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Adsorption of Cadmium (Cd) Metals Using Durian (*Durio Zibethinus*) Peel Biomass

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Abstract**—*The goal of this study is to determine the weight, contact time, pH, optimum concentration, and adsorption capacity of cadmium (Cd) metal by durian peel biomass with Langmuir and Freundlich isotherm. Local durian peel waste typical of Central Sulawesi provided the durian peel samples for this study. Atomic absorption spectrophotometers (AAS) were used to determine the adsorbed analytes. The obtained results indicated that the optimum weight of durian peel was up to 3 grams, with a percentage of Cd ions uptake of 90.56%. The optimum contact time of Cd ion adsorption occurred in the 80th minute with a percentage of uptake of 78.4%. The optimum pH was reached at pH 5, resulting in an uptake percentage of 84.44%. The concentration reaches its peak at 140 ppm, resulting in an uptake percentage of 94.5%. The Langmuir adsorption isotherm shows that the durian peel biomass can bind 1.6331 mg/g of Cd ions, while the Freundlich isotherm is 1.0427 mg/g.*

Keywords**—*Adsorption, Biomass, Durian Peel, Cadmium Metal, Langmuir Isotherm, Freundlich Isotherm.*

I. Introduction

Indonesia is renowned for its durian fruit (*Durio zibenthinus*). Consumption of durian fruit is notably prevalent among the median to lower middle class. The consumable portion of the durian fruit constitutes merely 20.52% of its overall mass. Consequently, 79.48% of durian fruit components, encompassing the skin and seeds, are inedible and infrequently utilized [1].

Waste from durian peels may smell foul if left unchecked and will pollute the air if burned. Durian peel has cellulose (50–60%), lignin (5%), and starch (5%). This cellulose may serve as a metal binder [2]. The elevated cellulose content of durian peel renders it exceptionally suited as a water filter adsorbent, proficient in absorbing contaminants in water.

Heavy metals that come from the surrounding environment and industry can cause pollution in waters. One of the dangerous heavy metals in water is cadmium. Cadmium metal pollution typically originates from residual substances found in various industries such as paint, soft drinks, smelting, and metal plating, among others. Cadmium metal is a heavy metal that is toxic after mercury; because of its toxicity, this metal in waters must have very small levels. The toxicity impact of cadmium metal can lead to dangerous diseases in humans, including damage to the lungs, kidneys, and liver, as well as high blood pressure and digestive damage [3].

Industrial waste liquids commonly use adsorption as an effective way to adsorb hazardous substances. The adsorbent materials used in this process are relatively expensive, so it is necessary to use cheaper, environmentally friendly adsorbents, such as those made from biomass waste. Adsorbents obtained from waste materials not only limit environmental pollution from solid waste but can increase the selling price of the adsorbent [4].

A suitable adsorbent must possess a large contact surface, active pores, purity, and the ability to not react with the adsorbate. To ensure optimal absorption, the adsorbate's size or particle size must be smaller than the pore diameter of the adsorbent [5]. Researchers in the past, like [6] used durian peel biomass as a bio adsorbent without an activator. They changed the adsorbent's weight from 40 mg to 80 mg to 100 mg to 120 mg. Researchers varied the contact time between 20, 40, 60, 80, and 100 minutes. They varied the pH between 2, 3, 4, 5, and 6, and the concentration between 50, 100, 150, 200, and 250 ppm to determine the optimum conditions of Pb adsorption. The tests showed that the best conditions for biosorption of durian peel were 120 mg, 60 minutes of contact time, pH 5 (99.81% absorption capacity), and 50 ppm concentration (99.59% absorption capacity).

Similar research was also conducted by [7] focusing on differences in absorbed metals. The parameters tested included adsorbent weight or powder weight variations of 50 mg, 70 mg, 90 mg, 110 mg, and 120 mg; contact time variations of 20 minutes, 40 minutes, 60 minutes, 80 minutes, and 100 minutes; pH variations of 2, 3, 4, 5, and 6; and concentration variations of 50 ppm, 100 ppm, 150 ppm, 200 ppm, and 250 ppm. The study's results show that the optimal conditions for the absorption of metallic copper by durian peel biomass are as follows: the optimum weight for biosorption is 120 mg, with an uptake capacity of 99.08%; the optimum contact time with uptake is 100 minutes, with a capacity of 98.31%; the optimum pH is 5, with an uptake capacity of 99.72%; and the optimum concentration is 50 ppm, with an uptake capacity of 98.92%.

Based on the above description, which serves as a reference material, the researcher aims to test the adsorption power of durian peel biomass against cadmium metal in various variations of mass, contact time, pH, and concentration without the use of activators. This is because durian peel contains 50%–60% cellulose, which can be used as an adsorbent. Given the large availability of durian peel waste and limited waste utilization, this research is expected to be more effective, practical, and economical.

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II. METHODS

A. Materials and Tools

This study utilized a 100-mL Erlenmeyer, a 25-mL measuring cup, a spatula, a 1000-mL volumetric flask, a 100-mL beaker, a drop pipette, an oven, a desiccator, a digital balance, a blender, a stirring rod, filter paper, aluminium foil, a 200-mesh sieve, a shaker, a funnel, a spray bottle, an atomic absorption spectrophotometer (AAS), and a stopwatch. The materials used in this study included durian skin, $CdSO_4.H_2O$ solids, filter paper, label paper, distilled water, and tissue.

B. Procedure

- Prepare the durian peel biomass adsorbent [8].

  This study uses durian peel biomass from Bondoyong village, Sidoan Selatan sub-district, and Parigi Moutong district, which is typical of Central Sulawesi. Durian skin was separated from the flesh and contents and then cleaned, cut into small pieces, dried, mashed, and then sieved as much as 100 grams using a 200-mesh sieve.
- Preparation of 1000 ppm Cd stock solution.

  The solution was made by adding 2.017 grams of $CdSO_4.H_2O$ into a beaker, then adding 5 mL of distilled water into a beaker containing solids, stirring until completely dissolved, putting the solution into a 1000 mL volumetric flask, then adding distilled water until the limit mark and shaking until homogeneous.
- Preparation of 100 ppm Cd stock solution.

  The 1000 ppm stock solution was taken in 10 mL and then put into a 100 mL volumetric flask, and then added distilled water until the limit mark and shaken until homogeneous [9].
- Determination of biomass quality based on the Indonesian National Standard (SNI 06-3730-1995).

  Determination of Water Content. In principle, the adsorbent's free water should evaporate until the water content balances with the surrounding air. Equation (1) is the formula used to determine the moisture content based on SNI 06-3730-1995.

  $$Water\ content\ (\%) = \frac{W1 - W2}{W1}\ x\ 100\% \quad (1)$$

  W1 = sample weight
  W2 = final weight of sample

  Determination of Ash Content. Ash content in adsorbents consists of minerals that cannot be lost or evaporated in the process of ignition. Equation (2) calculates the ash content based on SNI 06-3730-1995.

  $$Ash\ content\ (\%) = \frac{W1}{W2}\ x\ 100\% \quad (2)$$

  W1= ash weight
  W2 = sample weight
- Determination of optimum weight of durian peel biomass for cadmium metal adsorption [10].

  Adsorbents weighing 1 gram, 1.5 grams, 2 grams, 2.5 grams, and 3 grams were each put into 50 ml of 100 ppm cadmium solution with pH 5 in a 100 ml Erlenmeyer and then covered it with aluminium foil, then shaking for 60 minutes and allowed to stand for 15 minutes, then filtering the solution using Whatman filter paper, and then measuring the absorbance of the solution using an atomic absorption spectrophotometer at a wavelength of 324.8 nm.
- Determination of optimum time of cadmium metal adsorption by durian peel biomass [10].

  The durian peel was weighed to match the optimal weight obtained and placed into 50 ml of a 100 ppm cadmium solution at pH 5 within a 100 ml Erlenmeyer flask, which was subsequently sealed with aluminium foil. The mixture was agitated for varying durations of 20, 40, 60, 80, and 100 minutes, followed by a 15-minute standing period. The solution was then filtered using Whatman filter paper, and the absorbance was measured with an atomic absorption spectrophotometer at a wavelength of 324.8 nm.
- Determination of optimum pH of cadmium metal adsorption by durian peel biomass [10].

  The durian peel was weighed to match the optimal weight obtained and placed into 50 ml of a 100 ppm cadmium solution at pH 5 within a 100 ml Erlenmeyer flask, which was subsequently sealed with aluminium foil. The mixture was agitated for varying durations of 20, 40, 60, 80, and 100 minutes, followed by a 15-minute standing period. The solution was then filtered using Whatman filter paper, and the absorbance was measured with an atomic absorption spectrophotometer at a wavelength of 324.8 nm.
- Determination of optimum concentration of cadmium metal solution adsorbed by durian peel biomass [10].

  Weighing the durian peel as much as the optimum weight obtained, each was put into 50 ml of cadmium solution with a concentration variation of 20, 60, 100, 140, and 180 ppm with an optimum pH in a 100 ml Erlenmeyer and then cover it with aluminium foil, then shaking until the optimum contact time, then allowed to stand, then filtering the solution using Whatman filter paper after that measuring the absorbance of the solution using an atomic absorption spectrophotometer at a wavelength of 324.8 nm.

C. Data analysis techniques

- Determination of adsorption capacity.

  The concentration of cadmium absorbed by biomass can be calculated using (3) [11].

  $$Cb = Ci - Cq \quad (3)$$

  Cb = absorbed cadmium concentration (mg/L)
  Ci = initial concentration of cadmium solution (mg/l)
  Ceq = concentration of unabsorbed cadmium solution (mg/L)

  The percentage of cadmium concentration absorbed by durian peel biomass can be calculated using (4).

  $$\%\ Cd = \frac{Cb}{Ci}\ x\ 100\% \quad (4)$$
- Adsorption Isotherm.

  The research data were input into the *Q* (5) and *Ce* graphs, yielding a linear relationship with a slope of 1/qm and an intercept of 1/bqm. Equation (6), representing the Langmuir adsorption isotherm, may ascertain the parameters of the adsorption isotherm [12] from the *Q* versus *Ce* graph.

$$Q = \frac{b.K.Ce}{1+K.Ce} \quad (5)$$
$$Q = K.Ce.1/n \quad (6)$$

Ce = equilibrium concentration of adsorbate in solution after adsorption (mg/L)
Q = the amount of adsorbed adsorbate per adsorbent weight (mg/g)
K = the adsorption equilibrium constant (L/mg)
B = the maximum adsorption capacity of the adsorbent (mg/g)
n = empirical constant

Equation (7) is the Freundlich adsorption isotherm [12]. The above equation can be converted into linear form by taking its logarithmic form, as shown in (7).

$$Log\,Q = Log\,k + 1/n\,Log\,Ce \quad (7)$$

III. Results And Discussions

If left unattended, durian peel waste (Fig. 1) can emit an unpleasant odour, pollute the environment, and cause air pollution if burned. Despite the limited utilization of durian peel, research reveals that its high cellulose content, approximately 50% to 60% carboxymethlycellulose, can serve as a bio adsorbent for the absorption of heavy metals in water [13]. This study aims to determine the optimal conditions of durian peel biomass adsorbent for the adsorption of cadmium metal ions.

Fig. 1. Durian peel waste

A. Moisture Content

The adsorption power of the adsorbent can be influenced by its moisture content. If the moisture content is low, the adsorption process will occur optimally. This is because the lower the moisture content, the more adsorbate can occupy the pores on the adsorbent surface [14].

Table 1 presents data regarding moisture content. The investigation yielded a moisture content of 8.1%. This signifies that the water content in the durian peel biomass conforms to the maximum water content of 15% stipulated by SNI 06-3730-95 [15]. This indicates that the water content in the sample has evaporated during the heating process.

TABLE I. Biomass Moisture Content

Cup	Mass of adsorbent before heating (gram)	Initial weight of sample (gram)	Final weight of sample (gram)	Moisture content (%)
1	10.0009	41.2078	9.1607	8.4%
2	10.0022	49.7898	9.2067	7.9%
3	10.0020	57.6051	9.1812	8.2%

B. Moisture Content

The ash content can impact the quality of the adsorbent, potentially leading to pore blockage and subsequently affecting the absorption capacity. The pore blockage reduces the surface area of the biomass [16].

TABLE II. Biomass Ash Content

Cup	Mass of adsorbent (gram)	Mass of cup + adsorbent (gram)	Mass of cup + ash (gram)	Mass of ash (gram)	Ash content (%)
1	10.010	50.709	41.3289	0.629	6.29%
2	9.999	51.289	41.9180	0.628	6.28%
3					

The average ash content, according to the data in Table 2, was 6.2%. The ash content in this treatment complies with the SNI 06-3730-95 standard, which stipulates a maximum ash concentration of 10%.

C. Determination of optimum weight of durian peel biomass for cadmium metal adsorption

The optimal weight for studying the adsorption of cadmium ions by durian peel biomass was assessed using weight variations of 1 gram, 1.5 grams, 2 grams, 2.5 grams, and 3 grams. The objective is to determine the optimal weight of durian peel biomass for the adsorption of a cadmium solution at a concentration of 100 ppm, with a pH of 5 and a contact duration of 60 minutes. Table 3 presents the acquired data.

TABLE III. Cadmium metal adsorption at various weight of durian peel biomass

Weight (mg)	Abs	pH	Contact Time (minute)	C_i (mg/L)	Ceq (mg/L)	Cb (mg/L)	x/m (mg/g)
1	0.4307	5	60	100	21.28	78.72	3.9
1.5	0.4290	5	60	100	21.15	78.84	2.6
2	0.3980	5	60	100	20.37	80.47	2.0
2.5	0.2134	5	60	100	10.46	89.54	1.7
3	0.1920	5	60	100	9.43	90.56	1.5

A curve illustrating the correlation between adsorbent weight and %Cd absorbed may be constructed from the data in Table 3. The graph indicates an enhancement in the adsorption capacity of durian peel adsorbent for Cd metal ions in relation to the optimal weight variation. Fig. 2 illustrates the mass optimization curve for the adsorption of cadmium ions by durian peel.

Fig. 2 demonstrates that an increase in the adsorbent weight enhances the adsorption capacity for Cd metal ions. The adsorbent weighing 3 grams exhibits the maximum absorption value, achieving an adsorption efficiency of 90.56% through mass variation.

The augmentation in adsorption results from the heightened quantity of biomass engaging with cadmium ions. The augmentation of cadmium ion adsorption is attributable to the biomass cell density containing cadmium ions; a higher concentration of absorbent substances correlates with an increased number of reactive biomass active sites, thereby enhancing the adsorption capacity for cadmium ions by facilitating the expansion of the biomass surface area, which promotes cadmium ion absorption [17].

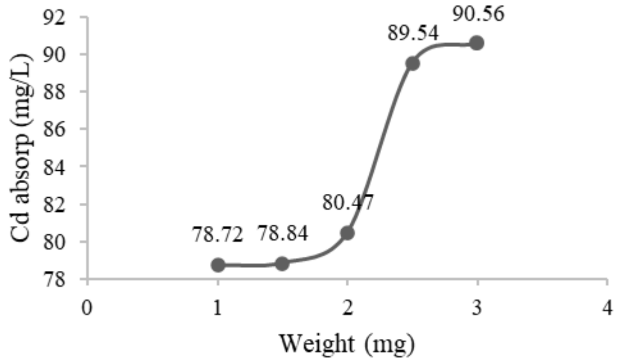

Fig. 2. Mass Optimization Curve for the Adsorption of Cadmium Ion by Durian Peel Biomass

D. Determination of optimum time of cadmium metal adsorption by durian peel biomass

The goal of studying changes in contact time is to find out how long it takes for the durian peel biomass to interact with Cd as an adsorbate, since the speed of the reaction depends on how many collisions happen in a given amount of time. The more collisions that occur, the faster the reaction takes place until equilibrium.

The needed contact time is found by contacting based on the best weight achieved during the previous treatment, which was 3 grams of durian peel adsorbent. This is then put into a cadmium solution with a concentration of 100 ppm and a pH of 5, and the contact time is changed between 20, 40, 60, 80, and 100 minutes. Table 4 displays the obtained data.

TABLE IV. Cadmium metal adsorption at various contact times of durian peel biomass

Weight (mg)	Abs	pH	Contact Time (minute)	C_i (mg/L)	Ceq (mg/L)	Cb (mg/L)	x/m (mg/g)
3	0.3318	5	20	100	24	76	1.26
3	0.3247	5	40	100	23.52	76.48	1.27
3	0.3189	5	60	100	23.17	76.83	1.28
3	0.2970	5	80	100	21.6	78.4	1.30
3	0.3044	5	100	100	22.04	77.96	1.29

The data in Table 4 is then made in the form of an adsorption absorption curve. The curve displays how the adsorption capacity of durian peels to Cd metal ions goes up and down as the optimal contact time changes. Fig. 3 displays the contact time optimization curve for the adsorption of Cd ions by durian peel.

Fig. 3 demonstrates an increase in adsorption power from 20 minutes to 80 minutes, followed by a decrease at 100 minutes. The time variation reveals that the adsorbent with an 80-minute contact time exhibits the highest absorption value, with an adsorption power of 78.4%. Generally, as the concentration of biomass rises, the surface area expands, leading to a higher concentration of metal bound in the bioadsorbent solute; conversely, the saturation of heavy metal-filled bioadsorbent surface pores, which prevents the bioadsorbent from absorbing back, results in a decrease in the quantity of bioadsorbent solute per unit weight. Within a specific range, the increase in adsorption capacity loses its significance, as an increase in the active side does not coincide with an increase in the volume of water media serving as a reaction site [18]. According to the results of testing the reduction of Cd levels using activated charcoal adsorbents, the optimal time for absorption of Cd metal ions is 80 minutes [19].

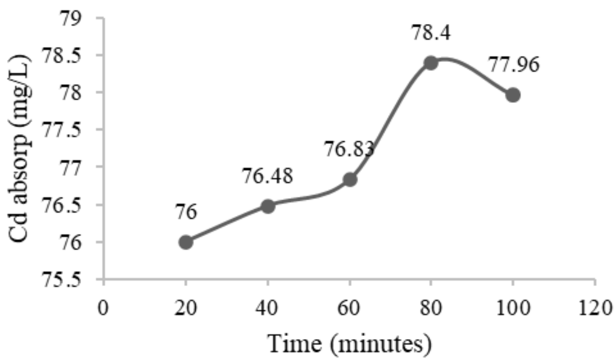

Fig. 3. Contact Time Optimization Curve for the Adsorption of Cadmium Ion by Durian Peel Biomass

E. Determination of optimum pH of cadmium metal adsorption by durian peel biomass

A crucial aspect of the adsorption process is determining the level of acidity (pH). The pH alters the charge of the active site on the adsorbent surface, significantly influencing metal absorption and solubility in solution [20]. The optimal pH is determined by utilizing 3 grams of durian peel adsorbent, which is introduced into a 100 ppm cadmium solution at pH 5, followed by agitation for the previously established optimal duration. Table 5 presents the acquired data.

TABLE V. Cadmium metal adsorption at various pH of durian peel biomass

Weight (mg)	Abs	pH	Contact Time (minute)	C_i (mg/L)	Ceq (mg/L)	Cb (mg/L)	x/m (mg/g)
3	0.3840	3	80	100	21.15	78.84	1.31
3	0.3486	4	80	100	19.19	80.81	1.34
3	0.2827	5	80	100	15.56	84.44	1.40
3	0.3041	6	80	100	16.74	83.26	1.38
3	0.3087	7	80	100	16.97	83.03	1.38

The data in Table 5 is subsequently presented as an adsorption-absorption curve. The figure illustrates the fluctuations in the adsorption capacity of durian peel adsorbent for Cd metal ions in relation to optimal pH variations. Fig. 4 illustrates the pH optimization curve for the adsorption of cadmium ions by durian peel.

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In Fig. 4, the results obtained in determining the optimum pH show that the higher the pH, which means a decrease in acidity, the greater the adsorption power, although the increase is not significant. Adsorption at pH 3, 4, and 5 is increasing; at pH 3, the absorption is 78.84%, at pH 4, it is 80.81%, and at pH 5, it reaches 84.44%, while at pH 6, it decreases, where the absorption is 83.26% and at pH 7, it is 83.03%. This aligns with [21] belief that the degree of acidity (pH) significantly influences the metal adsorption process in solution, as the presence of H^+ ions in the solution competes with cations for binding to active groups.

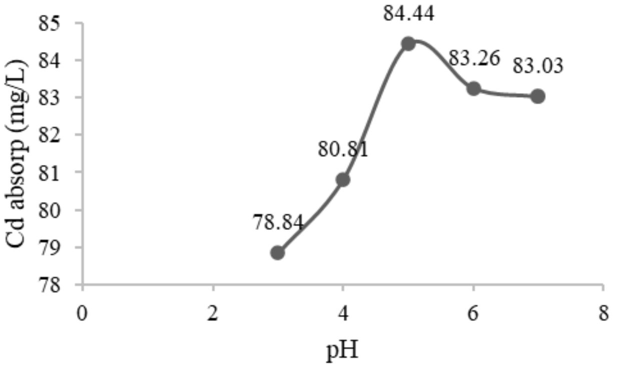

Fig. 4. pH Optimization Curve for the Adsorption of Cadmium Ion by Durian Peel Biomass

Also, pH affects how ions interact with adsorbent active groups. When pH is below 5, not much Cd metal is absorbed. This is because when pH is too low or too acidic, there are a lot of H^+ ions, which makes it harder for metals to bind to adsorbents. This means that heavy metals are not absorbed as well. At pH 6, the absorption was 83.26%, and at pH 7, it was 83.03%. This decrease in absorption can be attributed to the relatively small number of protons or H^+ in an alkaline or excessively high pH, which can potentially bind large amounts of heavy metals and form deposits of metal ions [22].

According to research done by [23], the best pH for adsorbing metal ions is 5, and the absorption rate is 39.27%. This means that adsorbing Cd metal ions without the bact method is better, with an absorption rate of 84.44% and lower costs.

F. Determination of optimum concentration of cadmium metal solution adsorbed by durian peel biomass

The goal of a concentration study is to identify the optimal adsorbate concentration that the adsorbent can absorb. The higher the concentration of adsorbate, the faster the adsorption rate. However, under specific conditions, the adsorbate will stabilize as it reaches a saturation point, leading to an equilibrium process [24]. Determination of the optimum Cd concentration in this study was carried out by contacting 3 grams of durian peel adsorbent, which was then inserted into 50 mL of Cd solution with a concentration variation of 20, 60, 100, 140, and 180 ppm. The pH of the Cd solution was set at pH 5, and the adsorption contact time was carried out for 80 minutes, which is the weight, pH, and contact time that have been obtained from previous experiments. Table 6 presents the data collected.

The data obtained in Table 6 can then be made into a graph of the relationship between the initial concentration of Cd (ppm) and Cd adsorption (mg/g). The curve shows the increase and decrease of durian peel adsorbent absorption of Cd metal ions based on concentration variations. Figure 5 displays the concentration optimization curve for the adsorption of Cd ions by durian peel.

TABLE VI. Cadmium metal adsorption at various concentration of durian peel biomass

Weight (mg)	Abs	pH	Contact Time (minute)	C_i (mg/L)	Ceq (mg/L)	Cb (mg/L)	x/m (mg/g)
3	0.3655	5	80	20	5.5	14.5	1.19
3	0.2314	5	80	60	8.31	51.69	1.36
3	0.3170	5	80	100	12.4	87.6	1.46
3	0.1406	5	80	140	18.09	121.91	1.57
3	0.2127	5	80	180	28.55	151.45	1.52

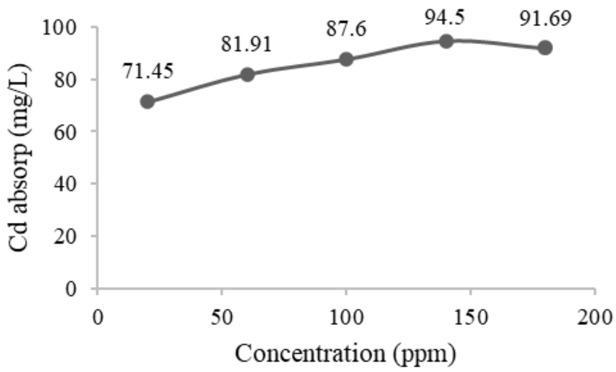

Fig. 5. Concentration Optimization Curve for the Adsorption of Cadmium Ion by Durian Peel Biomass

Fig. 5 reveals that an increase in concentration leads to an increase in adsorption power, although the change is not statistically significant. At a concentration of 20 ppm, adsorption keeps going up until it reaches 140 ppm. At 20 ppm, the percentage of absorption is 71.45%, at 60 ppm, it's 81.91%, at 100 ppm, it's 87.6%, at 140 ppm, it's 94.5%, and at 180 ppm, it goes down, with a percentage of absorption of 91.69%. The unsatisfied active sites on the cellulose-adsorbent durian skin contribute to the increase in absorption capacity from 20 to 140 ppm, enabling it to continue absorbing Cd ions. The decrease in uptake capacity at a concentration of 180 ppm is likely the result of saturated active sites. This shows that the higher the concentration of adsorbate, the faster the rate of adsorption. However, under certain conditions, the adsorbate will become stable as it reaches a saturation point, leading to an equilibrium process [25].

G. Determination of Isotherm Adsorption

The determination of adsorption isotherms enables the examination of variations in adsorbate concentration resulting from the adsorption process in alignment with the adsorption mechanism. The typically utilized adsorption isotherms are the Langmuir and Freundlich isotherms. Equilibrium model testing is conducted to identify the suitable equilibrium model employed in a study. The establishment of the equilibrium model relies on the coefficient of determination (R^2), with a regression value (R^2) approaching 1. This study determined the adsorption isotherms utilizing the Langmuir and Freundlich models. The concentration of the cadmium solution mixed with the durian peel biomass adsorbent was altered. The outcomes of the Langmuir adsorption isotherm curve analysis (Fig. 6) and the Freundlich isotherm (Fig. 7).

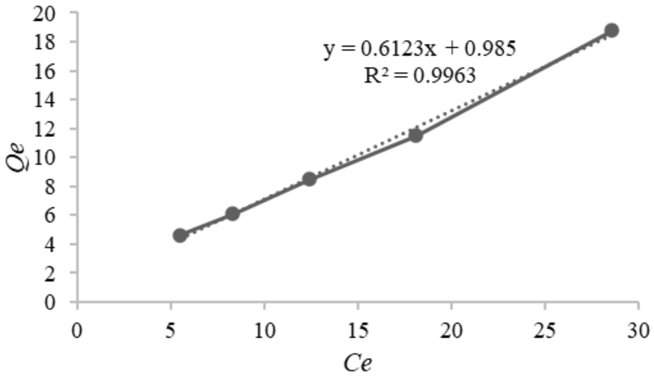

Fig. 6. Langmuir linearity curve for cadmium adsorption at different concentrations

This research utilized the Langmuir adsorption isotherm equation to analyze the adsorption of cadmium metal by durian peel biomass, as illustrated by the curve in Figure 6. The Langmuir isotherm operates under the premise that the resultant layer is a monolayer, wherein the bond between the adsorbent and adsorbate is sufficiently robust due to the establishment of a chemical bond [26]. The correlation coefficient R^2 = 0.9963 was determined, with a maximum absorption capacity (±) = 1.6331 mg/g, derived from the linear curve representing Cd uptake at varying concentrations. The value of Langmuir's constant (β) in this study is 0.6216.

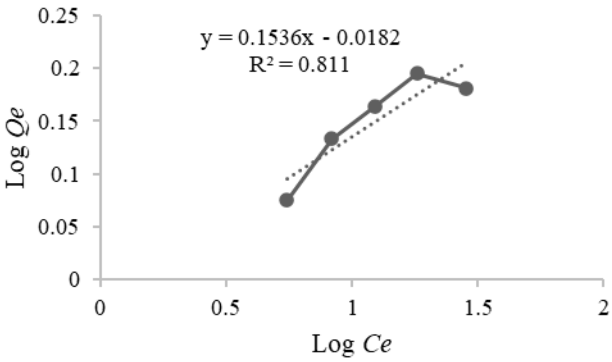

Fig. 7. Freundelich linearity curve for cadmium adsorption at different concentrations

Fig. 7's curve guides the use of the Freundlich isotherm. Van Der Walls force, which prevents the bond from being too strong, is believed to cause the multilayer bond between the adsorbent and the adsorbate [26]. The curve that showed that Pb uptake was linear at different concentrations had an R^2 value of 0.9261, a maximum uptake capacity (k) of 5.0288 mg/g, and an n value of -178.5714.

Adsorption equilibrium is a mathematical description of an isothermal condition specific to each adsorbent. Therefore, each adsorbent and adsorbed material has its own adsorption equilibrium. The R^2 value of 1 show that the Langmuir isotherm equation is more likely to describe how the Cd ions attach to the biomass of durian peel than the Freundlich equation. This value assumes that adsorption occurs on each side of the adsorption and is homogeneous. The fact that these two results are similar shows that the lead metal adsorption experiment using durian peel biomass follows the Langmuir adsorption equation, since it works on a single layer of adsorbed substances [27].

IV. CONCLUSIONS

The study's findings indicate that durian (*Durio Zibethinus*) peel biomass can function as a bioadsorbent. The optimal weight of durian peel biomass adsorbent for cadmium metal absorption is 3 grams, achieving a 90.56% uptake. The ideal contact time for this biomass is 80 minutes, resulting in a 78.4% uptake. The optimal pH for cadmium metal absorption by durian peel biomass is pH 5, with an uptake of 84.44%. Additionally, the optimal concentration for cadmium metal absorption is 140 ppm, yielding a 94.5% uptake. The capacity of durian peel biomass to adsorb cadmium metal adheres to the Langmuir adsorption isotherm, quantified at 1.6331 mg/g. Conversely, the Freundelich adsorption isotherm reveals that the capacity of durian peel biomass to adsorb cadmium metal is 1.0427 mg/g.

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