



## BAB V

### KESIMPULAN DAN SARAN

#### 1. Kesimpulan

Kesimpulan dari penelitian “Analisis Kinerja Kolom Adsorpsi Kontinu untuk Pengolahan Larutan Zat Warna *Strawberry Red* Menggunakan Adsorben Karbon Aktif”:

1. Isotherm adsorpsi yang paling cocok digunakan untuk hasil data percobaan adalah Isotherm Langmuir dengan nilai kapasitas maksimum ( $q_m$ ) adalah 29,878 mg/g dan didapatkan pada pH 2,5.
2. Secara keseluruhan, pH terbaik dalam adsorpsi larutan *Strawberry Red* yaitu 2,5.
3. Semakin tinggi *hydraulic loading* maka kapasitas adsorpsi semakin kecil karena berkurangnya *residence time* antara adsorbat dengan adsorben.
4. Semakin tinggi konsentrasi awal umpan, kapasitas semakin besar, karena adanya *driving force* yang semakin besar pula.
5. Semakin tinggi ukuran unggun, maka kapasitas adsorpsi akan semakin besar dikarenakan *binding sites* yang semakin banyak.
6. Model kurva breakthrough Adams-Bohart memiliki kecocokan dengan percobaan ini.
7. Kapasitas tertinggi yang didapatkan pada penelitian ini adalah 71,579 mg/g pada kondisi pH 2,5, tinggi unggun 20 cm, konsentrasi awal larutan 50 mg/L, serta *hydraulic loading* 95,492 L/menit.m<sup>2</sup>.

#### 2. Saran

Saran untuk para praktikan selanjutnya yang akan menggunakan kolom adsorpsi kontinu adalah:

1. Melakukan variasi ukuran adsorben untuk mengetahui pengaruhnya terhadap kinerja kolom adsorpsi kontinu.
2. Dapat mempersiapkan waktu yang lebih panjang agar bisa mendapatkan run yang utuh (hingga unggun karbon aktif benar-benar jenuh dan konsentrasi efluen yang didapat sama dengan konsentrasi umpan).



## DAFTAR PUSTAKA

- Abak, H., Alkan, M., & Dog ̇an, M. 2008. *Adsorption of methylene blue onto hazelnut shell: Kinetics, mechanism and activation parameters*: Elsevier.
- Agency of Toxic Substance and Disease Registry. 2016. Diambil kembali dari Agency of Toxic Substance and Disease Registry: <http://www.atsdr.cdc.gov/toxprofiles/tp85-c2.pdf>
- Ahmad, T. F., Aprilia, H., & Rusdi, B. 2016. *Analisis Kualitatif dan Kuantitatif Pewarna Ponceau 4R Ci 16255 (E 124) Pada Permen Gulali dan Sirup Jajanan dengan Metode Spektrofotometri UV-Sinar Tampak*: Universitas Islam Bandung.
- Ahmada, A. A., Hameed, B. H., & Idrisa, A. 2013. *Modeling of disperse dye adsorption onto bamboo- based activated carbon in fixed-bed column*: Taylor & Francis
- Al-Ghonemiy, A. F., Salem, M. A., & Zaki, A. B. 2009. *Photocatalytic degradation of Allura red and Quinoline yellow with Polyaniline/TiO<sub>2</sub> nanocomposite*: Elsevier.
- Alimohammadi, Z., Bahramifar, N., & Younesi, H. 2016. *Batch and Column Adsorption of Reactive Red 198 from Textile Industry Effluent by Microporous Activated Carbon Developed from Walnut Shells*: Elsevier
- Amrita Vishwa Vidyapeetam University. 2016. Diambil kembali dari Amrita: <http://vlab.amrita.edu>
- Asaithambi, M. 2015. *Fixed bed adsorption studies of Rhodamine-B dye using polymer bound adsorbent*: Pelagia Research Library
- Bai, S. 2014. *Removal of Water from Anisole by 3A Molecular Sieve in Batch and Fixed-bed Column Systems*: Asian Journal of Chemistry.
- Baqueru, F., & Oscar. *Design of Plant of Coal for the Study of Lowering of Micro pollutants in Water*. University of Seville. Diambil kembali dari <http://bibing.us.es/proyectos/abreproy/20087/fichero/CHAPTER+3.pdf>. 6 Agustus 2017.
- Benincá, C., Igarashi-Mafra, L., Peralta-Zamora, P., & Tavares, C. R. 2013. *Degradation of an Azo Dye (Ponceau 4R) and Treatment of Wastewater from a Food Industry by Ozonation*: Taylor and Francis
- Bishwas, S. 2015. *Continuous Fixed-Bed Column Study and Adsorption Modeling: Removal of Lead Ion from Aqueous Solution by Charcoal Originated from Chemical Carbonization of Rubber Wood Sawdust*: Hindawi.
- Biswas, K., Chakrabarti, S., Ghosh, A., & Ghosh, U. C. 2015. *Column performances on fluoride removal by agglomerated Ce(IV)-Zr(IV) mixed oxide nanoparticles packed fixed-beds*: Elsevier.

- Chang, Z., Zhou, & Zhu, Q.2015. *Role of the Surface Chemistry of Activated Carbons in Dye Removal from Aqueous Solution: International Journal of Minerals, Metallurgy and Materials*. Volume 22.
- Chen, S. & Yue, Q.2011. *Adsorption of hexavalent chromium from aqueous solution by modified corn stalk: A fixed-bed column study: Bioresource Technology*.
- Chen, X. & Xiong, L.2016. *Estimation of fixed-bed column parameters and mathematical modeling of breakthrough behaviors for adsorption of levulinic acid from aqueous solution using SY-01 resin*.
- Chen, X. & Su, X.2015. *Adsorption Removal of Dyes from Single and Binary Solutions Using a Cellulose-based Bioadsorbent: ACS*.
- Cheng, J., Hana, R., Wanga, Y., Wanga, Y., Xie, F., Tanga, M., & Zhao, X.2008. *Adsorption of methylene blue by phoenix tree leaf powder in a fixed-bed column: experiments and prediction of breakthrough curves: Elsevier*
- Cheung, W., McKay, G., Szeto, Y., & Wong, Y.2004. *Adsorption of acid dyes on chitosan—equilibrium isotherm analyses: Elsevier*
- Chia, C. H., Sajab, M. S., Sillanpää, M., & Zakaria, S.2014. *Fixed-bed column studies for the removal of cationic and anionic dyes by chemically modified oil palm empty fruit bunch fibers: single- and multi-solute systems: Taylor and Francis*
- Coulson, J., Richardson, J. F., J.H, H., & Backhurst, J.2002. *Particle Technology and Separation Processes*. Woburn, Massachusetts, United States of America: Butterworth-Heinemann. Volume 2; 5th ed.
- Coulson.1980. *Synthetic organic colours for food, in Developments in Food Colours*. London: Applied Science Publishers. Volume 1, Walford J ed.
- Crini, G.2005. *Recent developments in polysaccharide-based materials used as adsorbents in wastewater treatment: Elsevier*. Volume 30.
- Crittenden, B., & Thomas, W. J. (1998). *Adsorption Technology and Design: Elsevier Science & Technology Books*. 1st ed.
- Cui, Z. & Zhang, Y.2014. *Continuous adsorption of Pb(II) and methylene blue by engineered graphite oxide coated sand in fixed-bed column: Elsevier*.
- Dai, M.1997. *Mechanism of Adsorption for Dyes on Activated Carbon: Journal of Colloid and Interface Science*.
- Damant, A. P.2011. *Handbook of textile and industrial dyeing*. Cambridge, UK: Woodhead Publishing Limited. Volume 2.
- Damodar Jhare, D., Mittal, A., & Mittal, J.2012. *Adsorption of hazardous dye Eosin Yellow from aqueous solution onto waste material De-oiled Soya: Isotherm, kinetics and bulk removal: Elsevier*.
- Department of The Army U.S. Army Corps of Engineers.2001. *Engineering and Design Adsorption Design Guide*.

- Dinc, E. B.2002. *Spectrophotometric multicomponent determination of sunset yellow, tartrazine and allura red in soft drink powder by double divisor-ratio spectra derivative, inverse least-squares and principal component regression methods.*
- Edinger, T., Falk, M., Lewis, K., & Nigg, J. T.2012.*Meta-Analysis of Attention-Deficit/Hyperactivity Disorder or Attention-Deficit/Hyperactivity Disorder Symptoms, Restriction Diet, and Synthetic Food Color Additives:*Elsevier.Volume 51.
- Eisazadehb, H.2017. *Adsorption of manganese ion using polyaniline and it's nanocomposite: Kinetics and isotherm studies:*Elsevier.
- Elmchaouri, A., Gil, A., Korili, S. A., Mahboub, R., & Mouzdahir, Y. E.2007.*Adsorption of Methylene Blue from Aqueous Solutions on a Moroccan Clay:*American Chemical Society.Volume 52.
- European Food Safety Authority (EFSA).2009. *Scientific Opinion on the re-evaluation of Ponceau 4R (E 124) as a food additive:* European Food Safety Authority.
- FAO.Diambil kembali dari FAO: [http://www.fao.org/3/a-a0691e/Total\\_colouring\\_matters\\_volume%204.pdf](http://www.fao.org/3/a-a0691e/Total_colouring_matters_volume%204.pdf).6Agustus 2017.
- Food and Agriculture Organization. (2011). *Ponceau 4R*. Diambil kembali dari [www.fao.org](http://www.fao.org): <http://www.fao.org/ag/agn/jecfa-additives/specs/monograph11/additive-329-m11.pdf>.6 Agustus 2017.
- Fu, R.2012. *Preparation of carbon aerogels with different pore structures and their fixed bed adsorption properties for dye removal:*Elsevier.
- Fu, R., Wu, D., Wu, X., & Zeng, W.2012. *Preparation of carbon aerogels with different pore structures and their fixed bed adsorption properties for dye removal:*Elsevier
- Gao, B. & Xu, X.2011. *Adsorption characteristics of dyes in columns of activated carbon prepared from paper mill sewage sludge:*Elsevier.
- Geankoplis, C. J. (2003). *Transport Processes and Separation Process Principles* 4th International Edition ed. New Jersey, USA: Prentice Hall.
- Goshadrou, A., & Moheb, A.2010. *Continuous fixed bed adsorption of C.I. Acid Blue 92 by exfoliated graphite: An experimental and modeling study:*Elsevier.
- Gupta, V. K., Jain, R., Shrivastava, M., & Nayak, A.2010. *Equilibrium and Thermodynamic Studies on the Adsorption of the Dye Tartrazine onto Waste "Coconut Husks" Carbon and Activated Carbon:*American Chemical Society
- Ikbal dan Nugroho, R.2005. *Pengolahan Air Limbah Berwarna Industri Tekstil dengan Proses AOPs.*Volume 1.
- Islam, M. A., Khan, M. M., & Rukanuzzaman, M.2009.*Adsorption of methylene blue from aqueous solution by jackfruit (Artocarpus heteropyllus) leaf powder: A fixed-bed column study:*Elsevier.

- Ji-Lai Gong.2014.*Continuous adsorption of Pb(II) and methylene blue by engineered graphite oxide coated sand in fixed-bed column*:Elsevier.
- Kassem, M.2014.*Environmental Analytical Chemistry Adsorption of Tartrazine on Medical Activated Charcoal Tablets under Controlled Conditions*:Elsevier.
- Kharub, M.2012. *Use of Various Technologies, Methods, and Adsorbents for the Removal of Dye*: Department of Biotechnology and Environment Sciences, Thapar University, Patiala, Punjab (INDIA).Volume 6.
- Kim, D.2017.*Equilibrium isotherms, kinetics, and thermodynamics studies for congo red adsorption using calcium alginate beads impregnated with nano-goethite. Ecotoxicology and Environmental Safety*:Elsevier.
- Kwartiningsih, E., & Setiarini, N.2005.*Adsorpsi Logam Cu dari Limbah Elektroplating Menggunakan Karbon Aktif dalam Kolom Fix Bed*.
- Lazo, P. (2009). *Determination of Cr(VI) in Environmental Samples Evaluating Cr(VI) Impact in Contaminated Area*:Journal of International Environmental Application & ScienceVolume 4.
- Lewinsky, A. A.2007.*Hazardous Materials and Wastewater: Treatment, Removal, and Analysis*. New York: Nova Science Publishers, Inc.
- Ling, L., Lang, L., Qiao, W., & Zha, Q.1997. *Preparation of a pitch-based activated carbon with a high specific surface area*: Kluwer Academic Publishers.Volume 32.
- McCabe, W. L., Smith, J. C., & Harriott, P.2005. *Unit Operations of Chemical Engineering 7th edition*. New York: McGraw-Hill .
- Motarjemi, Y.2014. *Encyclopedia of Food Safety*: Elsevier Science.
- Nagapadma, M.2015. *Modeling of Fixed Bed Column Studies for Adsorption of Azo Dye on Chitosan Impregnated with a Cationic Surfactant. International Journal of Scientific & Engineering Research*.Volume 6.
- Ozsoy, H. D., & van Leeuwen, J.2011. *Removal of color from fruit candy waste by activated carbon adsorption*:Elsevier.
- Roy, D., & Swaroop, V. R.2011. *Genotoxicity of Synthetic Food Colorants*:David Publishing.
- Ruthven, D. M. 1938. *Principles of Adsorption and Adsorption Processes*. Canada: John Wiley & Sons, Inc.
- Sanghi, R., & Sharma, S. K. 2012. *Advances in Water Treatment and Pollution Prevention*. London, United Kingdom: Springer.
- Shanthakumar, S., & Vilvanathan, S.2016. *Modeling of fixed-bed column studies for removal of cobalt ions from aqueous solution using Chrysanthemum indicum*:CrossMark.
- Sibel Tunali Akar, D. Y.2014. *Effective biodecolorization potential of surface modified lignocellulosic industrial waste biomass*:Elsevier.

- Skoog, A. D., West, M. D., & Holler, J. F. 1995. *Fundamentals of Analytical Chemistry, 7th Edition*. New York: Saunders College Publishing.
- Soylak, M., Unsal, Y. E., & Tuzen, M. 2011. *Spectrophotometric determination of trace levels of allura red in water samples after separation and preconcentration*:Elsevier.
- Stylidi, M. K.2003. *Pathways of solar light-induced photocatalytic degradation of azo dyes in aqueous TiO<sub>2</sub> suspensions*:Environ.
- Tang, W. Z.2004. *Physicochemical Treatment of Hazardous Wastes*. United States of America: Lewis Publishers.
- The Nordic Council.2002. *Food additives in Europe 2000*. Copenhagen: Nordic Council of Minister.
- Thomas, W. J., & Crittenden, B.1998. *Adsorption Technology and Design*:Elsevier Science & Technology Books.
- Treybal, R. E.1981. *Mass Transfer Operations*. Singapore: Mc Graw-Hill.
- Udyani, K.2013. *Adsorpsi Deterjen dalam Air Menggunakan Adsorben Karbon Aktif pada Kolom Fluidisasi*.
- Wallas, S. M.1990. *Chemical Process Equipment, Selection and Design*. Washington, DC.: Butterworth-Heinemann.
- Worch, E. 2012. *Adsorption Technology in Water Treatment*. Berlin: Walter de Gruyter GmbH & Co.
- Yang, R. T.2003. *Adsorbents: Fundamentals and Applications*. Hoboken, New Jersey, United States of America: John Wiley & Sons, Inc.