Jurnal Matematika dan Pengetahuan Alam ISSN 0853-0033
Volume 6, Nomor 1, Tahun 1997

REMOVAL OF MANGANESE ION FROM WATER BY RICE HUSK

(Menghilangkan ion mangan dari air dengan menggunakan sekam padi)

Edison Munaf*, Rahmiana Zein, Novesar Jamarun and Irmanto

Laboratory of Analytical Environmental Chemistry,
Faculty of Mathematics and Natural Sciences, Andalas
University, Padang 25163.

ABSTRAK

Kemampuan sekam padi untuk menghilangkan mangan dari air telah diperiksa. Beberapa parameter yang dapat mempengaruhi pengambilan mangan seperti ukuran partikel, pH, dan temperatur diterangkan disini. Pada kondisi optimum, ion mangan yang dapat dihilangkan dari larutan adalah 96,6%. Metoda ini telah diaplikasikan untuk menghilangkan ion mangan dari contoh air.

Keywords : *rice husk, manganese removal, water samples*

*Author for corresponding.

INTRODUCTION

From the problems of environmental pollution, the removal of toxic and sometimes valuable heavy metals from sewage and industrial and mining streams has become an indispensable need and a keen attention has been paid in recent years. Tough synthetic ion exchanger resins are effective, they are often unsuitable for the mass

removal of heavy metals because their costs are rather expensive. Then, the need for effective and economical removal of these ions resulted in a search for unconventional methods and material might be useful in this field.

Recently, a great deal of attention has been focused upon the use of nonliving biomaterial or agricultural byproduct (Drake and Rayson, 1996) such as apple waste (Maranon and Sastre, 1994), coconut husk (Low et al., 1995), tea leaves (Tan and Majid Khan, 1989), most (Lee and Low, 1989), algal (Mahan et al., 1989) and rice husk (Munaf et al, 1997a,1997b) as a potential tool for the removal of toxic pollutants from river water, waste water and mining effluent.

The biosorption, or binding, of metal ions by nonliving biomaterial arises from the coordination of the ions to different functional groups in or on the biocell. These coordinating groups (provided by proteins, lipid, and carbohydrates) include amino, thioether, sulfhydryl, carboxyl, carbonyl, imidazole, phosphate, hydroxyl and amide moieties. These polyfunctional biosorbent often exhibit unique metals adsorption abilities. Other advantages of this kind of sorbent is that they can regenerated and reused (Munaf et al, 1996c).

Rice husk, a by product of rice, is readily available in great abundance in Indonesia. It is generally discarded as a waste or use as a fuel. The cell walls of rice husk consist mainly of cellulose, silica, lignin, carbohydrates and having a lots of hydroxyl groups in their structures. Where the exchange properties of the husk are due to the presence of their various functional groups.

This work reports on the use of rice husk for removal of mangan from waste water. The method has been aplied to removal such metal from industrial waste water.

MATERIAL AND METHOD

Treatment of rice husk

Rice husk were washed with an excess of pure water, dried at room temperature for a day. Then ground and screened to within the

particle range of 150 – 500 m. To remove the trace amounts of metal ions indigenous to rice husk, 10 g of rice husk particle is rinsed with 20 mL of 15 hydrochloric acid, and then washed with 50 mL of deionized water. After the washing solution is discharded, the rice husk was dried at room temperature for 1 day before used.

Chemicals and apparatus

All reagents employed in this work were of analytical reagent grade or better, and obtained from E. Merck (Darmstadt, Germany), unless otherwise noted. Aqueous standard solution of mangan chloride was prepared from the stock solution (1,000 mg/L Mn) and obtained from Wako Pure Chemicals Co., (Osaka, Japan). Column experiment were conducted in glass tube (10 x 150 mm). Glass wool was inserted at the top to prevent the substrate from floating. Metal ion concentration was analyzed by using Ana Lab Model Alpha-4 atomic absorption spectrometer.

Procedure

Three grams of treated rice husk was inserted into the column made of glass tube. Water was then slowly added to wet the packing. The metal solution having a known concentration of metal ion was passed through the column. The initial and final concentration of mangan ion is determined.

The procedure for the removal of mangan ion from real water is as follows : 1 L of water sample is flowing into the column experiment. The flow rate of sample inserted to the column and the flow rate of the eluate were controlled to be the same. The initial concentration of mangan ion present in water sample and the final concentration after the column was determined as described above.

RESULTS AND DISCUSSION

Effect of the particle size on mangan ion adsorption

The adsorption capacity of rice husk much depends on the surface activity, namely spesific surface area available for solute-surface interaction, which is accessible to the solutes. Consequently, it is

expected that the adsorption capacity increases with increasing surface area of the husk. This means that the sorption material having larger surface area or in other words has small particle size could adsorp metal ion stronger than the smaller one.

Figure 1 shows the percentage of mangan ion uptake in the various particle size of husk. When the particle size of the rice husk was changed from 150 to 500 m, the the percentage of mangan ion sorption by the husk is increased up to 92% in the particle range from 150 to 250 m. And decrease to nearly 65% in the particle size 425 m for mangan ion investigated. Therefore 250 m was selected as the particle size for mangan ion investigated. This results are much better than if 2 mm size of rice husk was used for removal of metal ions (Suemizu et al., 1986). Where they reported that unmodified rice husk gave only around 40% of metal ions sorption by the husk.

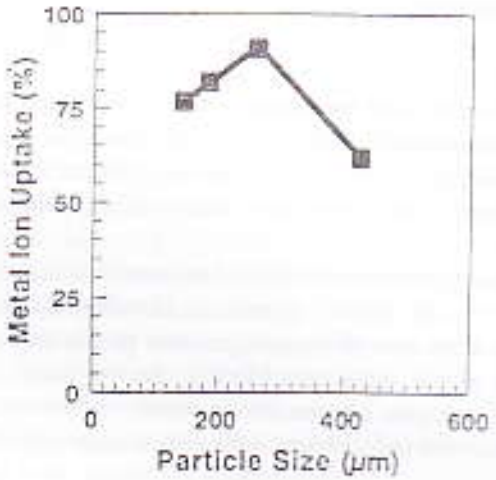

Figure 1. Effect of particle size of the husk on manganese ion adsorption.

Effect of pH on mangan ion adsorption

It is well known that adsorption of metal ions by solid substrates much depends on pH values of the solution. Figure 2 shows the effect of pH on mangan adsorption by the rice husk.

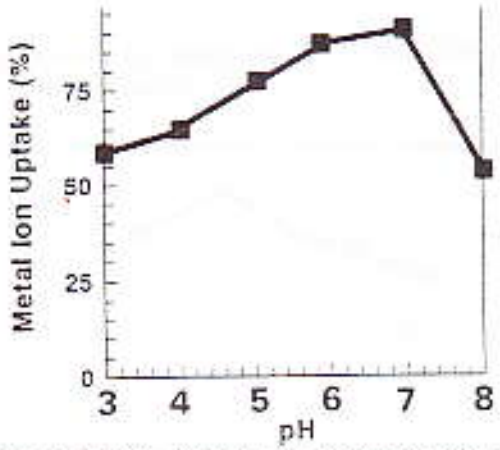

Figure 2. Effect of pH on the manganese ion adsorption

As can be seen from Figure 2, when the pH solution was changed from 3 to 8, the rice husk showed favourable sorption in the pH range of 6 to 7. Solution of pH will influenced both aqueous mangan ion and surface binding of the rice husk. At lower pH values (smaller than 4) the surface of the sorbent would surrounded by the hydronium ion (H^+), which would hinder the mangan ion from reaching the binding sites of the sorbent caused by the repulsive forces. At higher pH, Sorption will increases with increasing pH to the point where the mangan ion investigated will precipitated, which occur at pH higher than 7. In the optimum range from 6 to 7 maximum uptake of mangan ion by rice husk is 92%. For this reason solution of pH 7 was selected as the optimum.

Effect of temperature on manganese ion adsorption

The effect of temperature on adsorption of metal ions on rice husk have received little attention. Therefore, we examined the adsorption of mangan ion by the rice husk by using husk which was heated at temperature ranged from 60 to 200 °C, prior to used. The husk with the particle size of 250 m was heated in an oven for 15 min. The temperature was kept constant during the heating time. As can be seen from Figure 3, when the temperature was changed from 60 to 200 °C, the adsorption power will increases with increasing temperature up to 150 °C, and tended to decrease at higher temperatures.

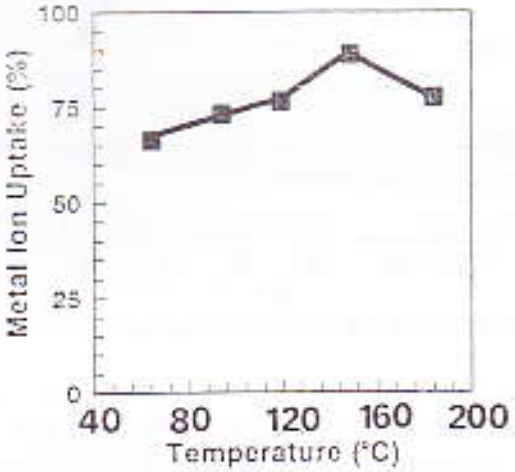

Figure 3. Effect of temperature on manganese ion adsorption

At temperature ranged from 60 to 150 °C the heat of hydration of mangan ion being higher than is heat of adsorption. As expected, change in temperature cause appreciable changes the surface adsorption. On the other hand, at temperature higher than 150 °C, the adsorption tended to decrease. This is probably because at temperature higher than 80 °C, some of the functional groups that can affect the sorption process of the husk was decomposed, due to the carbon black occurred at higher temperature. Therefore, 150 °C was selected as optimal heating temperature required for the rice husk before used.

Removal of mangan ion from waste water

In order to verify the capability of the rice husk for removal mangan ion in river water and waste water samples. The present method was applied to remove mangan ion present in water samples.

The sample was filtered and adjusted to pH approximately 7 by adding appropriate volume of sodium hydroxide solution. The volume sample used is 1 L. The results obtained is shown in Table 1.

Table 1. Removal of manganese ion from river water and waste water samples

Kind of water	Concentration (mg/L)		Metal Uptake (%)*
	Original	Effluent	
River water	0.45	0.20	55.5
Car wash waste water	0.76	0.35	53.9

*Based on 3 measurements.

As can be seen from the table, the percentage of mangan ion removal from real water samples were 55.5 and 53.9 %, respectively. This result seem to be less than the removal obtained by using the standard single mangan ion investigated. Since real water sample contain other ions, the reason is may be due to the possibility of competition for adsorption site. This is because the amount of mangan adsorbed would depend on the ionic size, the stability of the metal ion-husk bonding, nature of metal ion-husk interaction and the distribution of the reactive groups on the husk.

In conclusion, the rice husk could be used as a potential biosorbent for removal of mangan from real water sample. However, the possibility of metal ions competition for adsorption site needs to be assessed.

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