Study of the Utilization of Heavy Metal Biosorption (Cr, Co, Cu, Fe, Cu, Mn, Ni) with Chitosan from Crab and Kupang Shell Waste

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Abstract. Pollution is defined as the entry of an object, substance or energy into the aquatic environment that has a negative impact on living things. This study aims to determine the adsorbent absorption of crab shell ash and kupang ash to the levels of heavy metal chromium (Cr), CrChromium (Cr), Cadmium (Cd), Cobalt (Co), Iron (Fe), Copper (Cu), Manganese (Mn) and Nickel (Ni) in standard solution. Shell ash is made by calcination using a furnace at 900 ° C for ± 9 hours. The standard solution was added to the shell then stirred and allowed to stand for 8 hours. and for metal analysis using a Serum Spectrophotometer. metal analysis using Atomic Absorption Spectrophotomer. From the results of the study, it was found that the absorption capacity of crab and kupang ash on Fe and Cu metals reached 100%. The absorption capacity of the three metals on Co, Mn and Ni is not too different with values above 99%. Shell ash was able to absorb Cr more than the other compared to other shell ashes with a value of 99.91%.

1 Introduction

Pollution is defined as the entry of an object, substance or energy into the aquatic environment by humans that has a negative effect on the health of living things and their ecosystems. Pollution can be caused by shipwrecks, industrial discharges into waters, marine oil drilling processes, garbage disposal and pesticides from agriculture. Wastes tend to contain toxic chemicals and are harmful to the human body [1–6].

One contamination that can be the subject of pollution is heavy metals. Heavy metals are one of the major pollutants in industrially-derived aquatic effluents. Before discharging their waste streams into the environment, industries must reduce the concentration of such metals below the concentration standards set by the government. Heavy metals such as cadmium, nickel, copper, chromium, etc. can have highly toxic

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effects on living things. Heavy metals can enter the food chain mainly through fish and plants. Plants tend to take up heavy metals dissolved in water, and the metals accumulate in their roots and are then transferred to the parts that can be eaten by humans such as vegetables & fruits [7–11].

Although minimal concentrations of heavy metals are necessary for the body, exceeding the limit is harmful to humans. Nickel, which usually comes from battery manufacturing, can cause chronic asthma, dermatitis and lung cancer. Cadmium, mainly from the alloy industry, and smelting can cause kidney damage. Copper from the electronics industry can cause insomnia, Wilson's disease and liver damage [1–4,10,12–15]. The same as other heavy metals such as chromium, manganese, iron and cobalt are also very harmful to living organisms and therefore, wastewater treatment must be done properly before being discharged into the environment [8,9,14,16,17].

Several methods have been developed to remove heavy metals from wastewater such as ion exchange [18], reverse osmosis [19], solvent extraction [20] and using membrane [21]. However, these processes have certain drawbacks such as high cost, secondary waste generation and limited use in industry.

One technique to reduce heavy metals in wastewater that is widely researched due to its low cost, simplicity, regenerability and effectiveness is adsorption [22]. Adsorption as one of the most convenient methods for wastewater treatment, researchers continue to focus on developing adsorbents that are cheap, effective, environmentally friendly and reproducible. The result is that some shells from marine animals such as crabs and kupang can be used as adsorbents [8–10,15,17].

This study aims to determine the adsorption capacity of crab shell ash and kupang ash on heavy metal levels of Chromium , Cadmium , Cobalt , Iron, Copper , Manganese and Nickel in the standard solution used.

2 Method

The tools used in this study include: KERN ABT 320-4AM analytical balance, Shimadzu AA-7000 atomic absorption spectrophotometer, Thermolyne 6000 furnace, cup, whatman-41 filter paper, magnetic stirrer, sieve, funnel, erlenmeyer, beaker, 500 mL volumetric flask and pipette. The materials used in this study include: clam shells, crab shells, kupang shells, standard solution of Chromium , Cadmium, Cobalt, Iron, Copper, Manganese and Nickel (1000 ppm) MERCK brand, distilled water and HNO3.

2.1 Preparation of crab and mussel shell ash

The process of making crab and kupang shell ash begins with the separation of shells and meat, then rinsed thoroughly and dried, then each shell is ground until smooth or using a grinder. Each shell is put into the furnace at 900 ° C for ± 9 hours. The ash was cooled and then put into a desiccator for 1 hour. Each ash was sieved with a 200 mesh sieve for size homogenization.

2.2 Preparation of Metal Solution

Each standard solution of Chromium , Cadmium, Cobalt, Zinc, Copper, Manganese and Nickel (1000 ppm) was taken as much as 5 mL and then diluted into a 500 mL measuring flask using distilled water containing nitric acid (0.05 M). The solution was metered to the mark and homogenized by flipping the volumetric flask.

2.3 Determination of Absorbency of Crab and Kupang shell ash to heavy metals

Crab shell ash, and shellfish were weighed 2 grams each into a 250 mL Erlenmeyer, then 100 mL of Cr, Cd, Co, Fe, Cu, Mn and Ni standard metal solutions were added. The mixture was stirred and allowed to stand for 16 hours, then filtered with Whatman filter paper. The standard metal solution and filtrate were analyzed using an atomic absorption spectrophoto meter (Shimadzu AA-7000).

3 RESULTS AND DISCUSSION

3.1 Absorben of Crab Shell Ash

Crab shell ash can absorb heavy metals found in standard solutions as shown in Table 1. The absorption capacity of crab shell ash towards Fe and Cu metals is the highest compared to other metals with the standard concentration after contact being less than 0.0002 and 0.0008 ppm, respectively. In addition, other metals such as Cr, Cd, Co, Mn and Ni can also be adsorbed effectively leaving only metals with concentrations of 0.4022, 0.0173, 0.0162, 0.0071 and 0.0125 ppm, respectively.
The results of Absorption Power in this study are supported by previous research, crab shell ash can absorb heavy metals. Crab shell ash can absorb Cu metal significantly, which is 99.75% [23]. These results are not significantly different from this study, where the absorption capacity reached 100%. In addition, another study also showed that crab shell ash can also adsorb Cr metal [24].

Table 1. Metal Content Before Contact with After Contact with Crab Shell Ash

No.	Metal	Metal content (ppm) in solition		
		Before	After	Adsorben (%)
1	Cr	11.0794	0.4022	96.37

2	Cd	5.0158	0.0173	99.66
3	Co	10.7588	0.0162	99.85
4	Fe	8.7478	<0.0002[#]	100
5	Cu	8.6202	<0.0008[#]	100
6	Mn	7.7951	00071	99.91
7	Ni	7.2828	0.0125	99.83

3.2 Absorben of Kupang Ash

Based on Table 2, the absorption capacity of shell ash to heavy metals is quite significant. For example, for Fe and Cu metals, the shell ash is able to reduce the concentration of the standard solution to below the detection limit of the AAS device used, which is less than 0.0002 ppm for Fe metal and 0.0008 ppm for Cu metal. Cr, Cd, Co, Mn and Ni metals can also be absorbed significantly, leaving only standard solutions with concentrations of 0.0096, 0.0143, 0.0129, 0.0098 and 0.0100 ppm, respectively.
The absorption power carried out by the shell ash in this study is also linear with previous studies. Research by Garrigado [25] showed that shell ash can also adsorb Cd, Cu, and Ni metals. In addition, the shell ash can also adsorb Cr metal [26].

Table 2. Metal Content Before Contact with After Contact with Kupang Ash

No.	Metal	Metal content (ppm) in solution		
		Before	After	Adsorben (%)
1	Cr	11.0794	0.0096	99.91
2	Cd	5.0158	0.0143	99.71
3	Co	10.7588	0.0129	99.88
4	Fe	8.7478	<0.0002[#]	100
5	Cu	8.6202	<0.0008[#]	100
6	Mn	7.7951	0.0098	99.87
7	Ni	7.2828	0.0100	99.86

3.3 Comparison of Ash Absorben of Crab and Kupang Shells

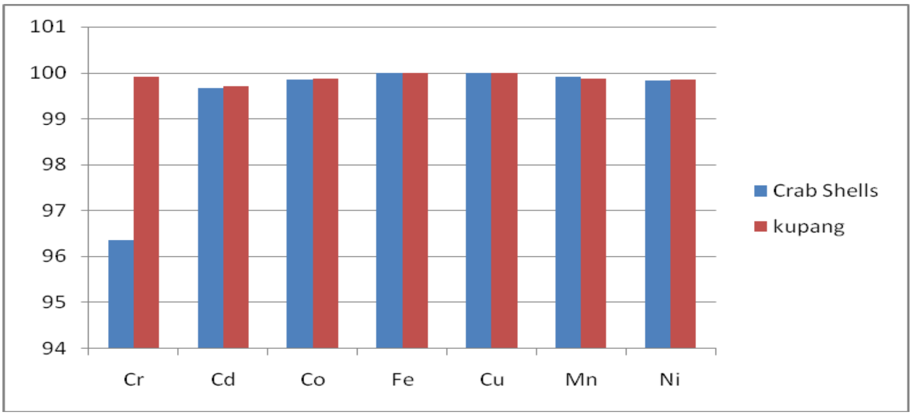

Figure 1. Absorbency of Waste to Metals

The figure above shows the comparison of adsorbent absorption of crab shell ash and shell ash. For Zinc and Chromium metals, the adsorption capacity of the three adsorbents reached 100%. This shows that both adsorbents can absorb these metals maximally. Different results were found for Chromium metal, where the shell ash could absorb more metal than the crab shell ash with a value of 99.91%. The absorption capacity of the two adsorbents for Cadmium, Cobalt, Manganese and Nickel metals is not too different with the absorption value reaching above 99%.

4 Conclusion

The adsorption capacity of crab shell ash and kupang shell ash on Fe and Cu metals reached 100%. The absorption capacity of both metals on Co, Mn and Ni is not too different with values above 99%. Shell ash was able to absorb Cr more than other shell ashes with a value of 99.91%.

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