SINTESIS, KARAKTERISASI, DAN UJI PERFORMA S/CRF PVA/BORAT/ALGINAT/$CaCO_3$ TERSISIPI KCl

SKRIPSI

Diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains pada Program Studi Kimia

Di susun oleh:

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PROGRAM STUDI KIMIA

FAKULTAS PENDIDIKAN MATEMATIKA DAN ILMU PENGETAHUAN ALAM UNIVERSITAS PENDIDIKAN INDONESIA

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Oleh

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Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

Universitas Pendidikan Indonesia

September 2024

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PERNYATAAN

Dengan ini saya menyatakan bahwa skripsi dengan judul "**SINTESIS, KARAKTERISASI, DAN UJI PERFORMA S/CRF PVA/BORAT/ALGINAT/$CaCO_3$ TERSISIPI KCl**" ini beserta seluruh isinya adalah benar- benar karya saya sendiri. Saya tidak melakukan tindakan penjiplakan atau pengutipan dengan cara- cara yang tidak sesuai etika yang berlaku dalam Masyarakat keilmuan. Dengan mengemukakan pernyataan ini, saya siap menerima konsekuensi atau sanksi yang berlaku, apabila di kemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

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Skripsi ini merupakan hasil penelitian yang di dalamnya dikemukakan masalah penelitian, teori yang mendukung, hipotesis, metode penelitian, dan teknik analisis, serta data yang diperoleh. Hal- hal tersebut penulis kemukakan dengan merujuk pendapat dari para ahli. Penulis berharap skripsi ini dapat meningkatkan wawasan bagi penulis sendiri, para pembaca, dan peneliti selanjutnya yang bergerak dalam bidang kimia. Penulis menyadari bahwa masih terdapat kekurangan pada skripsi ini. Oleh karena itu, penulis mengharapkan kritik dan saran yang bersifat membangun dari berbagai pihak guna perbaikan dan penyempurnaan pada skripsi ini.

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SINTESIS, KARAKTERISASI, DAN UJI PERFORMA S/CRF PVA/BORAT/ALGINAT/$CaCO_3$ TERSISIPI KCl

ABSTRAK

Dalam sepuluh tahun terakhir, peningkatan aktivitas manusia telah menyebabkan perubahan iklim, penurunan sumber daya, dan penurunan energi yang berdampak pada kelangsungan pasokan pangan. Oleh karena itu, banyak petani melakukan pemupukan yang berlebihan untuk meningkatkan hasil panen. Namun, faktanya hal ini dapat menyebabkan masalah yang lebih buruk bagi lingkungan dan ekologi serta menurunkan efisiensi penggunaan pupuk yang luar biasa. Penggunaan pupuk pelepasan terkendali atau *Slow/Controlled Release Fertilizer* (S/CRF) merupakan metode yang digunakan untuk mengatasi masalah ini. Penelitian ini bertujuan untuk mengetahui komposisi optimum sintesis, karakterisasi, dan uji performa hidrogel sebagai material *slow*/*controlled release fertilizer* (S/CRF). Hidrogel S/CRF disintesis dalam dua bentuk yaitu lembaran dan granula. Prekursor yang digunakan adalah poli (vinil alkohol) (PVA), boraks sebagai *crosslinker*, alginat sebagai *filler*, KCl sebagai nutrien, dan $CaCO_3$ sebagai *filler* anorganik pada granula. Tahapan penelitian meliputi sintesis hidrogel melalui metode *solution mixing*, optimasi komposisi rasio PVA/B dan PVA/B/A, karakterisasi menggunakan instrumentasi spektrofotometer *Fourier Transform Infra-Red* (FTIR), *Scanning Electron Microscopy* (SEM), dan *water contact angle* (WCA), serta uji performa agrokimia meliputi *swelling ratio*, *water retention*, biodegradabilitas, dan *release behavior* nutrien. Hasil penelitian menunjukkan S/CRF PVA/B/A/KCl berhasil disintesis melalui metode *solution mixing* dengan komposisi optimum 80:20:5 dan PVA/B/A/KCl-$CaCO_3$ berhasil disintesis melalui metode pelapisan granula oleh hidrogel. Hasil karakterisasi hidrogel PVA/B/A menunjukkan terjadi pergeseran beberapa puncak serapan untuk vibrasi O-H, C-H sp^3, C=O, C-H sp^2 *stretching* serta vibrasi B-O dan C-O *bending*, tetapi tidak terlihat ada puncak serapan gugus baru. Hal ini mengindikasikan terjadinya interaksi ikatan fisik antara gugus alkohol dari PVA, gugus hidroksil dari alginat, dan gugus reaktif dari boraks yang membentuk struktur/jaringan tiga dimensi hidrogel, tetapi tidak ada interaksi kimia antar alginat dan PVA/B. Analisis SEM menunjukkan PVA/B memiliki struktur yang lebih berongga dibandingkan PVA/B/A. Peningkatan nilai sudut kontak dari 39,31º menjadi 52,10º menunjukkan penurunan sifat hidrofilisitas hidrogel. Hasil uji performa menunjukkan terjadi peningkatan *swelling ratio* maksimum dari 1007,96% menjadi 2828,65% dan menurunkan *water retention* dari 1190 menit menjadi 1280 menit untuk masing- masing PVA/B dan PVA/B/A. Penambahan alginat terhadap campuran PVA/B menghasilkan hidrogel berbentuk lembaran yang mampu melambatkan pelepasan KCl dibandingkan hidrogel lembaran PVA/B. Hidrogel PVA/B/A mampu memberikan penghambatan pada pelepasan KCl saat digunakan untuk melapisi granula $CaCO_3$-KCl. Uji biodegradabilitas menunjukkan bahwa PVA/B/A memiliki sifat biodegradabilitas yang lebih baik dibandingkan PVA/B.

Kata kunci: hidrogel, agrokimia, S/CRF, PVA/Borat/Alginat, *release behavior*

ABSTRACT

In the last ten years, increased human activities have led to climate change, resource depletion, and energy depletion, impacting the sustainability of food supply. Therefore, many farmers over-fertilize to increase crop yields. However, the fact is that this can cause worse problems for the environment and ecology and decrease the efficiency of fertilizer use tremendously. The use of Slow/Controlled Release Fertilizer (S/CRF) is a method used to overcome this problem. This research aims to determine the optimum composition of synthesis, characterization, and performance test of hydrogel as slow/controlled release fertilizer (S/CRF) material. S/CRF hydrogels were synthesized in two forms, namely sheets and granules. The precursors used were poly (vinyl alcohol) (PVA), borax as crosslinker, alginate as filler, KCl as nutrient, and CaCO3 as inorganic filler in the granule. The research stages include hydrogel synthesis through solution mixing method, optimization of PVA/B and PVA/B/A ratio composition, characterization using Fourier Transform Infra-Red (FTIR) spectrophotometer instrumentation, Scanning Electron Microscopy (SEM), and water contact angle (WCA), as well as agrochemical performance tests including swelling ratio, water retention, biodegradability, and nutrient release behavior. The results showed that PVA/B/A/KCl S/CRF was successfully synthesized through solution mixing method with optimum composition of 80:20:5 and PVA/B/A/KCl-CaCO3 was successfully synthesized through granule coating method by hydrogel. Characterization results of PVA/B/A hydrogel showed a shift of several absorption peaks for -OH, -CH sp3, C=O, -CH sp2 stretching vibrations as well as B-O and -CO bending vibrations, but no new group absorption peaks were seen. This indicates that physical bonding interactions between alcohol groups of PVA, hydroxyl groups of alginate, and reactive groups of borax form the three-dimensional structure/network of the hydrogel, but there is no chemical interaction between alginate and PVA/B. SEM analysis shows that PVA/B has a more hollow structure than PVA/B/A. The increase in contact angle value from 39.31º to 52.10º indicates a decrease in hydrophilicity of the hydrogel. Performance test results showed an increase in maximum swelling ratio from 1007.96% to 2828.65% and a decrease in water retention from 1190 minutes to 1280 minutes for PVA/B and PVA/B/A, respectively. The addition of alginate to the PVA/B mixture produced a sheet-shaped hydrogel that was able to slow down the release of KCl compared to the PVA/B sheet hydrogel. PVA/B/A hydrogels were able to provide inhibition on KCl release when used to coat CaCO3-KCl granules. Biodegradability tests showed that PVA/B/A has better biodegradability properties than PVA/B.

Keywords: hydrogel, agrochemical, S/CRF, PVA/Borate/Alginate, release behavior

DAFTAR ISI

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DAFTAR LAMPIRAN

DAFTAR SINGKATAN

FTIR	: *Fourier-Transform Infrared Spectroscopy*
PVA	: Polivinil Alkohol
PVA/B	: PVA/borat
PVA/B/A	: PVA/borat/alginat
S/CRF	: *Slow/Controlled Release*
SEM	: *Scanning Electron Microscope*
SR	: *Swelling Ratio*
WCA	: *Water Contact Angle*
WR	: *Water Retention*

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