ABSTRAK

PERUBAHAN KAPASITAS DAN ENERGI JERAP TERHADAP Cu DAN Zn TANAH TERCEMAR LOGAM BERAT AKIBAT PERLAKUAN BIOCHAR TONGKOL JAGUNG

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Logam berat tembaga dan seng merupakan bahan pencemar yang tidak dapat terurai dan dapat terakumulasi pada lingkungan dan organisme. Logam berat dapat menjadi berbahaya bagi makhluk hidup apabila melebihi batas kritis di dalam tanah akibat pencemaran logam berat dari limbah industri sendok logam dari PT *Star Metal Ware Industry*, Jakarta. Biochar dapat menjadi alternatif dalam mengurangi ketersediaan logam berat melalui kemampuannya dalam menjerap logam berat di dalam tanah. Penelitian ini bertujuan untuk mempelajari perubahan kapasitas dan energi jerap tanah tercemar logam berat Cu dan Zn yang diperlakukan biochar tongkol jagung yang menjadi bahan pembenah tanah.

Penelitian ini dilaksanakan di Rumah Plastik Perguruan Tinggi Al-Madani, Laboratorium Jurusan Ilmu Tanah, dan UPTD Laboratorium Lingkungan Dinas Lingkungan Hidup Provinsi Lampung menggunakan Rancangan Acak Lengkap (RAL) dua faktorial yang terdiri dari sembilan kombinasi perlakuan dan diulang sebanyak tiga kali sehingga menghasilkan 27 satuan percobaan. Faktor pertama tanah tanpa logam berat 0 Mg ha^{-1} (S_0) atau kontrol, tanah logam berat konsentrasi rendah 15 Mg ha^{-1} (S_1) dan tanah logam berat konsentrasi tinggi 60 Mg ha^{-1} (S_2). Faktor kedua biochar tongkol jagung 0 Mg ha^{-1} (B_0), 5 Mg ha^{-1}(B_1), dan 10 Mg ha^{-1}(B_2). Perubahan kapasitas dan energi jerap ditentukan menggunakan persamaan Isotermal Langmuir dan konsentrasi diukur menggunakan *flame* AAS. Data dianalisis menggunakan *Standard Error of The Mean* (SEM) dan diuji lanjut menggunakan metode regresi linier dengan *Microsoft Excel* untuk melihat korelasi antar nilai b dan K, Cu dan Zn tersedia, pH tanah, KTK tanah C-organik, dan kadar liat.

Hasil penelitian menunjukkan bahwa penambahan biochar tongkol jagung 10 Mg ha^{-1} mampu menurunkan ketersediaan logam Cu dan Zn pada tanah dengan tingkat ketercemaran logam berat rendah (S_1), sedangkan biochar tongkol jagung

pada tingkat logam berat kontrol (S_0) dan tinggi (S_2) tidak menurunkan ketersediaan Cu dan Zn. Adanya perubahan yang terjadi setelah penambahan biochar tongkol jagung 10 Mg ha^{-1} yang mampu meningkatkan kapasiats adsorpsi maksimum logam Cu (b_{Cu}) disetiap tingkat logam berat, sedangkan pada tanah tingkat logam berat kontrol (S_0) penambahan biochar mampu menurunkan konstanta energi adsorpsi logam Cu (K_{Cu}), tetapi tingkat logam berat rendah (S_1) dan tinggi (S_2) tidak berbeda nyata. Nilai b dan K terhadap logam Zn dalam penelitian ini lebih rendah dibandingkan logam Cu dan koefisien determinasi (R^2) logam Zn tidak mendekati angka 1 pada grafik persamaan Isotermal Langmuir sehingga model Isotermal Langmuir tidak dapat digunakan untuk menggambarkan proses adsorpsi yang terjadi antara biochar tongkol jagung dan logam Zn. Adanya antara kapasitas adsorpsi maksimum logam Cu (b_{Cu}) yang berkorelasi nyata negatif dengan Cu tersedia, Zn tersedia dan pH tanah, berkorelasi negatif tidak nyata dengan C-organik tanah, berkorelasi nyata positif dengan kadar liat, dan berkorelasi positif tidak nyata dengan KTK tanah. Konstanta energi adsorpsi (K_{Cu}) berkorelasi nyata negatif dengan pH dan kadar liat tanah, berkorelasi tidak nyata negatif dengan ketersediaan Cu dan Zn, serta berkorelasi tidak nyata positif dengan KTK dan C-organik tanah dengan *Simple Linear Regression*. Kapasitas adsorpsi maksimum logam Cu (b_{Cu}) berkorelasi nyata negatif dengan ketersediaan Cu dan pH tanah serta berkorelasi nyata positif dengan ketersediaan Zn, KTK, kadar liat, dan C-organik tanah. Sementara itu, konstanta energi adsopsi logam Cu (K_{Cu}) berkorelasi nyata positif dengan ketersediaan Cu dan Zn, serta berkorelasi negatif dengan pH, KTK, kadar liat, dan C-organik tanah dengan uji *Multiple Linear Regression*.

Kata kunci : biochar, tongkol jagung, logam berat, kapasitas adsorpsi maksimum (b), konstanta energi adsorpsi (K), Isotermal Langmuir, *Standart Error of The Mean*, Cu tersedia, Zn tersedia, pH, KTK, kadar liat, C-organik.

ABSTRACT

CHANGES IN CAPACITY AND ABSORPTION ENERGY TOWARDS Cu AND Zn SOIL CONTAMINATED WITH HEAVY METALS DUE TO CORN COB BIOCHAR TREATMENT

By

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Heavy metals copper and zinc are non-biodegradable pollutants that can accumulate in the environment and organisms. Heavy metals can be harmful to living things if they exceed critical limits in the soil due to heavy metal pollution from metal spoon industrial waste from PT Star Metal Ware Industry, Jakarta. Biochar can be an alternative in reducing the availability of heavy metals through its ability to adsorb heavy metals in the soil. This study aims to study the changes in the capacity and adsorption energy of soil contaminated with heavy metals Cu and Zn treated with corn cob biochar as a soil conditioner.

This study was conducted at the Al-Madani College Plastic House, Soil Science Department Laboratory, and UPTD Environmental Laboratory of the Lampung Provincial Environmental Service using a two-factorial Completely Randomized Design (CRD) consisting of nine treatment combinations and repeated three times to produce 27 experimental units. The first factor is soil without heavy metals 0 Mg ha^{-1} (S_0) or control, low concentration heavy metal soil 15 Mg ha^{-1} (S_1) and high concentration heavy metal soil 60 Mg ha^{-1} (S_2). The second factor is corn cob biochar 0 Mg ha^{-1} (B_0), 5 Mg ha^{-1} (B_1), and 10 Mg ha^{-1} (B_2). Changes in adsorption capacity and energy were determined using the Langmuir Isothermal equation and concentrations were measured using flame AAS. Data were analyzed using the Standard Error of The Mean (SEM) and further tested using the linear regression method with Microsoft Excel to see the correlation between b and K values, available Cu and Zn, soil pH, CEC of organic-C soil, and clay content.

The results showed that the addition of 10 Mg ha-1 corn cob biochar was able to reduce the availability of Cu and Zn metals in soil with low levels of heavy metal contamination (S_1), while corn cob biochar at control (S_0) and high (S_2) heavy metal levels did not reduce the availability of Cu and Zn. The addition of

10 Mg ha^{-1} corn cob biochar was able to increase the maximum adsorption capacity of Cu metal (b_{Cu}) at each heavy metal level, while in the soil at the control heavy metal level (S_0) the addition of biochar was able to reduce the adsorption energy constant of Cu metal (K_{Cu}), but the low (S_1) and high (S_2) heavy metal levels were not significantly different. The b and K values for Zn metal in this study were lower than Cu metal and the coefficient of determination (R^2) of Zn metal did not approach the number 1 on the Langmuir Isothermal equation graph so that the Langmuir Isothermal model cannot be used to describe the adsorption process that occurs between corn cob biochar and Zn metal.. The existence of the maximum adsorption capacity of Cu metal (b_{Cu}) which is significantly negatively correlated with available Cu metal, available Zn and soil pH, negatively correlated not significantly with soil organic C, significantly positively correlated with clay content, and positively correlated not significantly with soil CEC. The adsorption energy constant (K_{Cu}) is significantly negatively correlated with soil pH and clay content, negatively correlated not significantly with the availability of Cu and Zn, and positively correlated not significantly with CEC and soil organic C with Simple Linear Regression. The maximum adsorption capacity of Cu metal (b_{Cu}) is significantly negatively correlated with the availability of Cu and soil pH and positively correlated with the availability of Zn, CEC, clay content, and soil organic C. Meanwhile, the adsorption energy constant of Cu metal (K_{Cu}) is significantly positively correlated with the availability of Cu and Zn, and negatively correlated with pH, CEC, clay content, and soil organic C with Multiple Linear Regression test.

Keywords : biochar, corn cob, heavy metals, maximum adsorption capacity (b), adsorption energy constant (K), Langmuir Isothermal, Standard Error of The Mean, available Cu, available Zn, pH, CEC, clay content, organic C.