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Using modified macadamia carbon by H_2O_2 as adsorbent to remove zinc (Zn^{2+}) in wastewater

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ABSTRACT

Using modified macadamia carbon by H_2O_2 as adsorbent to remove Zn^{2+} with H_2O_2 25% in 48 hours. The Parameters, such as pH, dosage and adsorption time affect the processing ability of modified macadamia carbon H_2O_2. The maximum removal efficiency of 64.52% was obtained at a pH of 4.5, the processing time is 80 minutes, dosage 1.8 g/L and an initial heavy metal concentration of 25ppm.

Keywords: *adsorption, H_2O_2, Zinc metal, macadamia, modified carbon*

1. Introduction

Macadamia trees are planted stretching from Ba Vi (Hanoi) to the Tay Nguyen, the area used to grow Macadamia is up to 10,000 ha until 2020. Every ton of macadamia has created 70 - 77% of the shell (Nguyen Cong Tan, 2009). In Macadamia shell contains many properties to make denatured coal such as content of cellulose in the shell accounts for about 41.2% (Rakesh Kumar et al., 2013), oxygen content 46.52%, Hidro content 6.10%, nitrogen content 0.36% and relatively low ash content of only about 0.22% (Nguyen Cong Tan, 2009).

Adsorbent materials from agricultural waste has the advantages of low price, available in natural and redundant in the process of agricultural production, requires less

processing, the material can be reused so when used to treat heavy metal in water will reduce investment costs, thereby reducing the cost of wastewater treatment.

Adsorbent was used extensively in the coal wastewater treatment is modified, removing the dangerous metals such as: Hg, Cd, As, Cu, Zn,... Removal of toxic metals in the air, improve groundwater sources, solvent recovery (Irem Okman et al., 2014). Many research indicate that some materials such as rice bran (Xue-song Wang and Yong Qin, 2003), the orange peel (Sha Liang et al., 2009), shell peanuts (Srinath Chamarthy et al., 2001), chrome wheat (Milan Gorgievski et al., 2013), cassava (Horsfall Jr, Abia & Spif, 2006), bagasse (Vinod Gupta & Imran Ali, 2000), inorganic (Daud & Ali, 2004), coconut (Daud & Ali, 2004) ... are capable of removing heavy metals in solution.

Zinc metal is highly toxic because it is carcinogenic and mutagenic in nature (Moore & Ramamoorthy, 1984). Zinc exists in water-soluble form, which is very dangerous for human health when zinc poisoning has abdominal pain, leg veins, seizures. For other types of aquatic, Zn^{2+} concentration equal to 0.3 mg/l will kill some species of freshwater fish (Tran Le Minh, 2012). Zinc is required in small quantities but when it exceeds the limit prescribed it can also adversely affect human health (Gül, Yilmaz & Isilak, 2009). The removal of toxic metal ions is a difficult task due to the high cost of treatment methods (Weng & Huang, 1994), especially for less developed countries.

Therefore, biologically modified coal obtained from Macadamia shell by H_2O_2 chemical agents being studied metal adsorption capacity of zinc (Zn^{2+}) in wastewater assumptions.

2. Materials and methods

2.1. Materials

Research object: Solution Zinc (Zn^{2+}) ($ZnSO_4.7H_2O$, 98%, China, 25ppm).

Research chemicals: H_2O_2 (China 30%), Sodium Hydroxide (China, 96%), HCl (1N - China).

Research material: Modified macadamia carbon by H_2O_2.

2.2. Experimental methods

Experiment 1: According to Vinod K. Gupta and Imran Ali (2000), Madhava Rao et al. (2007), Nasernejsf et al. (2004) **s**urvey pH: 2; 2.5; 3; 3.5; 4; 4.5; 5. The concentration of 25ppm, volume 50ml, fixed doses of 0.3 g/L, fixed time 60 minutes.

Experiment 2: According to Vinod K. Gupta and Imran Ali (2000), Madhava Rao et al. (2007), Nasernejsf et al. (2004) survey dosage: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0 g/L. The concentration of 25ppm, volume 50ml, pH optimum, fixed time 60 minutes.

Experiment 3: According to Vinod K. Gupta and Imran Ali (2000), Madhava Rao et al. (2007), Nasernejsf et al. (2004) survey time : choose time from 0, 20, 40, 60, 80, 100, 120 min. Concentration of 25ppm, volume 50ml, pH optimum, the optimal dose.

2.3. Method of evaluation

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.

The Zn metal meter uses the AAS (atomic absorption spectrometer) according to the atomic absorption method.

3. Results and discussion

3.1. Investigate the appropriate pH for processing

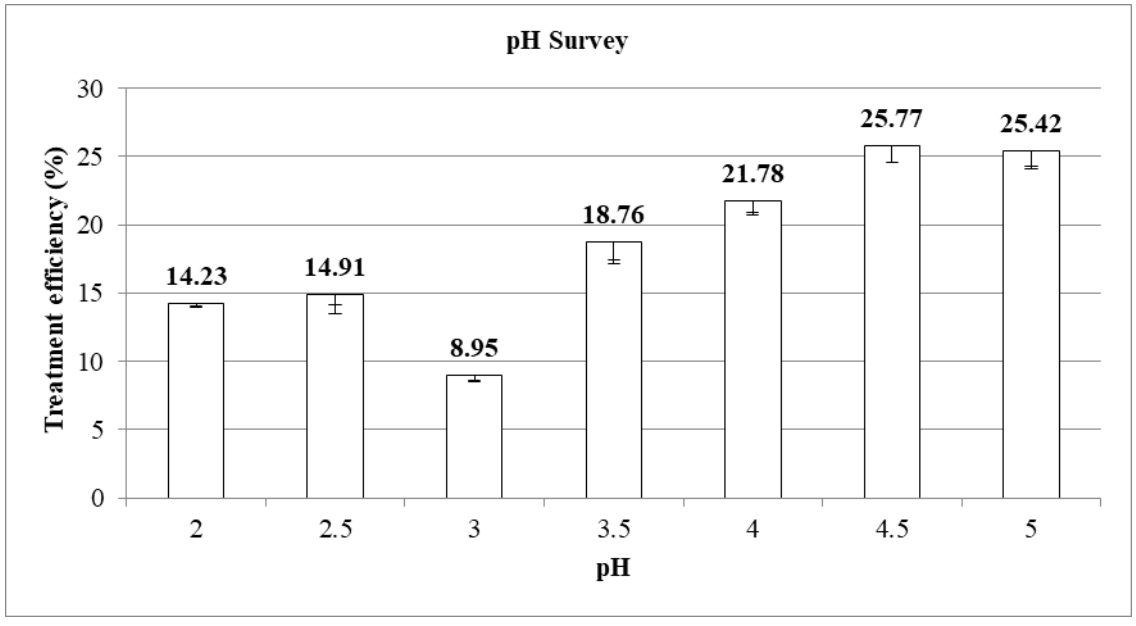

Figure 1 . *Heavy metal processing pH survey chart*

From the research results Figure 1 shows that pH ranges from 2-5 with the lowest pH treatment efficiency (8.95%) at pH = 3 and achieve maximum efficiency (25.77%) at pH = 4.5, with access to knives active at pH 5 is 25.42% and pH = 2 (14.23%)

The research results of the pH of modified macadamia carbon which has the best heavy metal processing capability Zn at about pH = 4.5 with a performance of 25.77% lower than some other research such as: research results using bagasse fly ash by the authors Vinod K. Gupta and Imran Ali (2000) has the ability to absorb zinc metal processor performance with 94% at pH = 5. The research results of the authors Madhava Rao et al. (2007) have used the shell Pentiba to remove metal ions Zn^{2+} at pH = 6, the performance gain is 99.1%. The research results of Dao Hong Tham (2015) use

denatured Cellulose extracted from bamboo chips as adsorbent of Zn^{2+} ions in water at pH = 5 achieved performance is 67.86%.

Therefore, modified carbon adsorption capacity with heavy metals effectively at pH = 4.5 with 25.77% performance gain is selected as the optimum pH for the following experiments.

3.2. Investigate the appropriate dosage for the treatment process

When the modified macadamia carbon has been determined the optimal pH value needs survey conducted experiments proper dosage is expressed through specific chart Figure 2:

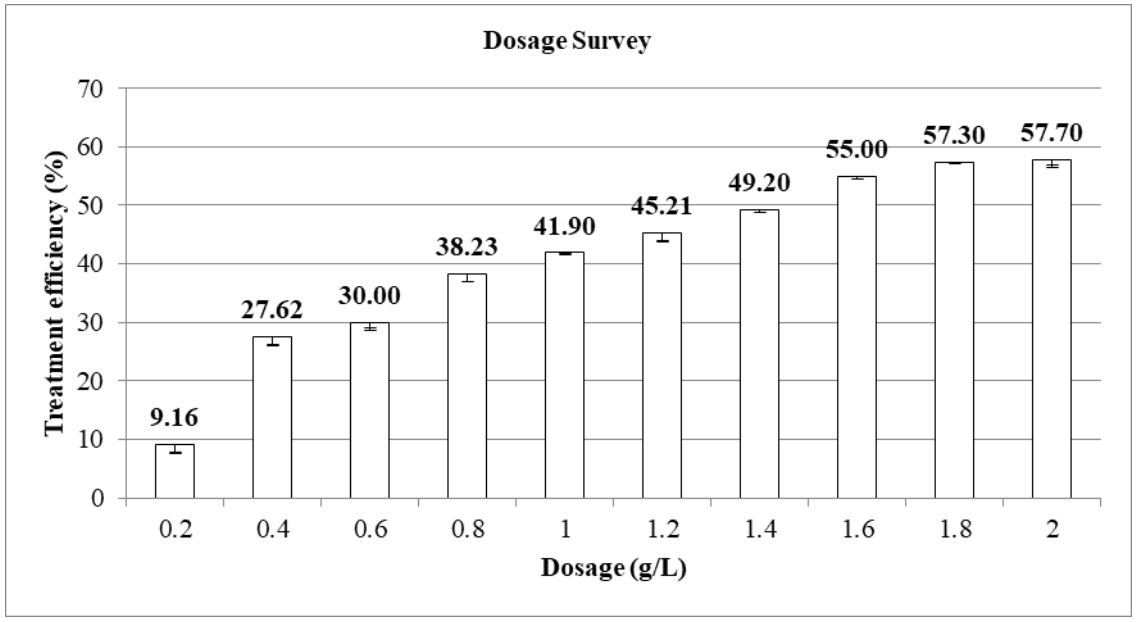

Figure 2. *Determination of dose effect on Zn metal treatment performance of H_2O_2 modified macadamia carbon*

Survey process dosage of coal in the process color at pH = 4.5 is shown in Figure 2 arranged with the amount of coal from 0.2, 0.4, 0.6, 0.8, 1, 1.2, 1.4, 1.6, 1.8, 2g/l has the following performance: 9.16%, 27.62%, 30.00%, 38.23%, 41.90%, 45.21%, 49.20%, 55.00%, 57.30%, 57.70%. During the treatment process at dosage 1.8 g/l and 2g/l the ability to handle heavy metals well and treatment was 57.30% metal and 57.70%. The survey showed that when increasing the dosage to pass 2g / L, the absorption capacity is saturated, so the optimal metal treatment dose reaches 1.8g / L with the handling efficiency of 57.30% determined for the experiments next experience

Results of research on modified macadamia carbon by H_2O_2 shows results higher results than some previous studies such as the research result of the authors Madhava Rao et al.

(2007) using Pentiba shell to remove Zn^{2+} metal ion in pH = 6, the dosage of 10g/l shows the efficiency is 99.1%. The research results of Dao Hong Tham (2015) use denatured Cellulose extracted from bamboo chips as adsorbent of Zn^{2+} ions in water at pH = 5, the dose of 3g/l achieved performance is 88.67%.

Metal processing of coal efficiency and good at pH 4.5 optimal and dosage is 1.8g/l with 57.30% efficiency. For best processing results, it is necessary to investigate the optimal processing time to get the best performance.

3.3. Surveying the appropriate time for processing

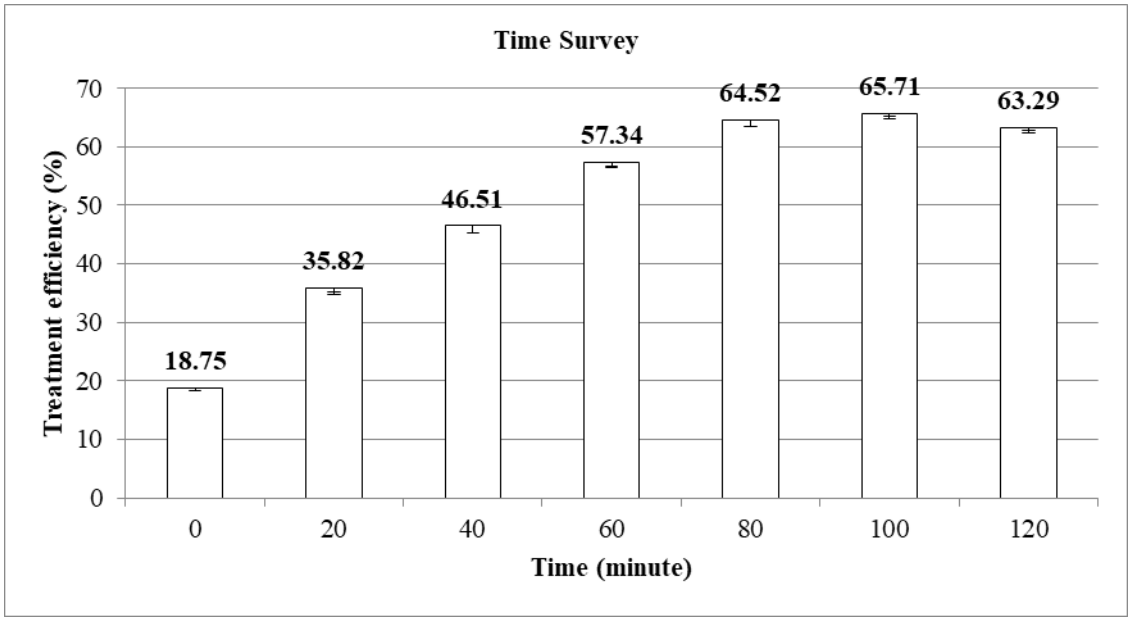

Figure 3. *Results determine the effect of time on Zn metal processing efficiency of H_2O_2 modified macadamia carbon*

Time survey process in handling heavy metals at pH = 4.5 and Zinc dosage coal is 1.8g/l shown in Figure 3 is arranged processing time from 0-120 minutes with the highest processor performance is 65.71% at time 100 minutes, but in 80 minutes processing time also gives high processing efficiency of 64.52%. If 20 minutes which increased processing performance increased just over 1%, the economic was unreasonable. To save time, select a time of 80 minutes is most suitable for modified macadamia carbon H_2O_2 metal processing.

These results are lower than the research result of Nasernejsf et al.(2004) show that the adsorption capacity of Zn in carrot residues reach 75% efficiency in 10 minutes and reached base in after 70 minutes. The research result by Madhava Rao et al. (2007) using shell Pentiba to remove metal ions Zn^{2+} at pH = 6 shows in the first 10 minutes

processing performance reaches 60 - 70% and reach equilibrium is at 50 minutes. The research results of Dao Hong Tham (2015) use denatured Cellulose extracted from bamboo chips as adsorbent of Zn^{2+} ions in water at pH = 5, the dose of 315 mg/l, in 90 minutes to reach the performance is 71.33%.

Thereby, it shows that the modified macadamia carbon H_2O_2 is capable of processing metal sign at pH = 4.5 Zinc well, dosage 1.8g/l and 80 minutes processing time achieving performance is 64.52% processor is assumed the laboratory with concentration 25ppm.

4. Conclusions

The research results prepared materials modified macadamia carbon by H_2O_2 agent with optimal denaturing conditions as concentrations of 25%, while denatured 48 hours. Results identified three factors that influence the performance showed that at pH 4.5 with charcoal appropriate dose of 1.8g/l in 80 minutes it can be treated with efficiency of 64.52% for metal-containing wastewater containing metals Zn^{2+} concentration of 25ppm.

Through the analysis results, modified carbon is prepared from macadamia shell by H_2O_2 capable of handling Zinc metal

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