendrayatna, Marwan, Munawar, E., & Zaki, M. (2009). *Water Quality Assessment in the Tsunami-Affected Areas of Banda Aceh*. Jurnal Rekayasa Kimia dan Lingkungan, Vol. 7, No.1: 1-4.
- Sutandi, I. (2012). *Air Tanah*. Bandung: Universitas Kristen Maranatha.
- Sylvia, N., Hakim, L., Fardian, N., & Yunardi. (2017). *Adsorption Performance of Fixed Bed Column for the Removal of Fe (II) in Groundwater Using Activated Carbon Made From Kernel Shells*. Banda Aceh: IOP Publishing.
- Taylor, R. (2011). *Adaptation of Bagasse Fly Ash Into Zeolites for the Removal of Phenols From Aqueous Solution*.
- Thien, C. (2019). *Introduction to Adsorption Basics, Analysis and Applications*. In Introduction to Adsorption.
- Treybal, R. E. (1981). *Mass-Transfer Operations, 3<sup>rd</sup> Edition*. Singapore: McGraw-Hill.

- Udyani, K. & Wulandari, Y. (2014). Aktivasi Zeolit Alam untuk Peningkatan Kemampuan sebagai Adsorben pada Pemurnian Biodiesel. Seminar Nasional Sains dan Teknologi Terapan II.
- Worch, E. (2012). *Adsorption Technology in Water Treatment*.
- Zamzow, M. J. & Murphy, J. E. (1992). *Removal of metal cations from water using zeolites*. Sep. Sci. Technol., 27(14), 1969–1984.
- Zevi, Y., Dewita, S., Aghasa, A. & Dwinandha, D. (2018). *Removal of Iron and Manganese from Natural Groundwater by Continuous Reactor Using Activated and Natural Modernite Minerall Adsorption*. IOP Conference Series: Earth and Environmental Science, 111(1).