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Effect of pH and Concentration on Cd (II) Ion Absorption Using Activated Carbon Longan Skin (Euphoria logan lour)

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Abstract:

The Cd (II) ion is one of the hazardous metal ions produced from various industrial wastes and the presence of the waste needs to be addressed. Adsorption using activated carbon adsorbent longan skin is proven to absorb Cd (II) ions. In this study, a batch method was used to test variations in pH (2, 3, 4, 5, 6) and concentration (50, 100, 150, 200, 250, 300, 400) mg / L. The optimum results obtained in each variation were at pH 3 with a concentration of 250 mg / L with an absorption capacity of 28.075 mg / g.

Keywords: Adsorption, Cd (II) Metal, Activated Carbon, Longan Shell, Batch Method.

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I. INTRODUCTION

Cadmium metal (Cd^{2+}) is a heavy metal which has carcinogenic properties to humans. Cadmium (Cd^{2+}) can accumulate in the kidneys and can cause kidney dysfunction and Cadmium (Cd^{2+}) can also disrupt the human skeletal system because it causes osteoporosis and also causes lung cancer[1]. Cadmium poisoning has occurred worldwide for example, causing more than 100 deaths in Japan from 1922 to 1965 and cadmium metal contamination occurred in more than 8% of hazardous materials in waste in the United States[2]. Cadmium is a toxic metal, in the Decree of the Minister of the Environment No.51 of 2004 states that the quality standard for Cadmium metal is 0.001 mg / L.

Several methods that can be carried out in the treatment of heavy metal waste are deposition, ion exchange, evaporation, oxidation, and membrane filtration, adsorption[3]. Of these several methods adsorption is a purification and separation technique that is effective in industry because it is considered more economical in wastewater treatment and is a technique often used to reduce heavy metal ions in wastewater.

Activated carbon is a mineral or absorbent substance (adsorbent) that has the ability to bind and retain ions or gases in it in the adsorption system on solids [4].

Research on the use of activated carbon from natural materials has long been carried out and developed, such as the use of peanut shells [5], nyamplung seed shells [6], and bark [7]. The development of materials from natural materials or agricultural waste is an alternative way to overcome environmental problems [8].

In this study, the use of active carbon from the skin is used for absorption of cadmium (II) ion by batch method which is expected to provide better absorption.

II. METHODS

A. Materials and tools

The materials used in this study were activated carbon from longan skin, distilled water, Cd $(NO3)_2$. $4H_2O$, HNO_3 65%, NaOH and H_2SO_4. Equipment that used on this research consists of equipment for analysis and characterization, equipment for analysis consisting of glassware, furnace, oven, pestle, spray bottle, shaker (model: VRN-480), pH meter, analytical balance (ABS 220-4) filter paper, magnetic stirer (MR Hey Standart), sieve (BS410). The equipment used for the characteristics is the Atomic Absorption Spectrometer / AAS (Perkin Elmer AA-100).

B. Sample Preparation

Longan skin is cleaned of dirt, cut, washed with deionized water, and dried. Longan skin sample is heated in furnace with temperature 400 Celsius for 1 hour for obtain charcoal. A total of 20 grams of longan skin charcoal was activated with 80 ml of H_2SO_4 2 M for 2 hours. Then washed with distilled water until neutral, then dried and dried. The resulting charcoal is dried in an oven at a temperature of 105 Celsius for 2 hours.

C. Research Treatment Using Batch System

Cadmium ion adsorption using activated carbon from longan skin was contacted in an erlemeyer containing 25 ml of cadmium solution with a stirring speed of 150 rpm with a contact time of 30 minutes and an adsorbent weight of 0.2 grams with particle size. Judging by the effect of pH (2-6) and concentrations (50 mg/L - 300 mg/L). The filtrate was measured using Atomic Absorption Spectroscopy.

III. RESULTS AND DISCUSSION

Effect of pH Variations

In general, the ability of activated carbon to adsorb heavy metal ions is greatly influenced by the pH of the solution. The level of acidity affects the competition between heavy metal ions and hydrogen ions to be bound to the active site on the adsorbent surface [9]. The pH variation was carried out at pH 2, 3, 4, 5, and 6.The effect of pH in adsorbingCd^{2+} metal ions is shown in Figure 1.

In Figure 1. it can be seen that the increase in absorption occurs from pH 2 to the optimum at pH 3. The absorption capacity obtained at pH 3 is 5.9086 mg/g.

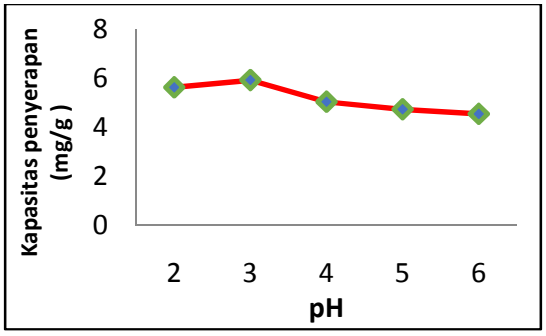

Figure 1. Effect of pH variations on absorption capacity

From Figure 1. It is known that at low pH there is an increase in adsorption until it reaches the optimum condition at pH 3. The decrease in pH causes an increase in ionsH^+ in the solution so that there is an increase in competition with the positive charge of metal ions. This causes ionsH^+ to be adsorbed earlier than Cd^{2+} ions so that Hions+ which are more reactive to activated carbon will

take the place of ionsCd^{2+} during the adsorption process [10].

At pH 3, which is the optimum pH the number of ionsH^{+} decreases, causing ionsCd^{2+} adsorbed first. In this state, all the active sites on the longan skin activated carbon have binded to the metal ions Cd^{2+}. The decrease in adsorption occurs at pH 4, 5 and 6, this is because the activated carbon of the longan skin has been saturated with ionsCd^{2+} so that the ability of the activated carbon to absorb metal ionsCd^{2+} decreases and the decrease in absorption is also due to a larger pH. From the optimum pH metal ions can form hydroxide deposits, namely Cd $(OH)_2$

Effect of Concentration Variation

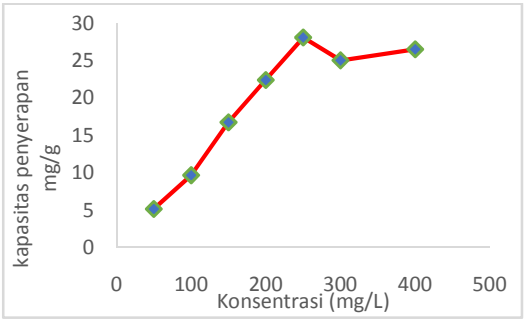

Figure 2. Effect of concentration on absorption capacity

Based on Figure 2, it can be seen that the concentration of the solution can affect the uptake of metal ionsCd^{2+} using longan skin activated carbon. The greater the initial concentration of the solution, the Cd^{2+}uptake will increase to a certain concentration limit[11]. The increase in Cd^{2+}uptake by the adsorbent was relatively sharp at a concentration of 50 ppm to 250 ppm with an absorption of 5.1375 mg/g to 28.075 mg/g

Furthermore, with the addition of the concentration of Cd^{2+} relatively did not increase the absorption, even the absorption decreased, this can be seen at a concentration of 300 ppm with an absorption of 25.0218 mg/g, the decrease in absorption indicates that the performance of the Cd^{2+}metal-absorbing compound or group on the adsorbent decreases, due to surface The adsorbent has been in a saturated state bymetal ionsCd^{2+} the increasingly concentrated.

If the active side on the surface of the activated carbon wall of longan skin is saturated with metal ions, it can no longer increase the absorption of metal ionsCd^{2+}[11]. So it can be said that the optimum concentration of Cdmetal solution2+ absorbed by the longan skin activated carbon adsorbent is 250 ppm with an absorption of 28.075 mg/g.

Adsorption Isotherm

The adsorption isotherm describes the relationship between the amount of adsorbate concentration in the solution absorbed by the adsorbent. In this study, the Langmuir and Freundlich isotherm models were evaluated in the adsorption process of cadmium ions on the activated carbon of longan skin. Table 1 shows the comparison between the Langmuir and Freundlich regression coefficients. Langmuir isotherm is more suitable for the adsorption process of metal ionunityCd^{2+} by the activated carbon of longan skin because the R^2 is close to.

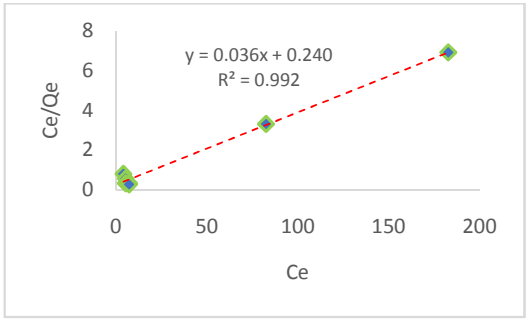

Figure 3. Langmuir Isotherm

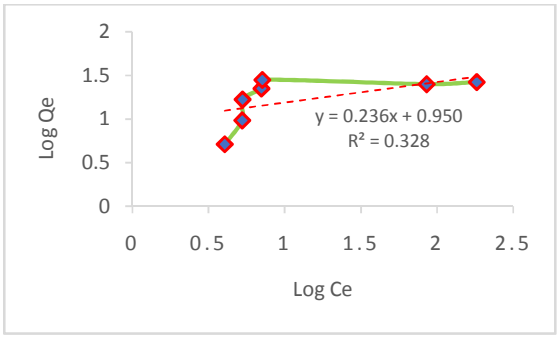

Figure 4. Freundlich Isotherm

Table 1. Comparison of Regression Coefficients Langmuir andFreundlich

Isoterm Langmuir			Isoterm Freundlich		
qm	KI	R^2	n	Kf	R^2
27,397	0,151	0,9925	4,228	0,111	0,328

IV. CONCLUSION

Based on the research conducted, it can be concluded that the optimum conditions for the absorption of metal ion Cd^{2+} are at pH 3 and the concentration of Cd^{2+}solution 250 mg/Lwith an absorption capacity of 28.075 mg/g so that the activated carbon from the longan skin is proven to absorb the ion cadmium (II).

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REFERENCE

[1] WHO. (2010). *Exposure to Cadmium*. A. Major Public Health Concern. Public Health Environ

[2] Kirkham, M. B. (2006).*Cadmium In Plants On Polluted Soils: Effects Of Soil Factors, Hyperaccumulation, And Amendments*. Geoderma, 137(1–2), 19–32. https://doi.org/10.1016/j.geoderma.2006.08.024

[3] Kurniawati, D. , Lestari, I., Sy, S., Harmiwati, Aziz, H., Chaidir, Z., et al. (2016). *Removal of Cu(II) from aqueous solutions using shell and seed of kelengkeng fruits (Euphoria longan Lour).8*(14), 149–154.

[4] Rasjiddin, I. (2006). *Logam Dalam Sisitem Biologi Makhluk Hidup*. *Jakarta*. UI-Press

[5] Tajar, A. F., Kaghazchi, T., & Soleimani, M. (2009). *Adsorption Of Cadmium From Aqueous Solutions On Sulfurized Activated Carbon Prepared From Nut Shells.165*, 1159–1164. https://doi.org/10.1016/j.jhazmat.2008.10.131

[6] Fadilah, N. (2013). *Penurunan Kadar Ion Cd Dalam Larutan Menggunakan Karbon Aktif Dari Tempurung Biji Nyamplung (calophyllum inophyllum L). Thesis*. Institut Teknologi Sepuluh November

[7] Vincent. (2015). *Sintesis Karbon Aktif Dari Kulit Salak Dengan Aktivasi Kimi-Senyawa KOH Sebagai Adsorben Proses Adsorpsi Zat Warna Metilen-Blue*. Parahyangan. Universitas Katolik Parahyangan

[8] Santoso, S. S. D. (2005). *Biosorpsi Ion Nikel (II) dengan Aspergillus oryzae : Pengaruh Aktifasi dan Immobilisasi pada Matrik Natrium Silikat*. FMIPA UNS. SURAKARTA

[9] Lestari, I., Sy, S., Kurniawati, D., Alif, A., Zein, R., & Aziz, H. (2016). *Effect of pH on the biosorption of heavy metal by alginate immobilized durian (Durio zibethinus) seed*. Der Pharma Chemica, 8(5), 294–300. http://derpharmachemica.com/archive.html

[10] Marlinawati, Yusuf, B., & Alimuddin. (2015). *Pemanfaatan Arang Aktif dari Kulit Durian (Durio zibethunu L.) sebagai Adsorben Ion Logam Kadmium (II)*. Jurnal Kimia Mulawarman, 13(1), 23–27.

[11] Suhud, I., Tiwow, V., & Hamzah, B. (2012). A*dsorpsi Ion Kadmium(II) Dari Larutannya Menggunakan Biomassa Akar Dan Batang Kangkung Air (Ipomoea aquatica Forks) (Adsorption of Cadmium(II) Ion from its Solution by Using Biomass of Roots and Stemsâ Water Spinach (Ipomoea Aquatic Forsk))*. Jurnal Akademika Kimia, 1(4), 224182.

