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Synthesis and Characterization of Activated Carbon/Alginate-Cu Composites

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ABSTRACT

OPEFB is one source of natural fiber-based composites which have the potential to become activated carbon. This study aims to synthesize and characterize the activated carbon/alginate -Cu composite. The characterization used in this study is FTIR. The results of this study The synthesis of activated carbon/alginate -Cu composites began with a process of carbonization and activation with H3PO4 to produce Activated Carbon. Alginate using commercial alginate. Furthermore, the three ingredients were mixed until homogeneous and put into a 0.1M CuSO4 solution to produce beads. The characterization of FTIR characterization on the activated carbon/alginate-Cu composite contained the functional group OH group, triple C bond from stretching alkyne, C=C aromatic group, C-H alkane group, C-O group , the P=O stretching vibration of the P-O-C group and the alcohol OH group expressing the active carbon; there are functional groups of hydroxyl (OH), carboxyl, carbonyl, and C-O-C and –COOH bonds which represent alginate and there are OH functional groups, stretching C-H bonds, C-O stretching, stretching C-C. The KALg Cu13 sample had a peak at a wavelength of 2838.79 Cm^{-1} Where the four samples show the presence of C≡N groups.

Keywords: Composite, OPEFB, Actived carbon, alginate, $CuSO_4$

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1. INTRODUCTION

Oil palm empty fruit bunches (EFB) contain solid waste from oil palm plantations with an amount of around 23% of the amount of fresh fruit[8]. The number of OPEFB reaches 30-35% of the weight of fresh fruit bunches at each harvest. However, until now the utilization of OPEFB waste has not been utilized optimally[9]. Therefore, to utilize and reduce OPEFB waste, it can be synthesized into a useful material, namely activated carbon. OPEFB has a high carbon content and is rich in lignin which has the potential to be a good precursor for activated carbon production and OPEFB can be used as a raw material for making inexpensive activated carbon[6]. OPEFB waste contains lignocellulosic material, which consists of cellulose 30-55D44, hemicellulose 15-35% and lignin 20-30D44[5]. Oil palm empty fruit bunches have great potential to be used as soil fertilizer due to their chemical and physical properties which can improve soil conditions. When compared to using other soil fertilizer materials. Oil palm empty fruit bunches are one of the organic fertilizers that contain high potassium (K) in addition to nitrogen (N) and phosphorus (P) content.

Composite materials can be defined as a combination of two or more materials that produce better properties than the individual components used alone[3]. Alginate is one of the most commonly used materials for the production of slow release beads. Alginate is designed to gradually release both water and metal present from the beads. This is due to the properties of viscosity and gelling, film forming, thickening, and stabilizing[4]. Alginate is a non-toxic polysaccharide that is easily degraded and has the potential to become a slow-release material because it can form cross-links by increasing the number of cations and forming beads[2]. Therefore activated carbon is combined with alginate to form a composite, the composite materials will not lose their respective identities but still associate their properties with the products produced from the mixture[11].

Slow release fertilizer has a Slow Release Ferlitizer (SRF) method which is an effective method by coating it in fertilizer to reduce the solubility of fertilizer in water and reduce the release rate of nitrogen in the fertilizer. The advantage of using SRF is that nutrients are available and released slowly as a result of which they have the potential to be absorbed by plants and reduce the frequency of use[1]

Plants not only need NPK as a macronutrient but also need Cu (II) metal as a micronutrient. Micronutrient elements are needed by plants in small amounts, but their presence is important in plant tissue. Micronutrients play an important role in plant disease resistance and root resistance. There are eight micronutrients which are defined as important elements needed in plant tissue, namely elements B, C1, Cu, Fe, Mn, Mo, Ni, and Zn.

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Based on the description above, the use of activated carbon and alginate as a matrix or binder is used as a reinforcing material in composites. Therefore, this study aims to synthesize and characterize the activated carbon/alginate-Cu composite.

2. EXPERIMENTAL

2.1. Chemicals, Equipment and Instrumentation

The tools used are glassware, grinder, 200 mesh sieve, analytical balance, vacuum pump, oven, furnace, hotplate, centrifuge. The materials used are empty palm oil bunches from PTPN II PKS Pagar Merbau, Metal $CuSO_4$, 10% H_3PO_4, alginate, distilled water, filter paper and pH meter. Fourier Transform Infrared (FTIR) Spectrophotometer.

2.2. Research Procedure

2.2.1. Carbonization and Activation of Activated Carbon

Empty Palm Oil Bunches (EFB) are washed in running water and dried in the sun then crushed and sifted. The biosorbent was carbonized in a furnace at 500℃ for 2 minutes. Carbon was activated with 10% H_3PO_4 for 24 hours, then washed until neutral and dried in an oven at 105 ℃. Activated carbon is characterized by FTIR[10]

2.2.3. Synthesis of Activated carbon/Alginate-Cu Composite

Activated carbon, and alginate are mixed in 100 mL of distilled water with the composition according to Table 1 until homogeneous. The solution was dripped using a syringe into 0.1 M $CuSO_4$ solution, filtered and washed after 24 hours until the pH was neutral. then dry in the oven. Activated carbon/alginate-Cu composite characterized by FTIR

Table 1. Composite Variation

Composite	Composite Variation (g)	
	Activated Carbon	Alginate
Sampel-1	1	1
Sampel-2	3	1
Sampel-3	1	3

3. RESULTS AND DISCUSSION

3.1. Carbonization and Activation of Activated Carbon

Carbonization in this study aims to release and remove volatile components in order to create and open pore structures. Carbonized carbon results, cooled and put in a closed container. Carbon activation in this study is a chemical activation because it uses H_3PO_4 activator which can help expand pores. After 24 hours, the activated carbon was filtered and washed using distilled water until the pH was neutral to remove any remaining phosphate residue.

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Figure 1. Activation of Activated Carbon

In the carbonization process, there is a process of decomposition of organic matter, removal of impurities, removal of non-carbon elements, release of volatile elements such as nitrogen oxides and sulfur oxides and carbon purification.

3.2. Synthesis of Activared Carbon/Alginate-Cu Composite

Activated carbon and alginate are mixed in 100 ml of distilled water with a composite variation ratio of 1:1, 1:3 and 3:1, blended until homogeneous. The solution was then dripped using a syringe in 0.1 M $CuS0_4$ solution. The results were in the form of composite beads then soaked for 24 hours, the composite was filtered and washed with distilled water until the washed filtrate was washed with distilled water until the pH was neutral, then dried in an oven at 105 ^{0}C until constant weight.

3.3. FTIR characterization

FTIR spectrum analysis showed several absorptions indicating the presence of several functional groups in a sample, the samples analyzed were alginate, KALg Cu11, KALg Cu13, KALg Cu31. FTIR characterization of the Activated Carbon/Alginate -cu Composite can be seen in Figure 2.

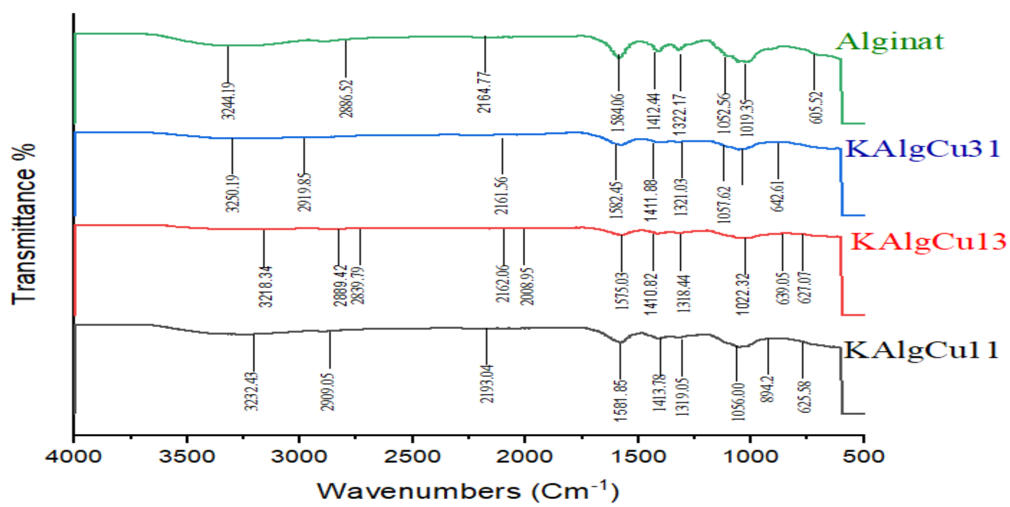

Figure 2. FTIR Characterization of Activated Carbon/Alginate -Cu Composites

Based on the graph above, FTIR Alginate is shown to have absorption in the 3244.19 Cm^{-1} region indicating hydroxyl groups, absorption in the 1584.06cm-1 area indicates carbonyl, absorption in the 1412.44

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Cm^{-1}region indicates C-O-H bonds, absorption in the 1052.56 Cm^{-1}region indicates C-O-C and –COOH bonds. Mushollaeni and Rusdiana's research., (2011) results of FTIR Alginate analysis showed the presence of hydroxyl (OH), carboxyl, carbonyl, and C-O-C and –COOH functional groups. The KALg Cu13 sample had a peak at a wavelength of 2838.79 Cm^{-1}, a KALg Cu11 sample had a peak at a wavelength of 2193.04 Cm^{-1}. Where the four samples show the presence of C≡N groups. While the alginate sample has a peak at a wavelength of 1584.06 Cm^{-1}, a KALg Cu31 sample has a peak at a wavelength of 1582.45 Cm^{-1}, a KALg Cu13 sample has a peak at a wavelength of 1575.03 Cm^{-1}, a KALg Cu11 sample has a peak at a wavelength of 1581.85 Cm^{-1}. Where the four samples showed the presence of –COOH groups.

4. CONCLUSION

The synthesis of the activated carbon/alginate-Cu composite comes from Empty Palm Bunches which begins with a process of carbonization and activation with H_3PO_4 to produce Activated Carbon. Alginate in this study used commercial alginate. After that, the activated carbon and alginate were mixed until it was homogeneous and put into a 0.1M $CuSO_4$ solution using a syringe (injection) and allowed to stand for 24 hours to produce composite granules or beads. FTIR characterization of the activated carbon/alginate -Cu composite contained the functional group OH group, triple C bond from alkyne stretching, C=C aromatic group, C-H alkane group, C-O group, P=O stretching vibration from P-O-C group and alcohol OH group which expressed active carbon; there are hydroxyl functional groups (OH), carboxyl, carbonyl, and C-O-C and –COOH bonds which represent alginate and there are OH functional groups, C-H bond stretching, C-O stretching, C-C stretching.

REFERENCES

1) Aviantri, F., & Maharani, D. K. (2017). Pelepasan Nitrogen Pada Pupuk Slow Release Urea dengan Menggunakan Matriks Kitosan–Bentonit. *UNESA Journal of Chemistry*, *6*(1), 68-72.
2) Bijang, C.M., Tehubijuluw, H., and Kaihatu, T.G. (2018). Biosorption of Cadmium (Cd2+) Metal Ion in Brown Seaweed Biosorbent (padina australis) from Liti Beach, Kisar Island. *Indo. J. Chem. Res*, 6, 51-58.
3) Campbell, F. C. (2010). *Structural composite materials*. ASM international.
4) Florentino, K. A., Santos, T. T. F., & Templonuevo, C. D. (2020). Comparison of Sodium Alginate-Based Slow-Release Beads with Varying Calcium Chloride Concentrations.
5) Hidayah, N., & Wusko, I. U. (2020). Characterization and Analysis of Oil Palm Empty Fruit Bunch (OPEFB) Waste of PT Kharisma Alam Persada South Borneo. *Majalah Obat Tradisional*, *25*(3), 154-160.
6) Hidayu, A. R., Mohamad, N. F., Matali, S., & Sharifah, A. S. A. K. (2013). Characterization of activated carbon prepared from oil palm empty fruit bunch using BET and FT-IR techniques. *Procedia Engineering*, *68*, 379-384.
7) Karunia F. S. A. F., Sani, & Astuty, D. H. (2021). Karakterisasi Karbon Aktif dari Batang Singkong sebagai Adsorben pada Adsorpsi Logam Tembaga. Seminar Nasional Teknik Kimia Soebardjo Brotohardjono XVII, 17, 1–9.

e-ISSN : 2622-4968, p-ISSN : 2622-1349

8) Maslahat, M., Hutagaol, R. P., & Lestari, S. (2012). Potensi Biosorben Tandan Kosong Kelapa Sawit (TKKS) Dalam Recovery Limbah Fenol. *Jurnal Sains Natural*, *2*(2), 155-168.
9) Setiawati, M. R., Suryatmana, P., Hindersah, R., Kamaluddin, N., & Efendi, S. (2019). The effectiveness of various compositions lignolytic and cellulolytic microbes in composting empty fruit bunch palm oil and sugar cane biomass. In *IOP Conference Series: Earth and Environmental Science* (Vol. 393, No. 1, p. 012032). IOP Publishing.
10) Zubir, M., Muchtar, Z., Syahputra, R. A., Sudarma, T.F., Nasution, H. I., Lubis, R.A.F., Fadillah, L., & Sandi, K. (2021). Characterization of Modified Fe-Cu Nanopartikel Actived Carbon Derived of Oil Palm Empty Bunches. *Journal of Physics*, 1-6.
11) Venkatesulu, M. (2021). A Review of Composite Materials: History, Types, Advantages And Aplications Over Traditional Materials. International Journal Of Research In Aeronautical And Mechanical Engineering, 9(4), 32-38.

e-ISSN : 2622-4968, p-ISSN : 2622-1349