

## **BAB V**

### **KESIMPULAN & SARAN**

#### **V.1 Kesimpulan**

Dari hasil percobaan yang telah dilakukan yaitu dengan melakukan penggabungan GO (Graphene Oxide), Kalsium Karbonat ( $\text{CaCO}_3$ ) dengan Organosilan dengan material obat yaitu ibuprofen maka dapat dikatakan bahwa penelitian atau percobaan ini dapat diaplikasikan sebagai *drug carier*. Dengan hasil penelitian yg didapatkan, kapasitas adsorpsi maksimum 300-418 mg/g dan proses *release* mencapai equilibrium pada menit ke 1080.

#### **V.2 Saran**

Pencampuran  $\text{GO@CaCO}_3\text{@Organosilan}$  ini dapat diaplikasikan dikarenakan kapsitas adsorpsi lebih besar dan proses *release* terkontrol. Penelitian kedepannya dapat memilih penghantar obat yang lebih cocok untuk pencampuran material ini. Selain itu dilakukan variasi dalam penambahan jumlah atau massa APTES dalam pembuatan organosilan.

## DAFTAR PUSTAKA

- [1] S. V. Tkachev, E. Y. Buslaeva, and S. P. Gubin, "Graphene: A novel carbon nanomaterial," *Inorg. Mater.*, vol. 47, no. 1, pp. 1–10, 2011, doi: 10.1134/S0020168511010134.
- [2] B. Campbell and J. Manning, "The rise of victimhood culture: Microaggressions, safe spaces, and the new culture wars," *Rise Vict. Cult. Microaggressions, Safe Spaces, New Cult. Wars*, pp. 1–265, 2018, doi: 10.1007/978-3-319-70329-9.
- [3] S. V. Tkachev, E. Y. Buslaev, A. V. Naumkin, S. L. Kotova, I. V. Laure, and S. P. Gubin, "Reduced graphene oxide," *Inorg. Mater.*, vol. 48, no. 8, pp. 796–802, 2012, doi: 10.1134/S0020168512080158.
- [4] W. S. Hummers and R. E. Offeman, "Preparation of Graphitic Oxide," *J. Am. Chem. Soc.*, vol. 80, no. 6, p. 1339, 1958, doi: 10.1021/ja01539a017.
- [5] A. A. Weiner, M. C. Moore, A. H. Walker, and V. P. Shastri, "Modulation of protein release from photocrosslinked networks by gelatin microparticles," vol. 360, pp. 107–114, 2008, doi: 10.1016/j.ijpharm.2008.04.037.
- [6] M. M. Li Liang, Zhu Yingjie, Cao Shaowen, "Persiapan Mikrosfer Berpori Berpori Berstruktur Nano Kalsium Karbonat dan Studi tentang Sifat Pelepasan Berkelanjutan Obat."
- [7] D. R. Dreyer, S. Park, C. W. Bielawski, and R. S. Ruoff, "The chemistry of graphene oxide," *Chem. Soc. Rev.*, vol. 39, no. 1, pp. 228–240, 2010, doi: 10.1039/b917103g.
- [8] Z. Zhou, Y. Li, S. Yao, and H. Yan, "Preparation of calcium carbonate@graphene oxide core-shell microspheres in ethylene glycol for drug delivery," *Ceram. Int.*, vol. 42, no. 2, pp. 2281–2288, 2016, doi:

10.1016/j.ceramint.2015.10.022.

- [9] S. Rohmani and H. Rosyanti, "Perbedaan Metode Penambahan Bahan Penghancur Secara Intragranular-Ekstragranular Terhadap Sifat Fisik Serta Profil Disolusi Tablet Ibuprofen," *JPSCR J. Pharm. Sci. Clin. Res.*, vol. 4, no. 2, p. 95, 2019, doi: 10.20961/jpscr.v4i2.33622.
- [10] J. Ortiz Balbuena, P. Tutor De Ureta, E. Rivera Ruiz, and S. Mellor Pita, "Enfermedad de Vogt-Koyanagi-Harada," *Med. Clin. (Barc).*, vol. 146, no. 2, pp. 93–94, 2016, doi: 10.1016/j.medcli.2015.04.005.
- [11] G. Shao, Y. Lu, F. Wu, C. Yang, F. Zeng, and Q. Wu, "Graphene oxide: The mechanisms of oxidation and exfoliation," *J. Mater. Sci.*, vol. 47, no. 10, pp. 4400–4409, 2012, doi: 10.1007/s10853-012-6294-5.
- [12] S. Setiadji *et al.*, "Preparation of reduced Graphene Oxide (rGO) assisted by microwave irradiation and hydrothermal for reduction methods," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 434, no. 1, 2018, doi: 10.1088/1757-899X/434/1/012079.
- [13] Z. Zhou, Y. Li, S. Yao, and H. Yan, "Preparation of calcium carbonate@graphene oxide core-shell microspheres in ethylene glycol for drug delivery," *Ceram. Int.*, vol. 42, no. 2, pp. 2281–2288, 2016, doi: 10.1016/j.ceramint.2015.10.022.
- [14] O. Mashinchian, M. Johari-Ahar, B. Ghaemi, M. Rashidi, J. Barar, and Y. Omid, "Carboxymethylcellulose/MOF-5/Graphene oxide bio-nanocomposite as antibacterial drug nanocarrier agent," *BioImpacts*, vol. 4, no. 3, pp. 149–166, 2019, doi: 10.15171/bi.2019.02.
- [15] E. Campbell, T. Hasan, C. Pho, K. Callaghan, and G. R. Akkaraju, "Graphene Oxide as a Multifunctional Platform for Intracellular Delivery , Imaging , and Cancer Sensing,"

- Sci. Rep.*, no. November 2018, pp. 1–9, 2019, doi: 10.1038/s41598-018-36617-4.
- [16] M. Hariharan *et al.*, “Synthesis and Characterisation of CaCO<sub>3</sub> ( Calcite ) Nano Particles from Cockle Shells Using Chitosan as Precursor,” *Int. J. Sci. Res. Publ.*, vol. 4, no. 10, pp. 1–5, 2014, [Online]. Available: [www.ijsrp.org](http://www.ijsrp.org).
- [17] S. M. Dizaj, M. Barzegar-jalali, M. H. Zarrintan, and K. Adibkia, “Calcium Carbonate Nanoparticles ; Potential in Bone and Tooth Disorders,” vol. 98, no. March, pp. 175–182, 2015.
- [18] R. H. Perry, “PERRY’s Chemical Engineering Handbook,” *Perrys’ chemical engineers’ handbook*. p. 21, 2007, [Online]. Available: <http://books.google.com/books?id=X1wIW9TrqXMC&pgis=1>.
- [19] A. M. Buckley and M. Greenblatt, “The Sol-Gel Preparation of Silica Gels.”
- [20] M. Sun and J. Li, “Graphene oxide membranes: Functional structures, preparation and environmental applications,” *Nano Today*, vol. 20, pp. 121–137, 2018, doi: 10.1016/j.nantod.2018.04.007.
- [21] E. Quesnel *et al.*, “Graphene-based technologies for energy applications , challenges and perspectives,” vol. 030204, doi: 10.1088/2053-1583/2/3/030204.
- [22] T. F. Yeh, S. J. Chen, C. S. Yeh, and H. Teng, “Tuning the electronic structure of graphite oxide through ammonia treatment for photocatalytic generation of H<sub>2</sub> and O<sub>2</sub> from water splitting,” *J. Phys. Chem. C*, vol. 117, no. 13, pp. 6516–6524, 2013, doi: 10.1021/jp312613r.
- [23] C. Yu, P. Yen, C. M. How, Y. Kuo, and V. H. Liao, “Chemosphere Early-life long-term ibuprofen exposure

- reduces reproductive capacity involved in spermatogenesis impairment and associated with the transcription factor DAF-5 in *Caenorhabditis elegans*,” *Chemosphere*, vol. 347, no. November 2023, p. 140717, 2024, doi: 10.1016/j.chemosphere.2023.140717.
- [24] M. E. Mohr, “Remington: The Science and Practice of Pharmacy, 21st Edition,” *J. Pharm. Technol.*, vol. 22, no. 2, pp. 133–134, 2006, doi: 10.1177/875512250602200217.
- [25] H. N. Abdelhamid, M. S. Khan, and H. F. Wu, “Graphene oxide as a nanocarrier for gramicidin (GOGD) for high antibacterial performance,” *RSC Adv.*, vol. 4, no. 91, pp. 50035–50046, 2014, doi: 10.1039/c4ra07250b.
- [26] X. Sun *et al.*, “Nano-graphene oxide for cellular imaging and drug delivery,” *Nano Res.*, vol. 1, no. 3, pp. 203–212, 2008, doi: 10.1007/s12274-008-8021-8.
- [27] S. Goenka, V. Sant, and S. Sant, “Graphene-based nanomaterials for drug delivery and tissue engineering,” *J. Control. Release*, vol. 173, no. 1, pp. 75–88, 2014, doi: 10.1016/j.jconrel.2013.10.017.
- [28] Z. Liu, J. T. Robinson, X. Sun, and H. Dai, “PEGylated nanographene oxide for delivery of water-insoluble cancer drugs,” *J. Am. Chem. Soc.*, vol. 130, no. 33, pp. 10876–10877, 2008, doi: 10.1021/ja803688x.
- [29] J. T. Robinson, S. M. Tabakman, Y. Liang, and H. Wang, “Ultra-Small Reduced Graphene Oxide with High Near-Infrared Absorbance for Photothermal Therapy Supplemental Information Materials and Methods,” *J. Am. Chem. Soc.*, vol. 133, no. 17, pp. 1–5, 2011.
- [30] K. Yang, J. Wan, S. Zhang, B. Tian, Y. Zhang, and Z. Liu, “The influence of surface chemistry and size of nanoscale graphene oxide on photothermal therapy of cancer using ultra-low laser power,” *Biomaterials*, vol. 33, no. 7, pp.

2206–2214, 2012, doi: 10.1016/j.biomaterials.2011.11.064.

- [31] A. Wang *et al.*, “Increased optical nonlinearities of graphene nanohybrids covalently functionalized by axially-coordinated porphyrins,” *Carbon N. Y.*, vol. 53, pp. 327–338, 2013, doi: 10.1016/j.carbon.2012.11.019.
- [32] Y. W. Chen, P. J. Chen, S. H. Hu, I. W. Chen, and S. Y. Chen, “NIR-triggered synergic photo-chemothermal therapy delivered by reduced graphene oxide/carbon/mesoporous silica nanocookies,” *Adv. Funct. Mater.*, vol. 24, no. 4, pp. 451–459, 2014, doi: 10.1002/adfm.201301763.
- [33] Y. Tang *et al.*, “An aptamer-targeting photoresponsive drug delivery system using ‘off-on’ graphene oxide wrapped mesoporous silica nanoparticles,” *Nanoscale*, vol. 7, no. 14, pp. 6304–6310, 2015, doi: 10.1039/c4nr07493a.
- [34] Q. Liu, T. Zheng, P. Wang, J. Jiang, and N. Li, “Adsorption isotherm , kinetic and mechanism studies of some substituted phenols on activated carbon fibers,” vol. 157, pp. 348–356, 2010, doi: 10.1016/j.cej.2009.11.013.
- [35] V. Gunasekar and V. Ponnusami, “Kinetics , Equilibrium , and Thermodynamic Studies on Adsorption of Methylene Blue by Carbonized Plant Leaf Powder,” vol. 2013, 2013.
- [36] R. Salomão, L. M. M. Costa, and G. M. de Olyveira, “Precipitated Calcium Carbonate Nano-Microparticles: Applications in Drug Delivery,” *Adv. Tissue Eng. Regen. Med. Open Access*, vol. 3, no. 2, pp. 336–340, 2017, doi: 10.15406/atroa.2017.03.00059.
- [37] S. Maleki Dizaj, M. Barzegar-Jalali, M. H. Zarrintan, K. Adibkia, and F. Lotfipour, “Calcium carbonate nanoparticles as cancer drug delivery system,” *Expert Opin. Drug Deliv.*, vol. 12, no. 10, pp. 1649–1660, 2015, doi: 10.1517/17425247.2015.1049530.

- [38] M. Rouget, D. M. Richardson, S. Lavorel, J. Vayreda, C. Gracia, and S. J. Milton, “Determinants of distribution of six Pinus species in Catalonia, Spain,” *J. Veg. Sci.*, vol. 12, no. 4, pp. 491–502, 2001, doi: 10.2307/3237001.
- [39] W. Wei, G. Hu, D. Yu, T. Mcleish, Z. Su, and Z. Shen, “Preparation of Hierarchical Hollow CaCO<sub>3</sub> Particles and the Application as Anticancer Drug Carrier,” *J. Am. Chem. Soc.*, vol. 130, no. 47, pp. 15808–15810, 2008.
- [40] B. Agarwal, P. Sengupta, and C. Balomajumder, “Equilibrium, Kinetic and Thermodynamic Studies of Simultaneous Co-Adsorptive Removal of Phenol and Cyanide Using Chitosan,” *Int. J. Chem. Nucl. Mater. Metall. Eng.*, vol. 7, no. 11, pp. 514–521, 2013, [Online]. Available: <http://waset.org/publications/9997226/equilibrium-kinetic-and-thermodynamic-studies-of-simultaneous-co-adsorptive-removal-of-phenol-and-cyanide-using-chitosan>.
- [41] Y. Xiang, J. Han, G. Zhang, F. Zhan, D. Cai, and Z. Wu, “Efficient Synthesis of Starch-Regulated Porous Calcium Carbonate Microspheres as a Carrier for Slow-Release Herbicide,” *ACS Sustain. Chem. Eng.*, vol. 6, no. 3, pp. 3649–3658, 2018, doi: 10.1021/acssuschemeng.7b03973.
- [42] H. Baishya, “Application of Mathematical Models in Drug Release Kinetics of Carbidopa and Levodopa ER Tablets,” *J. Dev. Drugs*, vol. 06, no. 02, pp. 1–8, 2017, doi: 10.4172/2329-6631.1000171.
- [43] S. Park *et al.*, “Aqueous Suspension and Characterization of Chemically Modified Graphene Sheets Chemically Modified Graphene Sheets,” 2008, doi: 10.1021/cm801932u.
- [44] N. Pranyoto *et al.*, “Facile Synthesis of Silane-Modified Mixed Metal Oxide as Catalyst in Transesterification Processes,” 2022.

- [45] A. Mukherjee, M. S. I, T. C. Prathna, and N. Chandrasekaran, "Antimicrobial activity of aluminium oxide nanoparticles for potential clinical applications," pp. 245–251, 2011.
- [46] A. Fasa, D. A. N. Struktur, M. Nanopartikel, and W. Ari, "HASIL MECHANICAL MILLING SEBAGAI FILLER NANOKOMPOSIT," vol. 3, pp. 171–178, 2011.
- [47] Q. Hu, S. Pang, D. Wang, and Q. Hu, "In-depth Insights into Mathematical Characteristics , Selection Criteria and Common Mistakes of Adsorption Kinetic Models : A Critical Review In-depth Insights into Mathematical Characteristics , Selection Criteria and Common," *Sep. Purif. Rev.*, vol. 00, no. 00, pp. 1–19, 2021, doi: 10.1080/15422119.2021.1922444.
- [48] B. Ater *et al.*, "MODEL ISOTERM FREUNDLICH DAN LANGMUIR OLEH ADSORBEN ARANG AKTIF BAMBU ANDONG ( *G . verticillata* ( Wild ) Munro ) DAN."
- [49] L. Botahala, *Adsorpsi Arang Aktif (Kimia Permukaan - Kimia Zat Padat - Kimia Katalis)* .