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International Journal of Current Research
Vol. 7, Issue, 08, pp.18926-18928, August, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

EFFECTIVENESS OF ACTIVATED CARBON MADE FROM COCONUT SHELL AND BAMBOO TO REDUCE IRON LEVEL (Fe) IN THE WELL WATER

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ARTICLE INFO

Article History:
Received 28th May, 2015
Received in revised form
30th June, 2015
Accepted 16th July, 2015
Published online 21st August, 2015

Key words:

Activated Carbon,
coconut Shell,
Bamboo,
Ironcontent,
Water Wells.

ABSTRACT

High concentration of iron in the water can cause technical and health problems. Activated carbon can be used to reduce iron levels in the water by absorption process. A variety of activated carbon can be made from many materials including coconut shells and bamboo. The purpose of this study was to compare the ability of activated carbon made of coconut shell and bamboo, in reducing iron contents of the well water. Experimentation was designed with pre and post-test control. The population of this study was well water with relatively high iron contents, whereas the sample was well water taken from the population. Data were collected by investigating the iron contents of the well water before and after contact with activated carbon. Data were processed and analyzed using independent T- test. The result showed a p 0.001 which means that there are differences in the ability of the activated carbon made of coconut shell and bamboo in reducing the iron contents of the well water,. Bamboo activated carbon could reduce iron contents of well water by 87.77 % while the coconut shell activated carbon 79.62 % . It can be concluded that bamboo activated carbon could reduce iron contents in the well water more effectively than coconut shell activated carbon.

Citation: Tati Ruhmawati, Chandra Ferdiansyah, and Elanda Fikri, 2015. "Effectiveness of Activated Carbon Made from Coconut Shell and Bamboo to Reduce Iron Level (Fe) in the Well Water", *International Journal of Current Research*, 7, (8), 18926-18928.

INTRODUCTION

One of the parameter to determine the quality of ground water is iron (Fe) concentration. High level of iron content in the water could cause several health (Parulian, 2009) and technical issues (Oktiawan, 2007) if continuously consumed. Many methods have been used to reduce the iron level in the water, one of the method is through absorption process. This study conducted to compare the ability of carbonised coconut shell and bamboo to absorb iron content in the water.

MATERIALS AND METHODS

The type of research was experimental study with pre and post-test design with control. The purpose of the study was to find out the ability of activated carbon made of coconut shell and bamboo in lowering the iron content in the well water. The research variables include dependent variable, independent variable and confounding variable. Independent variable is the different ability of activated charcoal made of coconut shell and bamboo, while the dependent variable is the iron content in the wells water and confounding variables are pH, temperature, quality of wells water, contact time and the diameter and thickness of the activated carbon.

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The research was conducted in the laboratory of the Department of Health of Environmental Health Polytechnic Bandung. Sampling in this study was completely randomized sampling, the trial was done only once for each sample with the same conditions and same treatment for all repetition. There were two treatments in this study, namely bamboo activated carbon and coconut shell, with a completely randomized design using the formula ($t (r - 1) \geq 15$) where t is the treatment and r is the repetition, the number of repetitions (replication) was nine times. Data was collected by taking well water sample and then examine (measure) the levels of iron, pH, and temperature before and after contact with activated carbon coconut shell and bamboo. Sampling techniques were done with the principles of sampling for chemical - physical examination using the grab sampling method. Data were processed through the stages of entry, editing and cleaning. At the end, data analysis was performed using independent T-test with normality test beforehand.

RESULTS

Changes in the levels of iron (Fe) in a well water sample before and after contact with activated carbon coconut shell and bamboo can be seen in the Figure 1. Figure 1 shows that the iron level in raw water (before contact with the activated carbon) was 6, 05 mg/L, there was a decrease in iron level after

contact with activated carbon from coconut shell and bamboo to 1.18 mg/L and 0.69 mg/L respectively. The percentage of iron level after contact with activated carbon coconut shell and bamboo can be seen in Figure 2.

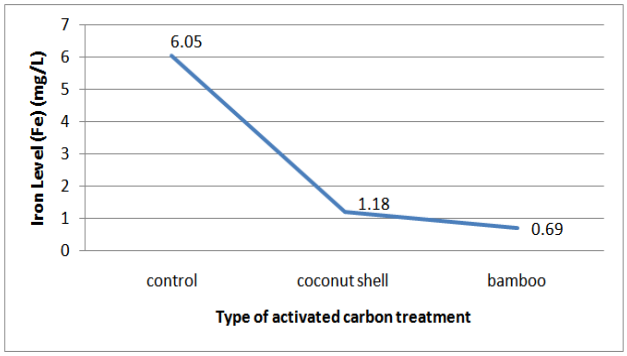

Figure 1. Changes in iron levels (Fe) in Well Water Samples After contact with Activated Carbon from Coconut Shell and Bamboo

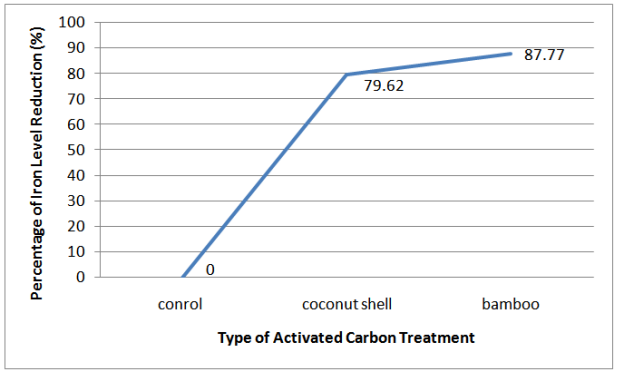

Figure 2 . Percentage of iron level (Fe) in Well Water Samples After contact with Activated Carbon from Coconut Shell and Bamboo

It can be clearly seen in Figure 2 that the activated carbon from coconut shell was able to decrease iron level in well water with the percentage of 79.62 %, while the activated carbon from bamboo was able to decrease iron level in well water with the percentage of 87.77 %. Based on the result data, there was a significant decrease in iron levels in the well water after contact with activated carbon from coconut shell and bamboo. The result from independent T-test showed that $p < \alpha$ ($0.001 < 0.05$), thus the difference between the iron level in well water before and after contact with activated carbon from coconut shell and bamboo was statistically significant ($p<0.05$).

As described earlier, activated carbon is an amorphous carbon that has a large surface area and internal volume. This characteristic gives activated carbon a high adsorptive power that can be used in the application of gas and liquid phase separation system (Cabe *et al.,* 1999, Monika, 2008). Micro-size pores of activated carbon capable of absorbing organic and inorganic substances. Therefore, the dissolved iron or suspended iron in well water can enter into the slit pore and trapped in there. The result of this research shows that activated carbon from bamboo has a greater ability to reduce iron level in well water compared to the activated carbon from coconut shell.

This was resulted from the characteristics of bamboo activated carbon which has more pores so it can absorb more iron particles than activated carbon from coconut shell. In addition, activated carbon from bamboo has lower water content than activated carbon from coconut shell. Water content on activated carbon affect its absorptive capacity (Treybal, 1980; Jusmaniza, 2011; Mui *et al*., 2010; krisdianto *et al*., 2000). Changes in well water temperature before and after contact with activated carbon from coconut shell and bamboo can be seen in Figure 3.The raw water temperature was 23.83^0C. The water temperature increased after contact with activated carbon from coconut shell and bamboo to 23.87 ^{0}C and 23.86^0C respectively. This confounding variable was not significant, because it turns out that the percentage of iron level reduction was high. It can be concluded that the rise of temperature did not interfere the absorption process. Changes in well water pH before and after contact with activated carbon from coconut shell and bamboo can be seen in Figure 4 below.

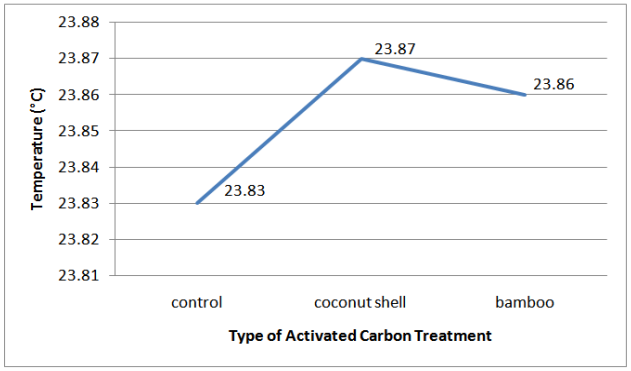

Figure 3. Temperature Changes in Well Water Samples After Contact with Activated Carbon from Coconut Shell and Bamboo

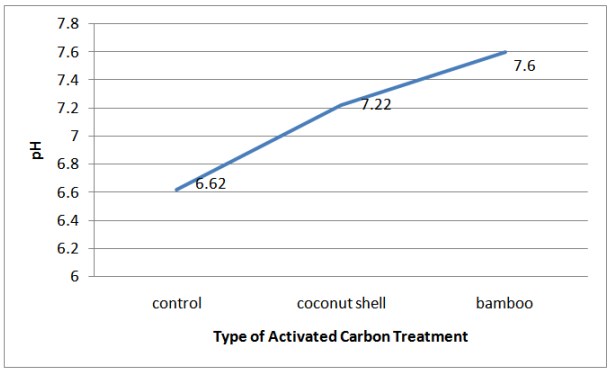

Figure 4. Changes in Well Water pH After Contact with Activated Carbon from Coconut Shell and bamboo

Figure 4 shows the degree of acidity (pH) of raw water (before contact with the activated carbon) was 6.62. After contact with activated carbon from coconut shell and bamboo, pH value was increased to 7.22 and 7.6 respectively. Although the pH value rised, it still in the neutral pH range. The rise in pH value was an indicator of the absorption of iron content in the water into the pores of activated carbon, this process results in the formation of salt, thus affecting pH value (Monika, 2008). pH is an important parameter of metal ion absorption, because it affects the solubility of metal ion.

Absorption capacity increased with increasing pH, it was due to the hydrolysis of the metal during absorption (Baes and Mesmer, 1976).

DISCUSSION

As described earlier, activated carbon is an amorphous carbon that has a large surface area and internal volume. This characteristic gives activated carbon a high adsorptive power that can be used in the application of gas and liquid phase separation system (Cabe, 1999; Monika 2008). Micro-size pores of activated carbon capable of absorbing organic and inorganic substances. Therefore, the dissolved iron or suspended iron in well water can enter into the slit pore and trapped in there. The result of this research shows that activated carbon from bamboo has a greater ability to reduce iron level in well water compared to the activated carbon from coconut shell. This was resulted from the characteristics of bamboo activated carbon which has more pores so it can absorb more iron particles than activated carbon from coconut shell. In addition, activated carbon from bamboo has lower water content than activated carbon from coconut shell. Water content on activated carbon affect its absorptive capacity (Treybal, 1980; Jusmanizah, 2011; Mui *et al*., 2010; Krisdianto *et al*., 2000).

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The limitation of this study is that the sample taken with varied temperature. Another issue is that unlike coconut shell activated carbon, there is no bamboo activated carbon industry existed in Indonesia, home-made product shall be produced but not in a proper procedure. The recommended temperature to produce bamboo activated carbon is approximately 1000ºC which is impossible to be made in home-scale production. This might affect the absorption ability of bamboo activated carbon. The benefit of this study is the based material is easy to be found, affordable, efficient and easy to apply in the community.

Conclusion

Activated carbon from coconut shell can reduce iron content in well water with the percentage of 79.62 %, while activated carbon from bamboo was able to reduce iron levels in well water with the percentage of 87.77 %. Based on independent T test, it was obtained $p<\alpha$ ($0.001<0.05$), thus there was a difference capability of absorption between activated carbon from coconut shell and bamboo charcoal. It can be concluded that activated carbon made of bamboo was more effective in reducing iron content in well water compare to activated carbon made from coconut shell.

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