

PERFORMANCE STUDY ON RELEASE
BEHAVIOUR OF CONTROLLED RELEASE
AND WATER RETENTION FERTILIZER
COATED WITH SUPERABSORBENT
POLYMER-BIOCHAR INCORPORATION

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SUPERVISOR'S DECLARATION

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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RELEASE AND WATER RETENTION FERTILIZER COATED WITH
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NUREEN BINTI NOORDIN

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ABSTRAK

Polimer superabsorbent (SAP) semakin terkenal dengan penggunaannya dalam bidang pertanian. Keupayaannya untuk menyerap serta menyimpan atau mengekalkan sejumlah besar kandungan air dalam tempoh yang lama, amat bermanfaat dalam mengekalkan kelembapan tanah. Kebiasaannya, hanya 30-40% daripada kandungan baja diserap oleh tumbuh-tumbuhan, dan selebihnya diserap ke dalam tanah dan boleh menyebabkan masalah alam sekitar. Penggunaan SAP yang dicampur dengan bahan organik seperti biochar, digunakan sebagai salutan kepada baja, boleh mengawal pembebasan nutrien, serta mengekalkan kandungan air. Ini dapat membantu mengurangkan penggunaan baja dan menjimatkan penyiraman. Objektif pertama kajian ini adalah untuk mengkaji komposisi unsur dan hasil biochar, yang dihasilkan melalui kaedah pirolisis. Yang kedua adalah untuk mengoptimumkan sintesis SAP-biochar sebagai selaput untuk menghasilkan baja yang mampu mengawal pembebasan nutrient baja serta mampu menyimpan kandungan air. Baja tersebut dikenali sebagai 'controlled release water retention (CRWR)'. Objektif terakhir adalah untuk mengkaji prestasi pelepasan nutrien SAP-biochar sebagai selaput untuk baja CRWR di dalam tanah. Dalam kajian ini, sisa agro seperti hampas tandan kelapa sawit digunakan untuk menghasilkan biochar melalui proses pirolisis. Suhu pirolisis digunakan pada 250⁰C dan 350⁰C. Dalam objektif kedua, lebih focus untuk mengoptimumkan sifat-sifat penyerapan air SAP-biochar menggunakan STATISTIKA di mana parameter yang dipilih adalah jumlah Metilene-bis-acrylamide (MBA) yang digunakan, kepekatan Acryl Amide (AM) dan peratusan biochar. SAP-biochar telah disediakan melalui kaedah 'graft co-polymerization'. Berdasarkan analisis STATISTIKA, nilai penyerapan yang paling optimum bagi sintesis SAP-biochar melalui kaedah graft co-polimerization adalah pada 123.44 g / g yang dikendalikan pada 5.87mol / L AM, 0.046g MBA dan 0.23% peratusan berat biochar. Prestasi baja CRWR yang disalut dengan SAP-biochar dikaji dari segi pembebasan nutrien serta tahap kemampuan untuk mengekalkan kandungan air. Dalam bahagian ini, air siraman larutan baja CRWR yang diuji pada tanah dikumpulkan untuk menentukan nutrien yang ada setiap 3 hari selama 30 hari. Keputusan untuk jumlah pembebasan nutrien dan sifat mengekal air menunjukkan bahawa fungsi SAP-biochar sebagai selaput baja terbukti bertindak sebagai penghalang dan membantu melambatkan pembebasan kandungan nutrien serta mengekalkan air. Kehadiran biochar, seperti yang diharapkan dapat mempengaruhi pelepasan nutrien yang disebabkan oleh sifat-sifat biochar, yang mampu menahan nutrisi di dalam tanah.

ABSTRACT

Superabsorbent polymer (SAP) had been gaining popularity on its use in agriculture. Its ability to absorb vast amount of water and retaining it for a period of time, proves to be beneficial to maintain soil moisture. In practices, only 30-40% of the fertilizer was absorb by plants while the rest are leached out and sometimes remain in the soil, creating environmental problem. The application of SAP with organic materials such as biochar as coating could control the nutrient release of fertilizer, and retaining water content. This helps reduces consumption of fertilizer and watering frequency. The first objective of this study is to study the elemental composition and yield of biochar, converted via pyrolysis method. The second one is to optimize the synthesis of SAP-biochar as coatings for controlled release water retention (CRWR) fertilizer. Lastly, is to study the nutrient release performance of SAP-biochar as coatings for CRWR fertilizer in soil. In this study, the agro waste of empty fruit bunch was utilized to produce biochar via pyrolysis. The pyrolysis temperature is varied at 250°C and 350°C. In the second objective, the design of experiment was carried out to optimize the water absorbency properties of SAP-biochar using STATISTIKA where the parameters chosen are the amount of Methylene-bis-acrylamide (MBA) used, concentration of Acryl Amide (AM) and percentage of biochar. The SAP-biochar was prepared via graft co-polymerization method. Based on STATISTIKA analysis, the most favourable condition by synthesizing SAP-biochar via graft-co polymerization method is at 123.44 g/g operated at 5.87mol/L of AM, 0.046g of MBA and 0.23% biochar weight percentage. The performance of the CRWR fertilizer coated with SAP-biochar was characterized in terms of nutrient release and water retention behavior. In this part, the leachates of CRWR fertilizer which tested on soil were collected in order to determine the nutrient present in every 3 days for 30 days. The results for nutrient release and water retention behavior showed that the presence of SAP-biochar as coatings was acted as a barrier. The coatings helps in slowing down the release of nutrient and retaining water content. The presence of biochar, as expected could influence the release of nutrient due to the properties of biochar, which are able to hold nutrients in the soil.

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LIST OF ABBREVIATIONS

AA	Acrylic Acid
APS	Ammonium Peroxodisulfate
CRWR	Control Release Water Retention
FTIR	Fourier Transform Infrared
K	Potassium
MBA	Methylene Bisacrylamide
NaOH	Sodium Hydroxide
N	Nitrogen
P	Phosphorus
SAP	Superabsorbent Polymer
SEM	Scanning Electron Microscopy

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