



LAPORAN HASIL PENELITIAN
“Sintesis Material Kalsium Kalium Fosfat (CaKPO_4) Berbahan Limbah Industri Gas Asetilena ($\text{Ca}(\text{OH})_2$) dengan Metode Pelarutan dan Presipitasi”

DAFTAR PUSTAKA

- Andika, R., Fadli, A. dan HS, I. (2015) ‘Pengaruh Waktu Ageing dan Kecepatan Pengadukan pada Sintesis Hidroksiapatit dari Cangkang Telur dengan Metode Presipitasi’, *JOM FTEKNIK*, 2(1), pp. 1–8.
- Anggoro, A.R.V. (2023) *Pengaruh Derajat Keasaman (pH) Presipitasi dan Suhu Kalsinasi terhadap Karakterisasi Kalsium Fosfat*. Universitas Pembangunan Nasional ‘Veteran’ Jawa Timur.
- Anggoro, A.R.V. *et al.* (2024) ‘Synthesis and Characterization of Calcium Phosphate Using Two Stages of Process’, *Jurnal Rekayasa Kimia & Lingkungan*, 19(1), pp. 72–80. Available at: <https://doi.org/10.23955/rkl.v19i1.37829>.
- Asri, N.P. *et al.* (2010) ‘Penurunan Kadar Logam Berat Limbah Cair Industri Emas (PT. X) di Surabaya’, *Jurnal Teknik Kimia Indonesia*, 9(2), pp. 55–61.
- Aulia, N. *et al.* (2024) ‘The Synthesis and Characterization of A New Composite Material $\text{Ca-Mg-NH}_4\text{-PO}_4$ Dolomite-Based for Effective Multinutrient Fertilizer in Plant Growth’, *Jurnal Kimia Sains dan Aplikasi*, 27(11), pp. 531–537. Available at: <https://doi.org/10.14710/jksa.27.11.531-537>.
- Babcock-Jackson, L. *et al.* (2023) ‘Sustainable Fertilizers: Publication Landscape on Wastes as Nutrient Sources, Wastewater Treatment Processes for Nutrient Recovery, Biorefineries, and Green Ammonia Synthesis’, *Journal of Agricultural and Food Chemistry*, 71(22), pp. 8265–8296. Available at: <https://doi.org/10.1021/acs.jafc.3c00454>.
- Badan Standardisasi Nasional (2005) *Pupuk Dolomit*. Jakarta.
- Badan Standardisasi Nasional (2024) *Pupuk NPK Padat*. Jakarta. Available at: www.bsn.go.idwww.bsn.go.idwww.bsn.go.idwww.bsn.go.id.
- Cheng, Q. *et al.* (2021) ‘Recent Advances of Metal Phosphates-Based Electrodes for High-Performance Metal Ion Batteries’, *Energy Storage Materials*, 41, pp. 842–882.



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“Sintesis Material Kalsium Kalium Fosfat (CaKPO_4) Berbahan Limbah Industri Gas Asetilena (Ca(OH)_2) dengan Metode Pelarutan dan Presipitasi”

- Darn, S.M. *et al.* (2006) ‘Experimental and computer modelling speciation studies of the effect of pH and phosphate on the precipitation of calcium and magnesium salts in urine’, *Clinical Chemistry and Laboratory Medicine*, 44(2), pp. 185–191. Available at: <https://doi.org/10.1515/CCLM.2006.034>.
- Fauziah, Sulakhudin dan Manurung, R. (2025) ‘Status Unsur Hara Tanaman Kelapa Sawit (*Elaeis Guineensis* Jacq) Belum Menghasilkan pada Tanah Ultisol di Desa Semuntai, Kecamatan Mukok, Kabupaten Sanggau’, *Jurnal Sains Pertanian Equator*, pp. 489–497. Available at: <https://doi.org/10.26418/jspe.v14i2.90864>.
- Gorazda, K., Kowalski, Z. dan Wzorek, Z. (2012) ‘From sewage sludge ash to calcium phosphate fertilizers’, *Polish Journal of Chemical Technology*, 14(3), pp. 54–58. Available at: <https://doi.org/10.2478/v10026-012-0084-3>.
- Gusti Ayu Ariani, N., Hadriyanto, W. dan Kristanti, Y. (2014) ‘Pengaruh Bahan Sterilisasi Kalsium Hidroksida dengan Bahan Pencampur Saline, Chlorhexidine Digluconate 2%, dan Lidocaine HCl 2% terhadap Kekerasan Mikro Dentin pada Segmen Duapertiga Servikal Saluran Akar’, *Jurnal Kedokteran Gigi*, 5(2), pp. 169–175.
- Hakim, L., Dirgantara, M. dan Nawir, M. (2019) ‘Karakterisasi Struktur Material Pasir Bongkahan Galian Golongan C dengan Menggunakan X-Ray Diffraction (X-RD) di Kota Palangkaraya’, *Jurnal Jejaring Matematika dan Sains*, 1(1), pp. 44–51. Available at: <http://e-journal.upr.ac.id/index.php/JMS>.
- Hariyanto, A., Sari, V.K. dan Pujiastuti, C. (2020) ‘Kinetika Reaksi Pembentukan Kalsium Fosfat dari Asam Fosfat dan Cangkang Kerang Darah’, *Journal of Chemical and Process Engineering*, 1(2), pp. 32–38.
- Hasmeda, M. *et al.* (2021) ‘Respon Pertumbuhan dan Hasil pada Tanaman Bayam (*Amaranthus* sp) terhadap Biofortifikasi Unsur Hara Kalsium (Ca) dan Besi (Fe) dengan Sistem Hidroponik DFT (Deep Flow Technique)’, *Penerbit & Percetakan Universitas Sriwijaya (UNSRI)*, 9, pp. 721–733.



LAPORAN HASIL PENELITIAN

“Sintesis Material Kalsium Kalium Fosfat (CaKPO_4) Berbahan Limbah Industri Gas Asetilena (Ca(OH)_2) dengan Metode Pelarutan dan Presipitasi”

- Issa, K. *et al.* (2022) ‘Brushite: Synthesis, Properties, and Biomedical Applications’, *IntechOpen* [Preprint]. Available at: www.intechopen.com.
- Jafar, N. (2017) ‘Analisis Unsur Endapan Bauksit Menggunakan X-Ray Fluorescence (XRF) PT. Antam Tbk. Unit Geomin Daerah Kenco Kabupaten Landak Provinsi Kalimantan Barat’, *Journal of Chemical Process Engineering*, 2(1), pp. 45–47.
- Jakubowicz, P., Steliga, T. dan Wojtowicz, K. (2022) ‘Analysis of Temperature Influence on Precipitation of Secondary Sediments during Water Injection into an Absorptive Well’, *Energies*, 15(23), pp. 1–17. Available at: <https://doi.org/10.3390/en15239130>.
- Kabdasli, I. *et al.* (2022) ‘Is K-Struvite Precipitation a Plausible Nutrient Recovery Method from Potassium-Containing Wastes?—A Review’, *Sustainability*, 14, pp. 1–35.
- Karim, H.M.A. dan Juniar, H. (2018) ‘Pemanfaatan Limbah Karbit sebagai Adsorben Penurunan Kandungan Logam pada Pengolahan Limbah Cair Pencucian Kain Tenun’, *Distilasi*, 3(2), pp. 1–9.
- Kuz'mina, M.A., Zhuravlev, S. V. dan Frank-Kamenetskaya, O. V. (2013) ‘The Effect of Medium Chemistry on the Solubility and Morphology of Brushite Crystals’, *Geology of Ore Deposits*, 55(8), pp. 692–697. Available at: <https://doi.org/10.1134/S1075701513080072>.
- Laili, Nurfanny, M. dan Asri, N.P. (2022) ‘Pemanfaatan Limbah Brine Pabrik Garam Beryodium untuk Pembuatan Pupuk Anorganik Multinutrien’, *Seminar Nasional Teknologi Industri Berkelanjutan II (SENASTITAN II)*, 2, pp. 288–293.
- Liang, C. *et al.* (2024) ‘Optimizing Phosphorus Fertilizer Use on the Loess Plateau: Impact on Soil Properties and Crop Production Efficiency’, *Soil Systems*, 8(3), pp. 1–14. Available at: <https://doi.org/10.3390/soilsystems8010003>.
- Madsen, H.E.L. (2008) ‘Influence of Foreign Metal Ion on Crystal Growth and Morphology of Brushite ($\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$) and its Transformation to



LAPORAN HASIL PENELITIAN

“Sintesis Material Kalsium Kalium Fosfat (CaKPO_4) Berbahan Limbah Industri Gas Asetilena ($\text{Ca}(\text{OH})_2$) dengan Metode Pelarutan dan Presipitasi”

- Octacalcium Phosphate and Apatite’, *Journal of Crystal Growth*, 310, pp. 2602–2612.
- Malanova, N. V, Korobochkin, V. V dan Kosintsev, V.I. (2014) ‘The Application of Ammonium Hydroxide and Sodium Hydroxide for Reagent Softening of Water’, *Procedia Chemistry*, 10, pp. 162–167.
- Mansour, S.F. *et al.* (2016) ‘Effect of preparation conditions on the nanostructure of hydroxyapatite and brushite phases’, *Applied Nanoscience (Switzerland)*, 6, pp. 991–1000. Available at: <https://doi.org/10.1007/s13204-015-0509-4>.
- Mazur, L.P. *et al.* (2018) ‘Brown Marine Macroalgae as Natural Cation Exchangers for Toxic Metal Removal from Industrial Wastewaters: A Review’, *Journal of Environmental Management*, 223, pp. 215–253.
- Mekmene, O. *et al.* (2009) ‘Effects of pH and Ca/P molar ratio on the quantity and crystalline structure of calcium phosphates obtained from aqueous solutions’, *Dairy Science and Technology*, 89, pp. 301–316. Available at: <https://doi.org/10.1051/dst/2009019>.
- Muljani, S., Matovanni, M.P.N., Pertiwi, B.C., Novanto, S.A. dan Yulia, P.A. (2025) ‘Preparation of Calcium-Potassium-Phosphorus (Ca-K-P) as a Material for Soil and Plant Improvement Using the Precipitation Method’, *Jurnal Teknik Kimia*, 19(2), pp. 26–31.
- Nascimento, C.A.C. do *et al.* (2018) ‘Phosphorus Mobility and Behavior in Soils Treated with Calcium, Ammonium, and Magnesium Phosphates’, *Soil Science Society of America Journal*, pp. 1–11. Available at: <https://doi.org/10.2136/sssaj2017.06.0211>.
- Novitasari, A., Suntari, R. dan Cahyono, P. (2019) ‘Pengaruh Dosis Berbagai Sumber Pupuk Kalsium terhadap Pertumbuhan Awal Tanaman Nanas di PT. Great Giant Pineapple Lampung’, *Jurnal Tanah dan Sumberdaya Lahan*, 06(01), pp. 1065–1074. Available at: <https://doi.org/10.21776/ub.jtsl.2019.006.1.5>.
- Noviyanti, A.R. *et al.* (2017) ‘Cangkang Telur Ayam sebagai Sumber Kalsium dalam Pembuatan Hidroksiapatit untuk Aplikasi Graft Tulang’, *Chimica et*



LAPORAN HASIL PENELITIAN

“Sintesis Material Kalsium Kalium Fosfat (CaKPO_4) Berbahan Limbah Industri Gas Asetilena ($\text{Ca}(\text{OH})_2$) dengan Metode Pelarutan dan Presipitasi”

- Natura Acta*, 5(3), pp. 107–111. Available at: <https://doi.org/10.24198/cna.v5.n3.16057>.
- Pangestu, T.O. *et al.* (2021) ‘Sintesis dan Karakterisasi Kalsium Fosfat dari Cangkang Bekicot dengan Metode Presipitasi’, *CHEESA: Chemical Engineering Research Articles*, 4(2), pp. 82–90. Available at: <https://doi.org/10.25273/cheesa.v4i2.8931.82-90>.
- Perry, R.H., Green, D.W. dan Southard, M.Z. (2019) *Perry’s Chemical Engineers’ Handbook*. 9th edn. New York: McGraw-Hill Education.
- Puspita, T.A. *et al.* (2017) ‘Pengaruh Pemberian Dosis Pupuk NPK dan Pupuk Pelengkap terhadap Pertumbuhan dan Produksi Tanaman Sedap Malam (*Polianthes Tuberosa L.*)’, *Jurnal Agrotek Tropika*, 5(1), pp. 20–26.
- Putra, B.E. dan Asfarina, S. (2024) ‘Pemanfaatan Limbah Karbit pada Campuran Beton Ringan Sebagai Bahan Tambah’, *AGREGAT*, 9(1), pp. 1022–1027.
- Rajasekar, M. *et al.* (2017) ‘A Review on Role of Macro Nutrients on Production and Quality of Vegetables’, *International Journal of Chemical Studies*, 5(3), pp. 304–309.
- Ramadhan, H. (2024) *Pabrik Kaporit Dari Kalsium Hidroksida Dan Natrium Hidroksida Dengan Gas Klorin Menggunakan Proses Kering*. Surabaya: Universitas Pembangunan Nasional ‘Veteran’ Jawa Timur.
- Rosikah, N.N., Rahmawati, F.N. dan Sumada, K. (2024) ‘Sintesis dan Karakterisasi Pupuk Multinutrien Calcium-Ammonium-Phosphate (CAP) Berbahan Cangkang Kupang Merah’, *Journal of Multidisciplinary Research and Development*, 6(5), pp. 1557–1565. Available at: <https://doi.org/10.38035/rj.v6i5>.
- Sahdiah, H. dan Kurniawan, R. (2023) ‘Optimasi Tegangan Akselerasi pada Scanning Electron Microscope – Energy Dispersive X-Ray Spectroscopy (SEM-EDX) untuk Pengamatan Morfologi Sampel Biologi’, *Jurnal Sains dan Edukasi Sains*, 6(2), pp. 117–123. Available at: <https://doi.org/10.24246/juses.v6i2p117-123>.



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“Sintesis Material Kalsium Kalium Fosfat (CaKPO_4) Berbahan Limbah Industri Gas Asetilena (Ca(OH)_2) dengan Metode Pelarutan dan Presipitasi”

- Sánchez-Campos, D. *et al.* (2021) ‘Modulated Monoclinic Hydroxyapatite: The Effect of pH in the Microwave Assisted Method’, *Minerals*, 11(3), pp. 1–13. Available at: <https://doi.org/10.3390/min11030314>.
- Sari, G.L.M., Pertami, R.R.D. dan Eliyatiningstih (2022) ‘Aplikasi Pupuk Kalium terhadap Pertumbuhan dan Produksi Tanaman Cabai Merah Besar (*Capsicum Annuum L.*)’, *AGROPROSS: National Conference Proceedings of Agriculture*, pp. 221–233. Available at: <https://doi.org/10.25047/agropross.2022.292>.
- Silva, N.M.P. da, Espitalier, F. dan Nzihou, A. (2016) ‘Precipitation Process of Calcium Phosphate from Calcium Carbonate Suspension’, *KONA Powder and Particle Journal*, (33), pp. 219–227.
- Siswanto, B. (2018) ‘Sebaran Unsur Hara N, P, K, dan pH dalam Tanah’, *Buana Sains*, 18(2), pp. 109–124.
- Sk, M.M. *et al.* (2016) ‘Review on Advances in Porous Nanostructured Nickel Oxides and Their Composite Electrodes for High-Performance Supercapacitors’, *Journal of Power Sources*, 308, pp. 121–140.
- Somalinggi, L.J., Phengkarsa, F. dan Febriani, L. (2020) ‘Pengaruh Limbah Karbit / Calcium Carbit Sebagai Bahan Substitusi Semen Pada Beton’, *Paulus Civil Engineering Journal*, 2(4), pp. 289–297. Available at: <http://ojs.ukipaulus.ac.id/index.php/pcej>.
- Sumada, K. (2011) ‘Pengkajian Air Limbah Pembangkit Listrik Tenaga Panas Bumi sebagai Pupuk Multinutrien Phosphate-Based’, *Digital Repository UPN Veteran Jatim*, pp. 1–9.
- Voronin, V. V. *et al.* (2018) ‘Acetylene in Organic Synthesis: Recent Progress and New Uses’, *Molecules*, 23(10), pp. 1–84. Available at: <https://doi.org/10.3390/molecules23102442>.
- Wadu, I., Soetjipto, H. dan Cahyanti, M.N. (2018) ‘Sintesa dan Penentuan Kadar Kalsium-Fosfat Hidroksiapatit (HAP) dari Kerabang Telur Ayam’, *JKPK (Jurnal Kimia dan Pendidikan Kimia)*, 3(1), pp. 1–5. Available at: <https://doi.org/10.20961/jkpk.v3i1.11860>.
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“Sintesis Material Kalsium Kalium Fosfat (CaKPO_4) Berbahan Limbah Industri Gas Asetilena (Ca(OH)_2) dengan Metode Pelarutan dan Presipitasi”

- Wahyusi, K.N. *et al.* (2021) ‘The Effect of Resin and NH_4OH Addition in The Making of Ammonium Silica Fertilizer from Geothermal Sludge’, *International Journal of Eco-Innovation in Science and Engineering*, 2(1), pp. 1–6.
- Wang, Z. *et al.* (2024) ‘Disordered Materials for High-Performance Lithium-Ion Batteries: A Review’, *Nano Energy*, 121, pp. 1–21.
- Wanta, K.C. *et al.* (2019) ‘Pengaruh Derajat Keasaman (pH) dalam Proses Presipitasi Hidroksida Selektif Ion Logam dari Larutan Ekstrak Spent Catalyst’, *Jurnal Rekayasa Proses*, 13(2), pp. 94–105. Available at: <https://doi.org/10.22146/jrekpros.44007>.
- Widarsaputra, A. Y., Prawatya, Y. E., dan Sujana, I. (2022) ‘Response Surface Methodology (RSM) untuk Optimasi Pengolahan Keripik Nanas Menggunakan Mesin Vacuum Frying’, *INTEGRATE: Industrial Engineering and Management System*, 6(2), pp. 70–77.
- Wiyantoko, B., Kurniawatii, P. dan Purbaningtias, T.E. (2017) ‘Pengujian Nitrogen Total, Kandungan Air, dan Cemarkan Logam Timbal pada Pupuk Anorganik Nitrogen Phospor Kalium (NPK) Padat’, *Jurnal Sains dan Teknologi*, 6(1), pp. 51–60.
- Xu, Q. dan Rochelle, G.T. (2009) ‘Solvent Reclaiming by Crystallization of Potassium Sulfate’, *Energy Procedia*, 1, pp. 1205–1212. Available at: <https://doi.org/10.1016/j.egypro.2009.01.158>.