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Removal of Heavy Metals from Textile Wastewater Using a Mixture of Carbon from Bare Hands and Carbide Waste as an Adsorbent

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ABSTRACT

Heavy metal pollution, mainly originating from textile waste containing synthetic dyes and stabilizers such as Fe, alum, and lime, poses serious risks to health and the environment. To overcome this problem, this research explores the use of activated carbon for heavy metal reduction. Empty palm oil fruit bunches (EFB) offer a promising source of activated carbon due to their high lignocellulose content and functional groups (-OH and -COOH) that enhance heavy metal adsorption. In addition, carbide waste, which is classified as hazardous and toxic waste, poses an ecological threat if disposed of incorrectly. This research focuses on the use of EFB waste and carbide to reduce Fe metal in Fe metal synthesis waste. Various adsorbent ratios (2:2.5, 2.5:2, and 2.5:2.5) and contact times ranging from 30 to 150 min were investigated, with an initial metal synthesis waste concentration of 40 mg/L. The findings showed that longer contact times resulted in the removal of large amounts of Fe(II) metal, with rates reaching 94.325%. The increase in the pH of the adsorbent mixture is caused by the alkaline nature of carbide waste in activated carbon. The Langmuir isotherm model provided the best fit to the data, with a correlation Equation of $y = 0.3882x + 1.4823$ ($R^2 = 0.995$, $R_L = 0.556$), which shows the effectiveness of the TKS-carbide waste mixture in reducing Fe(II) ions in the waste textile. The Freundlich isotherm model also showed a reasonable fit, with a correlation equation of $y = -0.2804x - 0.0133$ ($R^2 = 0.95$). In summary, EFB-carbide waste adsorbent is a successful, consistent, and environmentally friendly solution for the reduction of heavy metals in textile waste.

Keywords: activated carbon, adsorption, empty palm oil fruit bunches, carbide.

INTRODUCTION

Heavy metals have a dangerous impact on human health, and the presence of these metals is increasing due to industrial activities and modern industrialization (Balali-Mood et al., 2021). The problem of heavy metal pollution is a problem that is of serious concern both on a local, regional, and global scale. Because the presence of heavy metals in the environment can pose a threat to water quality and aquatic ecosystems, it can cause brain damage, as well as heart, kidney, and lung disease in humans (Barakat, 2011; Rai et al., 2007). Likewise, in Indonesian waters, heavy metal pollution is a serious problem. endanger human health in the surrounding area (Balali-Mood et al., 2021; Türkmen et al., 2022). The presence of heavy metals in water in high doses can disrupt the response in animals and humans, which can cause DNA damage and neuropsychiatric disorders (Gorini et al., 2014). One of the wastes that contain heavy metals is textile waste. The city of Palembang, South Sumatra Province, is a city that has various kinds of traditional handicraft textile industries, one of which is the cloth weaving industry such as the Palembang songket cloth and jumputan cloth industries. Jumputan fabric waste is textile waste that contains synthetic dyes.

In the dyeing production process using the jumputan fabric dyeing system using synthetic dyes including direct, naphtha hol, and indigo sol, these synthetic dyes generally contain the metals Cr, Pb, Cd, and Fe (Cundari et al., 2022; Purnawan, 2013). To produce different color combinations, locking agents are used, namely tunjung (a rock containing Fe), alum, and lime (Anggi, 2020). The liquid waste content of jumputan fabric in the city of Palembang on average contains BOD = 137.5 mg/L, COD = 498 mg/L, suspended solids = 859 mg/L, and Fe metal = 10.03 mg/L. Based on the Decree of the Governor of South Sumatra Number 16 of 2014 concerning the quality of raw materials for textile industry waste and the decree of the Minister of the Environment Number 51 of 1995, the Fe content must not exceed the maximum permitted limit, namely 5 mg/L.

If Fe in the environment exceeds a predetermined threshold, it can cause environmental pollution which is not good for the surrounding environment and can have an impact on health. Considering the dangers that Fe metal can cause, many methods have been developed to reduce heavy metal levels in water caused by textile liquid waste. In processing waste containing heavy metals, some of them are the membrane separation process (Abdullah et al., 2019), the chemical deposition process (Chen et al., 2018), the adsorption process (Gupta et al., 2015; Renu et al., 2017), the reverse osmosis process (Azimi et al., 2017; Mohseni et al., 2021), the coagulation process (Fu & Wang, 2011), and electrochemistry (Ahmad et al., 2019). However, this method has several weaknesses such as low efficiency and high energy requirements, so it is quite expensive and has operational problems in the form of the deposition of toxic substances, as well as cost ineffectiveness. Of the processes that have been carried out, the adsorption process has advantages, because the adsorption process is a low-cost, efficient, and easy-to-operate process for handling heavy metal waste (Fu & Wang, 2011). The adsorption process applied to remove various types of dyes provides the best results (Ho & McKay, 2003; Jain et al., 2003). Apart from that, adsorbents can also be recycled and regenerated so that the adsorption process is more profitable (Renge et al., 2012). Adsorption efficiency depends on the ability of the adsorbent to adsorb metal ions from the solution onto its surface. The adsorption of molecules onto various adsorbents is an ideal choice for decolorization, which is proven by the effectiveness of adsorption for various types of dyes (Pramana et al., 2021).

One of the agricultural waste biomass materials that has not been widely used and has quite good potential as a heavy metal adsorbent is empty oil palm fruit bunches (EFB) and carbide waste. EFB has a water content of 60% (Mehta et al., 2016), an oil content of 2.5%, and contains lignin, cellulose, and hemicellulose compounds which can be used as active carbon (Cundari et al., 2022). EFB has lignocellulosic material with a dry weight of 55–60%. Lignocellulose is the main component of TKS which is capable of adsorbing heavy metals because of the active groups –OH and –COOH in EFB (Mehta et al., 2016).

Carbide waste is the disposal of the remains of the welding process. The largest chemical composition of carbide waste is calcium oxide (CaO), which is 59.98%, so it has alkaline properties (Anggi, 2020). Carbide waste is included in dangerous and toxic materials (B3), and welders just throw it into the environment, if this continues then the waste will increase and accumulate, and it is very dangerous for the survival of living things around it if left like that, many craftsmen welds that are not functioning properly. regulations that have been regulated in Law (UU) no. 32 of 2009 concerning the environment.

This research aims to determine the ability of a mixture of activated carbon made from empty palm oil bunches with carbide waste to remove iron (II) ions contained in textile wastewater. The physicochemical properties of the two adsorbent mixtures of activated carbon from EFB and carbide waste were studied using SEM and EDX as well as FTIR, then the adsorption process was studied using two equilibrium models, namely the Langmuir and Freundlich models. This research is expected to determine the characteristics of a mixture of activated carbon made from empty palm oil bunches with carbide waste in removing iron (II) ions from textile wastewater as a good and cheap adsorbent.

RESEARCH METHODS

Chemicals and equipment

A mixture of activated carbon made from empty palm oil bunches with carbide waste is used as an adsorbent. Wet carbide waste is dried in the sun for 24 hours and then sieved until a 100-mesh powder is obtained. Meanwhile, the raw material for empty oil palm bunches is dried in the sun for 3 days, then cut into pieces and cleaned of any remaining dirt. Next, it is burned in *a furnace* at 350 °C for 60 minutes, then the empty palm oil bunches carbon is cooled, crushed, and sieved until a 100 mesh powder is obtained.

Characterization of iron (II) solutions

Heavy metal synthetic waste in this study was made by dissolving the compound in a 100 mL $FeSO_4 \cdot 7H_2O$ beaker with 200 ml of a single component Fe(II). Then diluted as necessary, then put into a 1 L measuring flask

Adsorption process

Batch adsorption studies were carried out with carbide waste and activated carbon made from empty palm oil bunches mixed with a solution containing berry metal ions (II) at the desired concentration. Mix 100 mL in a 250 mL beaker while stirring using a bath shaker at 100 rpm at intervals of 30 to 150 minutes. Then it was separated using filter paper, after which the solution was analyzed to determine the final concentration of Fe(II) ions. To determine the morphological structure of the functional groups of the adsorbent mixture before and after being used for the adsorption process, it was analyzed using SEM and FTIR.

RESULTS AND DISCUSSION

Studying character carbon adsorbent from EFB and carbide waste

The morphology and texture of the adsorbent particles were examined using SEM (Scanning Electron Microscopy) with a magnification of 5000 times. The test results using SEM for both adsorbents are shown in Figure 1. The mixture of the two types of adsorbents (EFB and carbide waste) is thought to have many cavities and pores, so it can absorb iron metal ions (Fe) found in textile waste. In Figure 1, it can be seen that the surface morphology of the adsorbent mixture (EFB and carbide waste) has a ratio of (2.5: 2) as a result of scanning using SEM.

It can be seen that the surface morphology structure of the adsorbent mixture varies from 2.5:2 after contact with synthetic Fe(II) metal waste. It can be seen that the structure is dense and mushroom-shaped which are separated from each other and several pores indicate that absorption occurs. The resulting surface morphology has a solid crystal structure and is separated from each other, this shows that Fe metal has been absorbed into the adsorbent. The Fe metal adsorption process was carried out using EDX analysis to see the compounds contained in the adsorbent. From the results of the analysis carried out with EDX, it can be seen that the main components of the two adsorbents consist of C, O, and Ca. The EDX test results of the two adsorbents after coming into contact with jumputan textile wastewater containing Fe(II) metal are shown in Table 1.

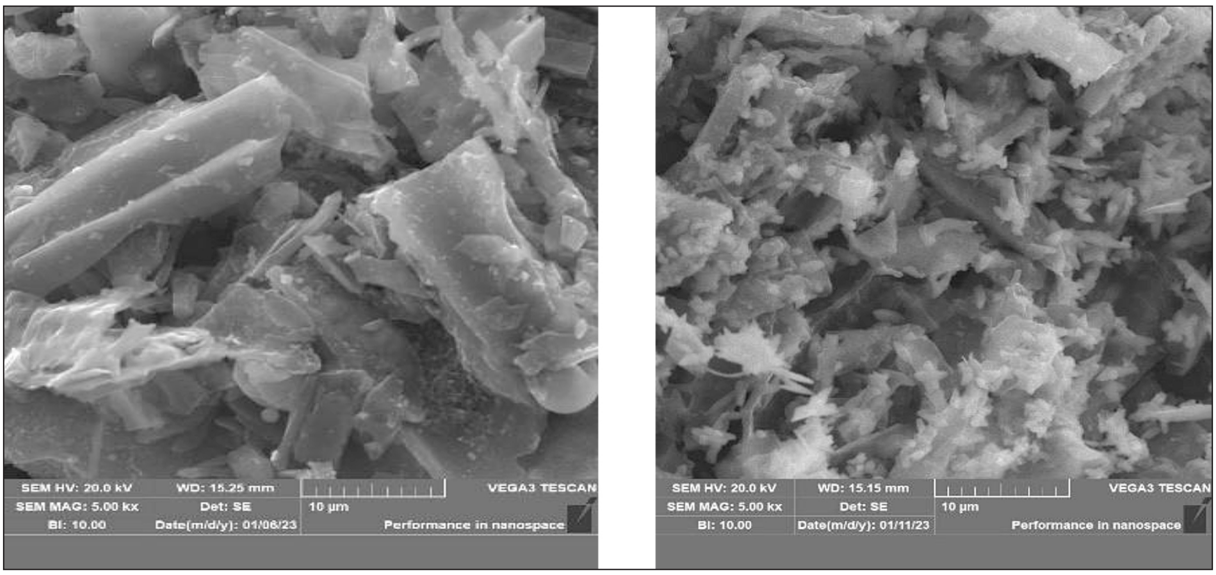


Figure 1. Variations in surface morphology 2.5:2 (a) before, and (b) after contact with textile waste containing Fe metal with a magnification of 5000×

Table 1. EDX elemental composition of both adsorbents

NO.	Combine	Mixture (EFB and carbide waste)
1	Carbon (C)	26.2
2	Oxygen (O)	19.97
3	Indium (Inside)	–
4	Potassium (K)	2.6
5	Silicon (Si)	1.54
6	Chlorine (Cl)	5.12
7	Calcium (Ca)	14.2
8	Sulfur (S)	0.6
9	Antimony (Sb)	10.21
10	Aluminum (Al)	3.5
11	Iron (Fe)	16.06

Characterization of adsorbent using FTIR test

Adsorbent characterization using FTIR testing has also been carried out to identify functional groups contained in adsorbents based on carbon EFB adsorbents and carbide waste which may play a role in the Fe(II) ion reduction process in textile industry liquid waste. The functional groups of carbon adsorbents from EFB and carbide waste were determined as in Figure 2.

In Figure 4, the absorption peaks at 3733.25 cm^{-1}, 3642.16 cm^{-1}, and 3379.65 cm^{-1} are functional groups from OH which indicate the presence of strong hydrogen bonds from carboxyl, phenol, or alcohol. Then at the wave bond 2359.73 cm^{-1}, there is a symmetric CH bond stretch, and at the bond wave 872.17 cm^{-1} there is an aromatic CH functional group. This activated carbon shows that a wave range of 900–1200 cm^{-1} is formed, this is due to the absorption of OH, CH, C-OH, and CH_2 in the glycosyl unit in the adsorbent mixture with a bond range of 950.35 cm^{-1} indicates the presence of CH bonds. deformation. The C-C stretch is at 1085.91 cm^{-1}, so the absorption band at the peak of 1412 cm^{-1} indicates the presence of deformed CH_2 bonds in cellulose, this area shows a crystalline area where the absorption area will increase as the refinement process increases so that the absorption in the carbon mixture from EFB and carbide Waste, absorption is faster and easier (Karim et al., 2023).

Iron (II) metal adsorption capacity

The adsorption capacity (mg/g) of an adsorbent can be defined as the amount of adsorbate (metal ion) adsorbed per unit weight of the adsorbent. The adsorption capacity and efficiency of removing heavy metal ions by adsorbents made from EFB and carbide waste can be expressed using Equation (1) as follows (Lo et al., 2012):

$$q_e = \frac{(C_i - C_e)}{m} \times V \quad (1)$$

Percentage (%R) or adsorption efficiency to determine the iron (II) ion removal rate using the following Equation (2):

$$(\%R) = \frac{(C_i - C_e)}{C_i} \times 100 \quad (2)$$

where: q_e – the equilibrium adsorption capacity (mg/g);

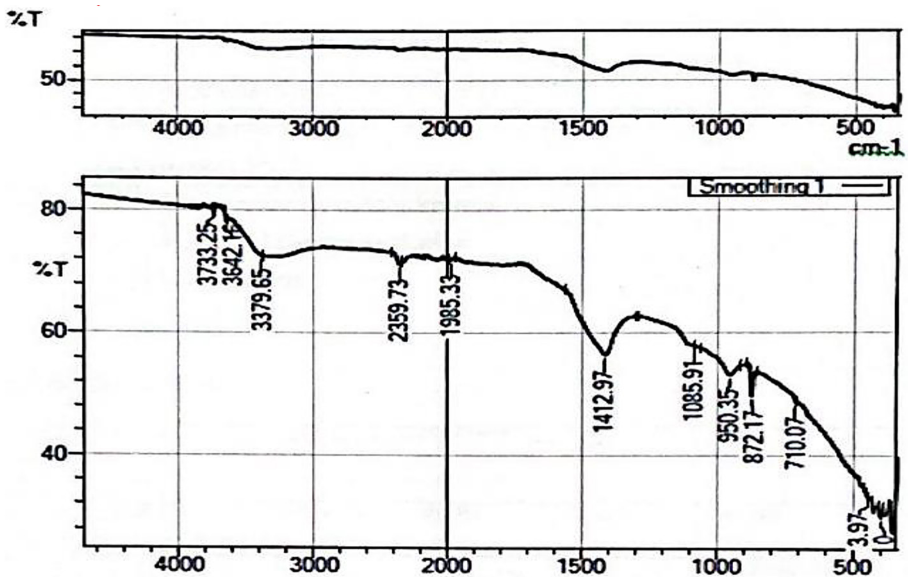


Figure 2. Variations in the spectrum of the 2.5:2 adsorbent after contact

(%R) – removal efficiency;
C_i – the initial concentration of metal ions in solution (mg/L);
C_e – the quilibrium concentration of metal in solution (mg/L);
V – the volume of solution (L);
m – the mass of the mixture adsorbent (g).

Adsorption isotherm

Adsorption is usually described through isotherms. The adsorption isotherm is an empirical relationship used to estimate the amount of solute that can be adsorbed (q_e) with its equilibrium concentration in the Ce solution phase. The distribution of metal ions between the liquid phase and the solid phase can be explained by several isotherm models such as Langmuir and Freundlich.

Langmuir adsorption isotherm

The Langmuir adsorption model is based on the assumption of single-layer adsorption on the adsorbent surface which has a uniform number of adsorption sites, without any transmigration on the surface of the adsorbent plane. Once the site is filled, there is no further adsorption. The Langmuir isotherm assumes monolayer adsorption on a surface containing several adsorption sites with a uniform strategy without transmigration of adsorbate on a flat surface (Hameed et al., 2007). Once a site is filled, no further absorption can occur at that site. This indicates that the surface reaches a saturation point where maximum surface adsorption will be achieved. The linear form of the Langmuir isotherm is represented as follows (3) (Christie, 2023).

$$\frac{C_e}{q_e} = \frac{1}{Q_m K_L} + \frac{C_e}{Q_m} \tag{3}$$

where: q_e – the equilibrium adsorption capacity (mg/g),
C_e – the equilibrium concentration of adsorbate (mg/L),
Qm – the maximum adsorption capacity (mg/g),
K_L – the Langmuir constant at the adsorption capacity (mg/g), then evaluated from the slope by plotting (C_e/q_e) and C_e from the linear model.

The important characteristics of the Langmuir isotherm are expressed in the dimensionless constant separation factor R_L according to Naseeruteen et al. (2018), the suitability of the Langmuir isotherm pattern can be determined using Equation (4) as follows:

$$R_L = \frac{1}{(1 + b.C_o)} \tag{4}$$

This value R_L shows the suitability of the Langmuir isotherm pattern for the adsorption process. It should be noted that the R_L value provides information about the adsorption properties in the Langmuir equation. If the R_L value < 1 indicates good adsorption (strong adsorption). If the R_L value = 12, it indicates that adsorption does not affect the initial concentration. If the R_L value > 1 indicates poor adsorption (weak adsorption) (Gupta et al., 2011).

Freundlich adsorption isotherm

The Freundlich isotherm represents multilayer absorption called physisorption which is based on the empirical relationship between the solute concentration on the heterogeneous surface of an adsorbent and the solute concentration in the liquid (Boparai et al., 2011). The adsorption experimental data was adjusted to the Freundlich adsorption isotherm which describes the adsorption equilibrium. The linear form of the Freundlich isotherm is expressed by Equation (5) (Tong et al., 2019):

$$ln\, q_e = ln\mathrm{K_f} + \frac{1}{n}(ln\mathrm{C_e}) \tag{5}$$

where: q_e – equilibrium (mg/L), the value $1/n$ obtained from the Freundlich equation serves to describe the linearity of adsorption or the degree of curvature of the isotherm in the concentration range tested. $1/n = 1$ – produces a linear plot, while n ≠ 1 produces a nonlinear plot), K_f – Freundlich's constant or maximum absorption capacity, C_e – the equilibrium concentration of the solution (mg/L).

Effect of contact time

The contact time in this experiment was carried out to measure how long it takes to reduce iron (II) ions in woven fabric waste using a batch process. By using Equation (3), it can be seen the percentage of Fe(II) metal ions absorbed by the mixture of TKKS carbon adsorbent and carbide

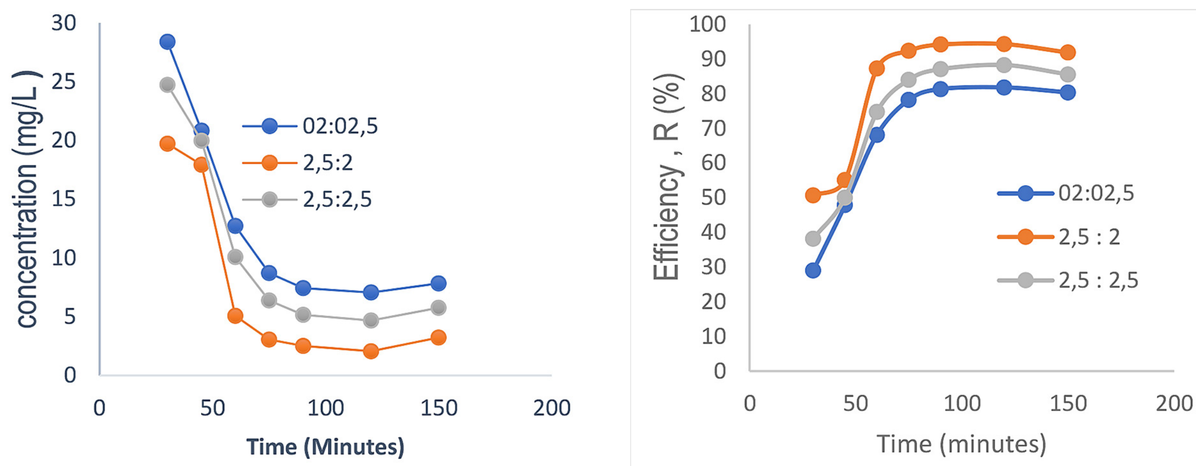


Figure 3. Effect of contact time

waste during the adsorption process. The results obtained are displayed in Figure 3.

Based on Figure 5 increasing the contact time from 30 to 150 minutes can significantly increase the percentage of Fe(II) metal removal. The final concentration of Fe(II) metal ions began to decrease at a contact time of 30 minutes, then generally stabilized at a contact time of 90 minutes to 120 minutes. This is because the absorption capacity of the adsorbent mixture is already at its saturation point. After that, it increased again. The concentration of Fe metal uptake in the lowest adsorbent variation was 2:2.5 with a contact time of 120 minutes of 2.07 mg/l with the highest removal efficiency of 94.33% and the highest was in the adsorbent variation 2.5:2 with a concentration of 7.26 mg/l. l with the lowest removal efficiency, namely 81.85%. From the picture above, it can be concluded that the best Fe metal absorption conditions occur in the 2.5:2 adsorbent variation with a contact time of 120 minutes. This is because, during these variations and contact times, a lot of Fe(II) metal is absorbed, this is proven by the adsorption capacity as shown in Figure 6 which has the largest adsorption capacity, namely 0.75 mg/g. After reaching the optimum time, the adsorption process experiences a decrease in absorption capacity, this occurs due to desorption or re-release of ions that bind to the adsorbent which experiences saturation where the pores in the adsorbent are filled. Balaji et al. (2014) also researched reducing iron metal by using an adsorbent made from coconut fiber which was processed in the solid phase, capable of removing iron metal by 96%. Apart from that, there are other researchers, namely Baharudin et al. (2018), who also researched reducing iron metal (Fe). using biosorbent from banana peels, the research results obtained showed that biosorbent from banana peels was able to reduce iron metal (Fe) by 90.84%. Meanwhile, Saravanan et al. (2022) conducted research using sugarcane bagasse adsorbent to reduce the concentration of iron metal, able to remove iron metal with a high removal percentage, namely 93%. According to Eletta et al. (2023), who researched the removal of iron metal using cocoa pod skin as an adsorbent, it was able to reduce iron metal by 85.32%.

Adsorption capacity

Adsorption capacity is an indicator of the adsorbent's performance in removing contaminants from the solution. The higher the adsorption capacity, the more effective the adsorbent is in absorbing and reducing the concentration of contaminants in the solution. Therefore, understanding adsorption capacity is essential in the design and encryption of adsorption processes in various fields, such as air treatment, gas purification, and metal recovery from waste.

Based on Figure 4, it can be seen that contact time affects adsorption capacity. The adsorption capacity increased with increasing time from 30 to 90 minutes, after that the adsorption capacity was stable until 120 minutes, then decreased until 150 minutes. The nature of the adsorbent and the availability of absorption sites affect the time required to reach equilibrium. From these conditions it can be said

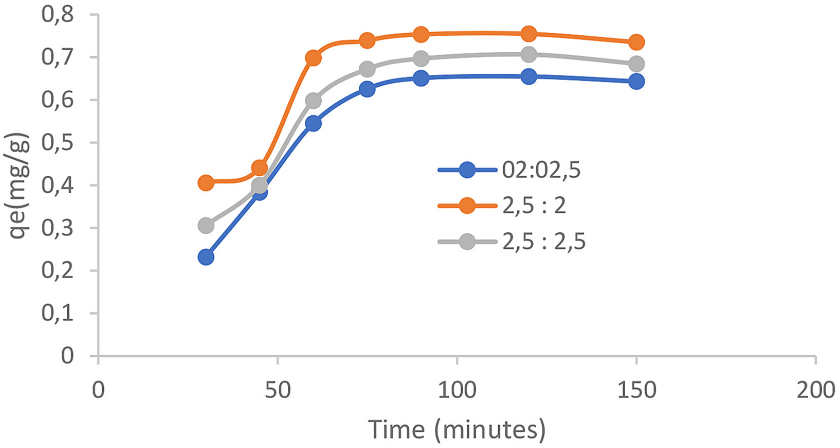


Figure 4. Adsorption capacity (mg/g)

that during the 90-minute adsorption process, there was an equilibrium between the interaction of Fe(II) metal ions with a mixture of carbon EFB and carbide waste of 2.5:2. At a contact time of 90 minutes, the highest adsorption capacity value was 0.75 mg/l and the lowest was for the 2:2.5 adsorbent variation with a capacity of 0.65 mg/l, while for the 2.5:2.5 adsorbent variation. The adsorption capacity is 0.70 mg/g. After 90 minutes the adsorption capacity decreased because the mixture of carbon EFB and carbide waste had reached stability and was at the saturation point, so it could not absorb optimally and tended not to experience a significant increase in Fe(II) metal uptake, this was because the group was active. The hydroxyl (-OH) contained in the mixture of carbon EFB and carbide waste experiences equilibrium so that the solution becomes saturated and absorption is no longer optimal (Crini, 2006; Tan et al., 2007).

Determination of the effect of pH on the adsorption process

Determining the optimum pH level for adsorption of Fe(II) metal aims to find out at what pH the adsorbent absorption capacity can work optimally. This is because pH levels can increase and optimize adsorption performance. The rate of change in pH is shown in Figure 5.

Based on Figure 5 can be concluded that contact time affects the pH level of the adsorbent mixture because the pH level increases as time goes by. The lowest pH level was 12.61 with a 2:2.5 adsorbent variation at 30 minutes, while at 90 minutes with a 2.5:2 adsorbent variation, it was 12.75 with the highest adsorption capacity value of 0.75 mg/l. This is greatly influenced by carbide waste. Because carbide waste has a high pH level (12–13) and carbide waste has a quite high CaO content, namely 59.98% (Karim et al., 2023). According to Karthikeyan and Elango. pH conditions are an important factor that influences

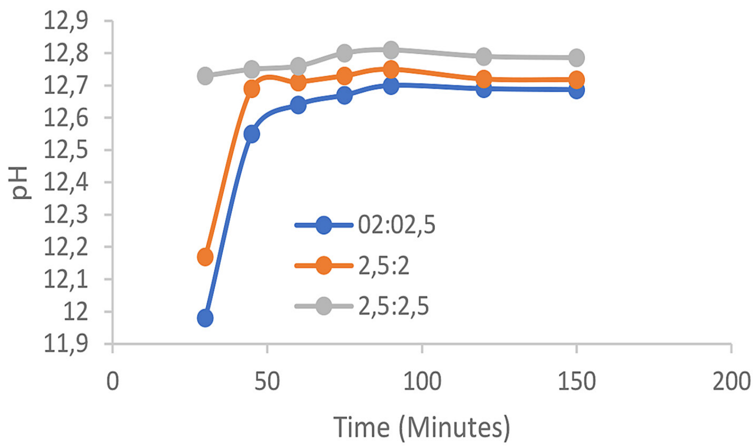


Figure 5. pH levels

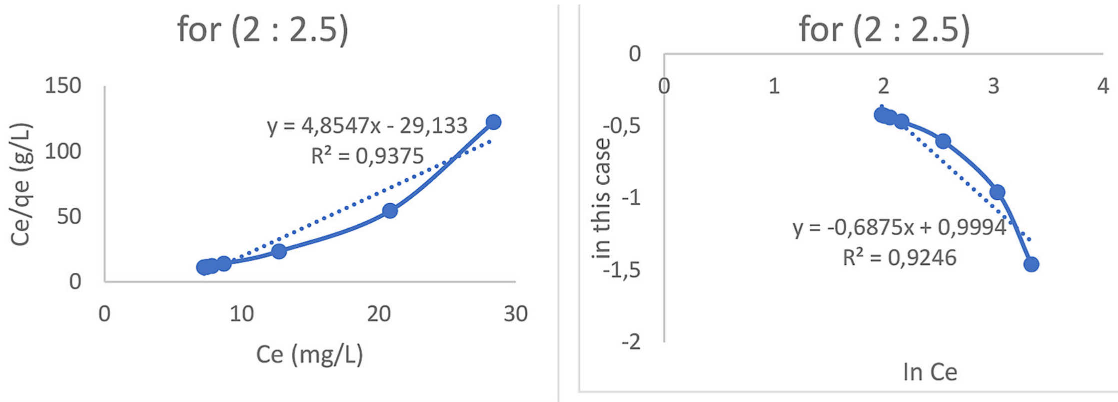
the adsorption process of Fe (II) iron metal ions in solvents. This is because the pH value can affect the ion charge and its interaction with ferrous metal adsorbents (Habuda-Stanić et al., 2014).

Adsorption Isotherm

The mechanism of the adsorption process is often described through an isotherm process. Adsorption isotherm is a quantitative method to characterize the adsorbate equilibrium between water and solid phases at constant ambient temperature (Tong et al., 2019). The distribution of adsorbate through the liquid/suspension phase to the solid phase can be explained mathematically using several isotherm models such as Langmuir (Hameed et al., 2007; Wang et al., 2015) and Freundlich Isotherm (Mehta et al., 2016). Both isotherm models were applied to fit the adsorption isotherm data. The second isotherm curve model approach can help analyze isotherm characteristics in the form of capacity, affinity, selectivity, and adsorption interaction mechanisms. The equilibrium data is depicted in the form of an adsorption isotherm curve for a mixture of carbon EFB and carbide waste, as seen in Figures 6 to 8.

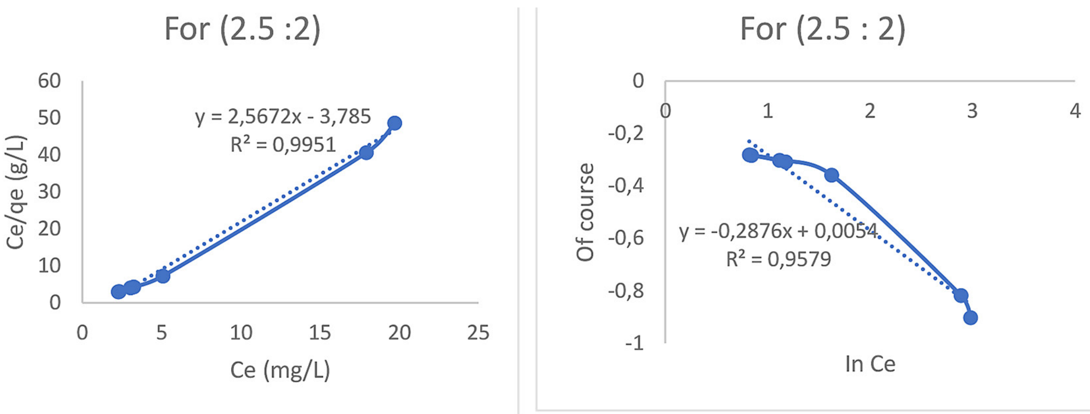
Figures 6 to 8 can be analyzed using an isotherm model to obtain constants and correlation coefficients for the Langmuir and Freundlich isotherm patterns as shown in Table 2.

From Table 2 it can be seen that Langmuir isotherm and Freundlich isotherm model data related to the reduction of single ion concentration of Fe(II) by TKKS carbon adsorbent and carbide waste mix ratios (2:2.5), (2.5:2) and (2.5:2.5), in the batch system at 27 °C. Langmuir and Freundlich Isotherm's approach to data when viewed from the correlation coefficient "R^2". It can be seen that the mixture with a ratio of 2.5:2 (2.5 EFB



(a) (b)

Figure 6. Langmuir isotherm adsorption model (a) and (b) Freundlich isotherm for comparison (2 carbon TKKS and 2.5 carbide waste)



(a) (b)

Figure 7. Langmuir isotherm adsorption model (a) and (b) Freundlich isotherm for comparison (2.5 carbon TKKS and 2 carbide waste)

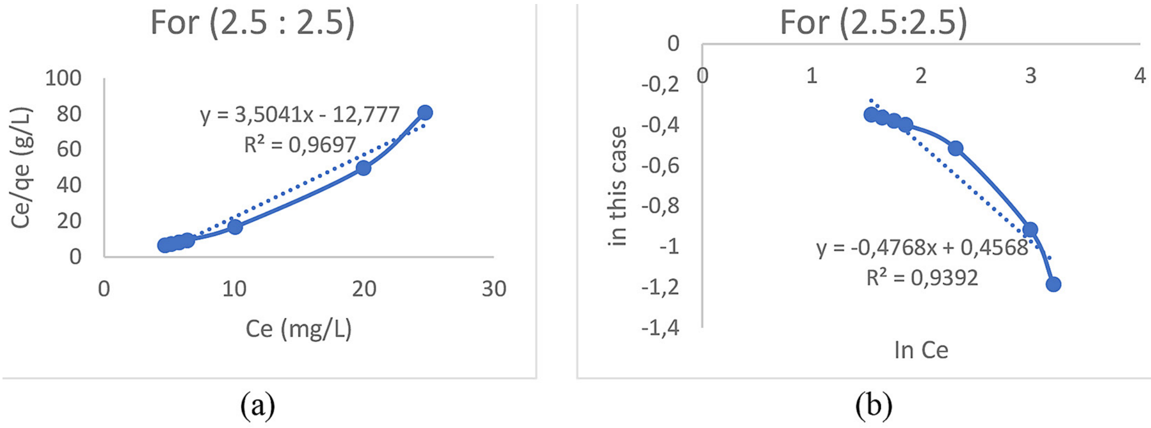


Figure 8. Langmuir isotherm adsorption model (a) and (b) Freundlich isotherm for comparison (2.5 carbon TKKS and 2.5 carbide waste)

Table 2. Isotherm parameters for removing Fe metal

Mixture adsorbent	Langmuir isotherm		
	q_m	K_L	R^2
2: 2.5	0.205	0.163	0.932
2.5:2	2,258	0.263	0.995
2.5:2.5	0.284	0.268	0.934
Mixture adsorbent	Freundlich isotherm		
	1/n	K_f	R^2
2: 2.5	0.679	0.024	0.911
2.5:2	0.280	4,349	0.950
2.5:2.5	0.477	0.783	0.968

carbon and 2 carbide waste), for the Langmuir isotherm pattern provides the best fit to the experimental data compared to Freundlich, for the non-competitive Fe(II) adsorption model. This can be seen in Figure 5a. For the Langmuir isotherm, the Equation $y = 0.3882x + 1.4823$ is obtained with a value $R^2 = 0.995$ when compared with the Freundlich isotherm with the Equation $y = -0.2804x - 0.0133$ and a value $R^2 = 0.95$. This n >1 (one) value indicates that the Freundlich isotherm adsorption process takes place physically (Tanaydin & Goksu, 2021; Zhou et al., 2019). From these results, it can be said that the Fe(II) ion adsorption process using a mixed adsorbent of carbon waste and EFB carbide is homogeneous. Because the Langmuir isotherm pattern assumes a homogeneous adsorbent surface. So the Langmuir isotherm adsorption process shows the best suitability for the Fe(II) metal ion adsorption process carried out using a batch system. To express the Langmuir adsorption isotherm, you can use the separation factor or dimensionless equilibrium parameter, R_L. In these conditions the value R_L obtained is 0.556. The separation factor value $R_L < 1$, indicates that the Langmuir isotherm form obtained is in the very good category and is suitable for use in the Fe(II) reduction process. The results of research conducted by Eletta et al. (2023), using cocoa pod skins to remove iron metal (Fe), the adsorption capacity was 85.32% with Langmuir isotherm constant q_m = 0.0153 mg/g, b = 0.9310 L/g and R^2 = 0.783. The Freundlich isotherm values obtained K_f = 3.8815 mg/g, n values = 0.09 and R^2 = 0.948.

CONCLUSIONS

In this research, it has been proven that adsorbent materials from waste such as carbon from empty oil palm fruit bunches and carbide waste are quite good for reducing Fe metal in textile wastewater. Based on research that has been carried out, increasing the contact time from 30 to 150 minutes can significantly increase the percentage of Fe(II) metal removal. namely 94.33% in the 2.5:2 adsorbent variation. The final concentration of Fe(II) metal began to decrease at a contact time of 30 minutes, then at a contact time of 90 minutes to 120 minutes, it was generally stable. Contact time of 90 minutes shows the highest adsorption capacity value, namely 0.75 mg/L. The Langmuir isotherm pattern provided the best fit to the experimental data compared to the Freundlich. For the Langmuir isotherm, R^2 = 0.995 the Equation y = 0.3882x + 1.4823 is obtained with a value of R_L = 0.556. Meanwhile, the Freundlich isotherm has the Equation $y = -0.2804x - 0.0133$, and value R^2 = 0.95. From these results, it can be said that the adsorbent mixture of carbon EFB and carbide waste is homogeneous. EFB is suitable for the adsorption process of Fe(II) ions on textile limbs.

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