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Survey of zinc metal processing capability with coal-chemistry activated carbon by chemical K_2CO_3

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ABSTRACT

Seed coat macadamia preparation of activated carbon with chemical agent K_2CO_3 from macadamia shells as per ratio: K_2CO_3: distilled water = 1:1:10ml, optimal temperature condition 650^0C and burning time 60 minutes. Efficiency removal of zinc (II) in wastewater efficiency (53.42%) with the concentration of 25ppm, conducted a survey at pH = 4.5 with 1.8g/l of carbon, treated in 100 minutes. Survey results have similarities with other studies and are applicable to application removal of zinc (II) in wastewater.

Key words**:** *Activated carbon, adsorbed* Zn^{2+}, K_2CO_3, *Macadamia*

1. Introduction

Macadamia trees are the most cultivated Tay Nguyen (Nguyen Dinh Hai, 2011). Each ton of macadamia grain produces (70-77%) shell, porous structure and large surface area (Le Huy Du et al., 1981). Macadamia husk has a higher surface area compared to other seed shells and their ash content is very low (less than 1%) (Xavier et al., 2016). Carbon content of about (85%-95%) (Le Huy Du et al., 1981). Thereby, Macadamia particles can be seen with the potential to become activated charcoal thanks to the above characteristics.

Macadamia activated carbon is applied to remove heavy metals in wastewater such as Hg, Cd, As, Cu, Zn ... are components harmful to the body and animals and the environment (Le Van Khoa 1995). The carboxyl functional groups (C = O), the OH groups represent good adsorption capacity of heavy metals (B. H. Hameed and A. A. Ahmad, 2009), (Minamisawa, Minamisawa, Yoshida and Takai5606 – 5611, 2004), (Kamib, Kabbani, Holail and Olama, 2014)

Zinc exists in heavy metal compounds ZnS, $ZnCO_3$, ZnO, accumulating in soil and dissolved water dispersed into groundwater and polluting surface (Vo Thi Diem Kieu 2015). For aquatic species, a Zn^{2+} concentration of 0.3 mg/l will kill some freshwater fish species (Tran Le Minh, 2012).

Therefore, bioactive carbon is made from Macadamia shell by chemical method using K_2CO_3 agent to activate. In addition, bioactive carbon investigated the adsorption capacity of Zinc metal (Zn^{2+}) in wastewater.

2. Research methodology

2.1. Means of research

- Object of study: Zinc solution (Zn^{2+}) ($ZnSO_4.7H_2O$, 98%, China).
- Chemicals for study: NaOH (China, 96%), HCl (1N - China), K_2CO_3 (China, 99.5%)
- Materials for study: Activated carbon K_2CO_3 from macadamia shells (Dao Minh Trung, Nguyen Thi Thanh Tram, 2019).

2.2. Arrangement of experiments

Experiments 1: Monitoring the processed pH of Zn metal

Metal treatment concentration of Zinc 25ppm, volume of 50ml, fixed dosage of 0.3g/L, fixation time of 60 minutes. Investigation of optimal treatment pH: Zinc metal treatment pH is 2; 2.5; 3; 3.5; 4; 4.5; 5. (Madhava Rao, Chandra Rao, 2007) , (Nasernejad, Esslam Zadeh, Bonakdar, 2004), (Vinod Guptaa , Imran Ali, 1999).

Experiments 2: Monitoring the processed amount of Zn metal

Concentration of 25ppm, volume 50ml, pH Optimum, time fixed 60 minutes. Optimal treatment dosage Survey: Zinc treatment dosages are 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0 g/l (M.Madhava Rao, Chandra Rao, 2007) , (Nasernejad, Esslam Zadeh, Bonakdar, 2004), (Vinod Guptaa , Imran Ali, 1999).

Experiments 3: Monitoring the processed time of Zn metal.

Concentrations of 25ppm, volume 50ml, pH optimum, optimal dosage. Optimal time Survey: 0, 20, 40, 60, 80, 100, 120 minutes (Madhava Rao, Chandra Rao, 2007) , (Nasernejad, Esslam Zadeh, Bonakdar, 2004), (Vinod Guptaa , Imran Ali, 1999).

2.3. Evaluation methodology

- Determine which pH is measured directly using a Mettler Toledo pH meter (2017). Standard TCVN 6492:2011 (ISO 10526:2008) of water quality – Determination of pH
- Zn metal gauge used the: AAS (Atomic absorption spectrometer) according to the atomic absorption spectrum method.

3. Results and discussions

3.1. pH survey on heavy Zn treatment

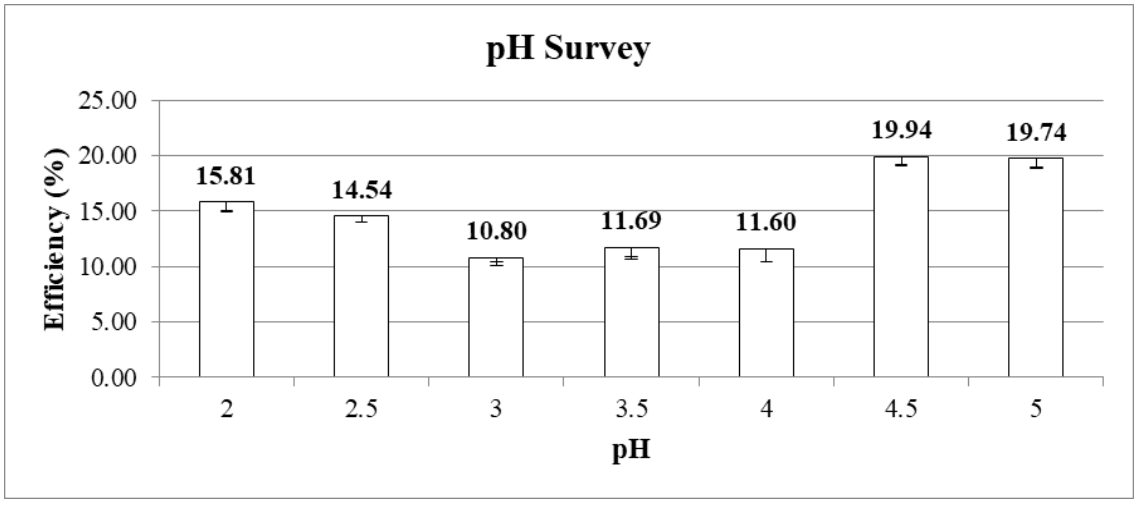

Figure 1. pH survey on heavy Zn treatment

The study result on the ability to treat heavy Zinc of the material according to Figure1, shows that pH ranges from 2-5 with the lowest pH treatment efficiency (10.80%) at pH = 3 and reaches the highest efficiency at pH = 4.5 (19.94%), there is a range from (19.74%) at pH = 5 and pH = 2 (15.81%).

The study result on pH of activated carbon in the treatment of heavy Zinc with the highest efficiency: only (19.94%) lower than some other studies such as: study results of Vinod K. Guptaa , Imran Ali. (1999) using bagasse ash, the ability to absorb heavy metals is higher than that of the study, the treatment efficiency is from (92% - 95%).

Therefore, activated carbon is capable of adsorbing heavy metals effectively at pH = 4.5 with an efficiency of (19.94%). It is necessary to have a suitable dosage of coal for better treatment efficiency.

3.2. Survey of carbon dosage in treatment of heavy Zn

When activated carbon has been determined to be the optimal pH value, it is necessary to conduct the appropriate test of the dosage that is specifically reflected through the chart of Figure 2:

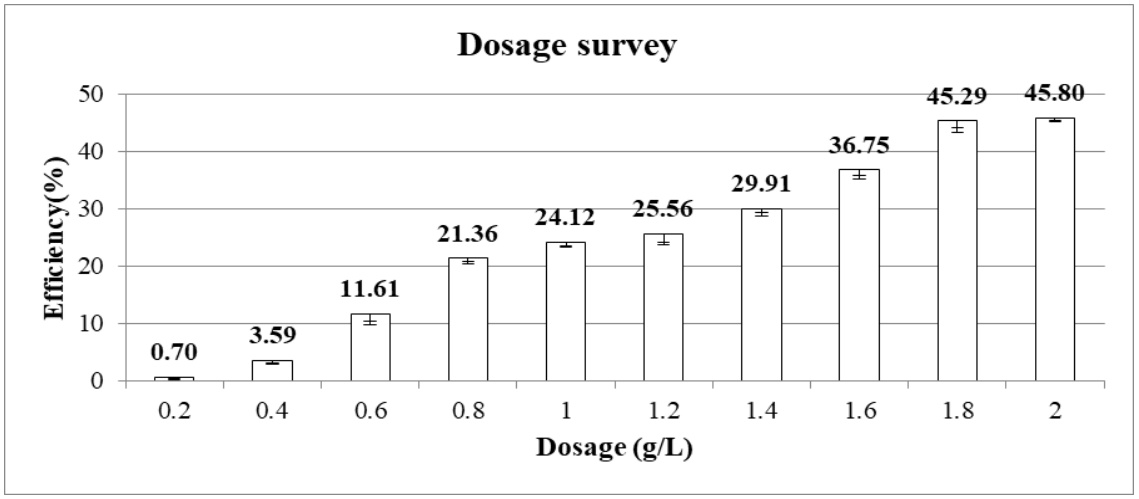

Figure 2. Results of the dose coal survey for heavy metal processing

The process of surveying the carbon dosage during metal treatment at pH = 4.5 shown in Figure 2, is arranged with coal quantity from 0.2, 0.4, 0.6, 0.8, 1, 1.2, 1.4, 1.6, 1.8, 2 with achieved productivity in turn (0.7%, 3.59%, 11.61%, 21.36%, 24.12%, 25.56%, 29.91%, 36.75%, 45.29%, 45.80%). In the process of treatment at 1.8g/l and 2g/l, the ability to handle heavy metals is good and the metal treatment is (45.29%) and (45.80%). But when the dosage is increased to 2 g/l, the adsorption is saturated. The study shows that the optimal metal treatment dosage is 1.8 g/l with a treatment efficiency of (45.29%).

The study results on activated carbon K_2CO_3 from Macadamia shells show that the achievement is lower than some previous studies such as the results of Mustafa Imamoglu*, Oktay Tekir, (2008). The research using rice husk to remove Cu (II) and Pb (II) ions shows that after 60 minutes with 0.3 g/25mL, the effective treatment of metal ions is from (97.2 to 99.6%). the research result of Vinod K. Guptaa , Imran Ali. (1999), shows that the heavy metal removal efficiency in Copper and Zinc from bagasse is (95%).

The metal treatment of carbon is effective at pH = 4.5 and at 1.8g/l with a processing efficiency of (45.29%). To get the best result, we need more time to reach best performance.

3.3. Time survey on heavy Zn treatment

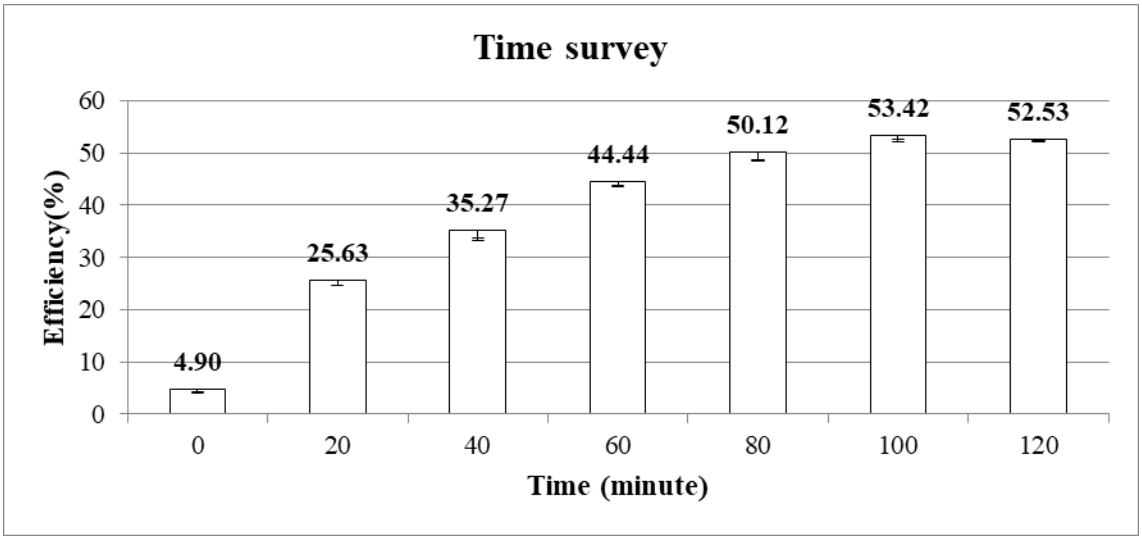

Figure 3. Results time survey on heavy Zn treatment

The process of survey time in handling heavy Zinc at pH = 4.5 and with coal dosage of 1.8g/l shown in Figure 3, are arranged from 0 minutes - 120 minutes, in which the highest processing efficiency is (53.42%) at 100 minutes and the lowest one is (4.90%) at 0 minute. During the 100 minute treatment period, the ability to handle heavy Zinc is good and the treatment is relatively effective in water, but when the time increases into 120 minutes, the efficiency is decreases.

The study result on activated carbon K_2CO_3 from Macadamia shell shows that the achievement is lower than some previous studies such as the result of Mustafa Imamoglu*, Oktay Tekir. (2008). The research using rice husk to remove Cu (II) and Pb (II) ions shows that the efficiency is (94.7% and 91.5%), respectively.

Thereby, it shows that activated carbon K_2CO_3 from Macadamia shell is capable of handling heavy Zinc at pH = 4.5, with the dosage of 1.8g/l and the processing time at 100 minutes have processing efficiency of (53.42%) assumed in a laboratory at the concentration of 25 ppm.

4. Conclusion

The survey result on the ability in heavy Zn treatment of bio-activated carbon is successfully prepared from agricultural residues of macadamia shells by chemical method using K_2CO_3 agent with the maximum activation condition such as the ratio: 1: 1: 10ml, temperature: 650^0 C, activation time: 60 minutes.

The result of determining the three factors affecting the performance shows that at pH = 4.5 with the appropriate amount of 1.8g/l and at time of 100 minutes, the efficiency is up to (53.42%) for heavy metal-containing wastewater (Zn^{2+}) with concentration of 25ppm.

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