Retraction

Retraction: Contaminated water treatment with Activated charcoal build from cocoa pod husk (IOP Conf. Ser.: Mater. Sci. Eng. 1145 012027)

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This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

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IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

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Contaminated water treatment with Activated charcoal build from cocoa pod husk

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Abstract. In this world, effluents released from the refinery affect the environment at major as different studies says that the natural agents have high capacity to absorb bivalent metal ions. Cocoa pod husk is widely produced in south India in minimum cost. During this study, the metal such as lead and copper was investigated. The cocoa pod husk is carbonized at five hundred degree Celsius and saturated with one molar hydrochloric acid at seven hundred degree Celsius in muffle furnace for two hours (atomic number-6). The final product is allowed to test by adsorbing the metals such as lead and copper to make different pH, dosage and contact time. The capacity to adsorb and metal removal percentage were documented when the contact time reaching two hours. The efficiency of the adsorbent to remove the heavy metal lead and copper was 78% and 97% respectively.

1. Introduction
Waste water is the main by-product by the company’s production sector which is being releasing into the environment [1]. One of the products like cocoa is used to adsorb the metals such as lead and copper present in the industrial waste water at high rate. The water from the industry should commit to treatment before being discharged [2-5]. Waste water is not only from the mining industries, but also from the food and drink enterprises, fabric industry producing garments, electronics manufacturing industry using persistent organic pollutants, cleat on our feet, motor vehicles we drive. The effluent from the firm must be treated before allowing it back into the nature-land and seaways and for recycling purpose. Here are just a few sources of waste water discharge: Metal finishers, industrial laundries, chemical manufacturing [6], mining, steel iron production, oil and gas leaking, power plants, waste water treatment plants, food processing etc., From the survey of last twenty years around the world, the pollution caused by the industrial effluents by-product such as lead, copper, chromium, mercury, cadmium is rapidly increased affecting the surroundings [7]. The ultimate goal of this study was to evaluate the treatment of industrial waste water and prepare carbon(activated) from cocoa pod husk and evaluate the way of protein adsorption on produced activated carbon.

2. Material and Methods
2.1. Activated carbon
Activated carbon is in the form powdered or granular carbon having a porous structure prepared by carbonization and chemical activation used to purify the waste water allowed into it by adsorption [8]. It used used to purify the variety of application of the gas and liquids like water and food processing [9]. It also has broad range of applications such as industrial pollution control, taste and odour removing agent in food processing. Among the uses, activated carbon is extensively used in treating waste water from industry and ground water. The preeminent effect of activated charcoal is its usage of the porous form. The production of activated charcoal from the cocoa pod husk involves two methods mainly physical and chemical method. Physical method employs carbonization in presence of 

\[ \text{CO}_2 \], stream and air at 620-1000°C to banish the mass of volatile matter. The final output from the carbonization process \([620\text{°C}-920\text{°C} \text{CN}_2 /\text{Ar}]\) is washed, dried and sieved.[10] The cellulosic material is made by infusing finely ground material with concentrated solution of a phosphoric acid or zinc chloride. The mixture is dried and heated at 390°C. The concentration of the chemicals accompanies dehydration prior to degradation minimizing the evolution of tars. The output is washed in-depth to eliminate the chemical form the activated carbon and sorted into different sizes.

2.2. Forms of activated carbon
Granular actuated carbon extending its sizes from 0.2 to 0.5 mm used in gas and fluid stages. Powdered activated carbon is less than .18mm in size used in liquid phase application and gas treatment. Extruded activated carbon used in gas application as it has low pressure drop, less dust content and size ranges from 0.8 to 5 mm.

2.3. Adsorption
Adsorption is the gluing of atoms and molecules from a gas, liquid or soluble solid on a surface creating a film on the surface of the activated carbon by the adsorbate. In other words, process in which material travels from a gas or liquid phase and establish a single-molecular coating on a solid or liquid condensed phase [11]. This process is not broadly used in treating wastewater, but can be used to treatment as the activated have exclusive properties on adsorption. Activated carbon treatment appear as a fancy process for water treatment which has already undergone biological treatment before. The carbon is utilized to eradicate a bit of the staying disintegrated natural issue. Numerous unpredictable natural mixes (VOCs) are harmful, representing a high danger to human wellbeing because of their broad use and event in working environment situations. Diminishing the measure of natural fumes in encompassing air is, in this manner, a significant assignment [12]. Enacted carbons are the most adaptable and as often as possible utilized adsorbents, and fixed beds of initiated carbon, as canisters or channels, are broadly utilized for cleaning debased air. Its enormous interior surface territory and pore volume, its capacity to ingest most natural fumes and ease make actuated carbon one of the most reasonable adsorbents [13].

2.4. Cacao (Theobroma cacao)
Cocoa (Theobroma cacao) is indigenous to South America. The Mayas, Toltecs and Aztecs knew the plant more than 3000 years ago. Theobroma bi-colour was known to Maya (one of the Indian races in America) as there is evidence to show that the Mayas in South America were cultivating cocoa which was wild and inferior in quality. Cocoa thus has one of the oldest histories among crops cultivated by man. It was only during seventeenth and eighteenth centuries that the cocoa tree was introduced to many other sub-tropical countries. As a perennial tree crop, it is traditionally and still predominantly cultivated beneath a diverse shade cover. The shaded system enhances the soil, protects it from erosion, provides non-cocoa products to the farmer and a refuge to an array of animal groups like birds, insects, small mammals, and reptiles as it provides a fine biodiversity within the system. It was introduced to Southern India during the present century mainly as an intercrop of coconut and areca nut gardens as it was found that the climate within the gardens is conducive to cocoa growth [14]. Cocoa trees grow best in the tropical rainforests. The cocoa tree grows to a height of 15 – 25 ft. The pods are 10-18 cm in diameter, having thick leathery rinds containing 20-50 beans inside in rows. The seeds are embedded in white or pinkish pulp.
2.5. Carbonization of cocoa pod husk
Cocoa shell collected from nearby scrubland was left in open area allowing it to dry and is artificially initiated, by the expansion half corrosive with consistent stirring. The cocoa gathered from the open dried area and placed in muffle furnace at 550°C for nearly seven hours. Then the resultant is double washed with water and soaked in 15% baking soda to throw out the presence of residual acid from the pores of the charcoal [15]. Repeatedly the fabric dried in hot air oven at 100°C for twelve hours after it attains pH of 7.0 when washed. The material from the oven is taken out and sieved with 150 μm sieve and kept unconsidered in tight and impermeable container.

2.6. Chemical activation process
The carbon sample from the carbonization was sieved by allowing it to pass through the pores of 0.2-2 mm in the mesh. Chemical activation of the sample is done by adding 250 mL of two molar concentration of hydrochloric acid in 100 grams of sieved carbon and heated for a day (24 hours). The sample is allowed to cool at certain degree. The slurry was washed with diluted acid followed by drying at seven hundred degree Celsius for two hours. The sample is deposited in airtight container or vessel allowing to dry. The drain water sample was collected from the BPCL Kochi refinery, Karimughal Road Thrippunithura, Ambalamugal, Kochi, Kerala. A fifty millilitre of the drain water was composed and evaluated.

3. Instrument Set-up (Atomic Adsorption Spectrometer)
The Atomic Adsorption Spectrometer was switched on and also the element, Hollow cathode lamp within the lamp holder was lighted. The instrument was permitted for getting ready around thirty minutes. The system is measured and the five points measuring standards was done. The sample blank was set on to be zero. The sample, standards is also achieved. The pc console gives out the reading digitally for required concentration in ppm to specimen. The standard intensities were monitored.

3.1. Adsorption Experiment
In this investigation, 50 mL of emanating water test gathered from the processing plant containing blended metals 3.56 mg/L of copper, 2.941 mg/L of lead, pH of 6.27 was monitored according to metal concentration. The drain water is added to 50ml shake flagon containing activated carbon prepared from cocoa husk. Hydrochloric acid of 1 molar concentration was used to adjust the pH of the solution. The adsorbent is placed in the mechanical shaker at 27°C running at a pace of 1000 pm. The atomic absorption spectrometer (AAS) examines the concentration of metals, the solution was filtered manipulating a 0.4 μm filter paper. Reading forms the atomic adsorption spectrometer was recorded. For figuring out the adsorption limit and metal expulsion rate (R%) the utilization of various adsorbent time (0.5,1,1.5, 2 hours) at encircling inversion. To process the adsorption limit and evacuation rate (R%) balance pH is applied as before.

4. Results
Material produced: cocoa pod granular activated carbon (GAC); particle size: 1.00 - 1.70 mm; Measured weight(M): 2.0 g; and Measured volume: 50 ml. Tables 1- 7 shows the results produced.

Table 1. Concentration of copper and lead in the waste water from the refinery

| S.No | Cu (ppm) Before Adsorption | Pb (ppm) Before Adsorption | pH Before adsorption |
|------|---------------------------|----------------------------|----------------------|
| 1.   | 3.570                     | 2.935                      | 6.25                 |

Table 2. Effect of pH

| S.No | pH values | Cu (ppm) After Adsorption | Pb (ppm) After Adsorption |
|------|-----------|---------------------------|---------------------------|
| 1.   | 2         | 2.714                     | 1.680                     |
Table 3. Effect of contact time on adsorption

| S.No | Contact Time (min) | Cu (ppm) After Adsorption | Pb (ppm) After Adsorption |
|------|-------------------|---------------------------|---------------------------|
| 1.   | 30                | 3.004                     | 1.978                     |
| 2.   | 60                | 1.489                     | 1.037                     |
| 3.   | 90                | 0.450                     | 0.391                     |
| 4.   | 120               | 0.043                     | 0.031                     |

Table 4. Effect of the dosages on adsorption

| S.No | Degree | Cu (ppm) After Adsorption | Pb (ppm) After Adsorption |
|------|--------|---------------------------|---------------------------|
| 1.   | 1      | 2.860                     | 1.844                     |
| 2.   | 2      | 1.045                     | 0.693                     |
| 3.   | 3      | 0.027                     | 0.006                     |
| 4.   | 4      | <0.001                    | <0.001                    |

Adsorption capacity (qt) and metal removal percentage (R%)  
Initial concentration for copper, Cu = 3.570; Initial concentration for lead, Pb = 2.935; Mass of adsorbent(g) = 2.0 g and volume of metal solution in shake flagon=50 mL. The adsorption capacity of the adsorbent and the metal removal percentage (R %) is shown in below table.

Table 5. Effect of pH variation on qt and R (%)  

| S.No | pH Values | Copper | Lead |
|------|-----------|--------|------|
|      |           | qt (mg/g) | R (%) | qt (mg/g) | R (%) |
| 1.   | 2         | 21.36  | 23.41 | 31.39  | 42.67 |
| 2.   | 4         | 59.22  | 66.49 | 54.90  | 74.68 |
| 3.   | 6         | 88.19  | 95.91 | 73.22  | 99.58 |
| 4.   | 8         | 0      | 0     | 0      | 0     |
Table 6. Effect of contact time on $q_t$ and $R$ (%)

| S.No | Contact Time (min) | Copper   | Lead     |
|------|--------------------|----------|----------|
|      |                    | $q_t$ (mg/g) | $R$ (%) | $q_t$ (mg/g) | $R$ (%) |
| 1    | 30                 | 13.96    | 15.67    | 25.96       | 32.658  |
| 2    | 60                 | 51.82    | 58.13    | 47.52       | 64.61   |
| 3    | 90                 | 77.91    | 87.43    | 63.82       | 86.80   |
| 4    | 120                | 88.12    | 98.88    | 72.86       | 99.07   |

Table 7. Effect of the dosage on adsorption capacity and metal removal percentage

| S.No | Weight Variation (g) | Copper   | Lead     |
|------|----------------------|----------|----------|
|      |                      | $q_t$ (mg/g) | $R$ (%) | $q_t$ (mg/g) | $R$ (%) |
| 1    | 1                    | 17.64    | 19.78    | 27.46       | 37.34   |
| 2    | 2                    | 62.95    | 70.64    | 56.14       | 76.33   |
| 3    | 3                    | 88.54    | 99.35    | 73.45       | 99.84   |
| 4    | 4                    | 0        | 0        | 0           | 0       |

5. Discussion

5.1. Effect of adsorbent dosage

Adsorption capability increases with the increase in adsorbent dosage from one to three grams. The maximum capability of the adsorbent recorded for copper was ninety-one mg/g and for lead was seventy-six mg. Increment in the adsorbent higher than three grams resulted in sudden fall from the maximum value to zero in the graph (figure 1). As there were lot of areas available in the market for metal extension, Expectation with the increase in adsorption capability with increase in adsorbent was frustrated. It was found that increment in the adsorbent dose forms an external thick layer in the cells, protecting the cells from the metals. Figure 2 shows the Effect of dosage.

![Figure 1. Effect of Dosage after adsorption](image1)

![Figure 2. Effect of dosage on $q_t$ and $R$%](image2)

5.2. Effect of pH

The initial value of copper and lead was 23 mg/g and 31 mg/g respectively at pH of the solution was 2 as shown in Figure 4. When the pH of the solution was increased to 6, the adsorption capacity showed its maximum for copper at 90 mg/g and for copper at 73 mg/g. But the adsorption capacity drops to 0
when there is increment in pH more than six. This implies that the adsorption capacity decreases with increase in pH greater than six. The adsorbent surface layer becomes particles loaded with negatively charged ions making larger metal removal. It can be concluded that metal ionic becomes less consistent normal process of metal ions inflated with increment in hydrogen ion. Figure 3 shows the Effect of pH.

![Effect of pH](image1)

**Figure 3.** Effect of pH

5.3. *Effect of contact time*

Contact time of the adsorbent with the drain water is an important factor in adsorption process. If the time increases the measure of metal ions increases. For the initial 30 minutes of contact time, a rapid metal reduction with further increase in time. The metal removal share approached equilibrium at intervals a hundred and fifteen min for metal and one hundred twenty min for metal as shown in Figure 6. For initial concentration, the adsorption rate increases quickly and the optimum efficiency reached within one hour. Uptake of metal ion initiated with rapid intake at first finally the subsequent slow uptake. The quick surface assimilation of the initial stage was in all probability because of the initial concentration gradient between the adsorbent in resolution. It had been determined that the superficial ability attains equilibrium for every metal with lead ninety-nine and copper ninety-seven. Figure 5 shows the Effect of Contact time after adsorption.

![Effect of contact time after adsorption](image2)

**Figure 5.** Effect of Contact time after adsorption

![Effect of contact time on qt and R%](image3)

**Figure 6.** Effect of contact time on qt and R%

6. Conclusion

An audit of shifted agricultural adsorbent given in this shows decent potential for the end of huge metal from squander material. The natural treatment capability depends on the absorbent tested and the both physical chemical properties of the drain water from the industries or home sewage. The metals ions can be easily and efficiently removed by using the agricultural by-products as adsorbents.
These products are available at very cheap rates which has capacity to remove the heavy metal ions such as lead (Pb) and copper (Cu). The powerful removal of the metal ions are variation dependent of pH scale, dose and contact time. We have reviewed the supply and toxicity of significant metals additionally because the reason why they have to be all from the environment, sadly, standard strategies of removal area unit dear and their prices render these strategies uneconomical. To deal with these trends, the employment of low price, teeming and environment friendly adsorbent ought to be inspired. Also, additional studies ought to be administrated to higher perceive the method of these trends, the employment of low price, teeming and environment friendly adsorbent ought to be inspired. Also, additional studies ought to be administrated to higher perceive the method of these trends, the employment of low price, teeming and environment friendly adsorbent ought to be inspired. 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