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AFFORDABLE WATER SUPPLY AND SANITATION

MOPAS for metal removal

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THE USE OF agricultural origin for water and wastewater treatment such as removal of toxic metals from aqueous solutions, has been reported by many workers (Fadil, 1989 & 1993). Summary of the reports is presented in Table 1. Most researchers used chemicals, such as concentrated acids, and high temperature for producing the adsorbents. It is needed in order to carbonise and activate the material. Such processes might not be suitable in certain cases. Furthermore, the weight loss is high, between 70 to 90 %. To minimise the loss and make the process simpler and more practicable, it is suggested that the temperature should be reduced to the optimal point and avoid the use of any chemical.

Being a developing country, Malaysia is also having water pollution as a result of industrialization and urbanization (Chan et al., 1978; Law and Singh, 1991; Third World Network, 1989; Zulkifli et al., 1991). Since Malaysia is one of the world palm oil producers, it is rich in oil palm shell as byproduct of the palm oil mills. Therefore, the discussion in this paper will be limited to the use of oil palm shell which was simply treated for toxic metal removal from aqueous solution. The shell used is abbreviated as **MOPAS** which means *modified oil palm shell*.

MOPAS preparation

Raw material of the shell was selected and washed out by water and dried in oven at 105° C for a period of 24 hours. It was then crushed to grains and sieved to separate particles at the sizes of 1.18 and 2.36 mm. The shell was heated in furnace at temperatures of 300, 350, 400 and 420 ° C for different period, two and four hours. After the heating, the MOPAS was washed by cold water and dried in the same oven at the same temperature for a period of 24 hours.

Batch experiments

In each 250 millilitre (or ml) conical flask containing various weights of MOPAS (0.0 to 6,0 grams), 100 ml sample solutions of 2 milligrams per litre (mg/l) cadmium (Cd) and lead (Pb) were added and then shaked at a speed of 100 rotations per minute (rpm) by a mechanical shaker for a period of three hours or more. After equilibrium, the particle was separated by filtration. The filtrate was analysed by flame absorption spectrophotometer for Cd and Pb determination and the amount of Cd and Pb adsorbed was established. The same procedure was aslo

Table 1. Examples of modified materials used for adsorbent as reported by some researchers.

Researchers	Materials	Chemical used	Heating & time	Sizes	Uses
Rivera-Utrilla,1986 & 1987	Almond Olive stones	HNO3 conc. 10%, 6 hrs H_2SO_4	850 ° C, 2 - 48 hrs	1.5 mm 2.0 mm	Co Pb
Arulanantham, et al., 1989	Coconut-shell	H_2SO_4 conc.	140 - 160 ° C 24 hrs	3.0 mm	Cd Pb
Heryanti & Satiah, 1991	Oil Palm Coconut rice husk	none	900 ° C	1.18 & 2.36 mm	Al, Fe Zn colour
Okieimen, et al., 1991	Ground nut husks EDTA	H_2SO_4 7%,1.5 hrs	reflux 30 hrs	300 um - 425 um	Cd, Pb
Asiah & Wan Rusli, 1992	Oil Palm shell	Phosphoric acid	450, 750 ° C 3 hrs.	75 um	M-Blue
Bhargava & Sheldarkar, 1993	Tamarind nut shell	$ZnCl_2$ HCl conc	1 hr digested, activated at 700° C	253 um 424 um	P
Fadil et al., 1993	Oil Palm shell	none	50 - 60 ° C	0.6 & 1.18 mm	Cd Pb

Table 2. Cadmium and Lead Removal from Aqueous Samples of 2 mg/l by various types of Modified Oil Palm Shell.

MOPAS Processes			Cd Removal (%)	Pb Removal (%)
Size (mm)	Heating (° C)	Times (Hours)		
1.18	300	2	33.35	88.98
1.18	300	4	72.2	91.56
1.18	350	2	64.5	93.54
1.18	350	4	83.5	94.32
1.18	400	2	81.8	95.83
1.18	400	4	96.0	97.0
2.36	400	2	18.55	75.26
2.36	400	3	55.26	93.2
2.36	400	4	54.75	97.08
2.36	420	2	97.35(in 5 mg/l)	99.0(in 5 mg/l)
2.36	420	4	97.34(in 5 mg/l)	99.0(in 5 mg/l)
2.36	450	2	27.28(in 10mg/l)	71.29(in 6 mg/l)
2.36	450	4	38.51(in 10mg/l)	73.1(in 6 mg/l)
Commercial activated carbon			94.03(in 10mg/l)	95.3(in 10 mg/l)

carried out to the sample solutions containing higher concentration of Cd and Pb. The solutions were of 3.0, 5.0, 7.0 and 10.0 mg / l.

Results and discussion

From the studies, it was found that for the higher temprature of MOPAS, the percentage of metal removal was higher, but the lower concentration of the sample solution gave higher removals. The temperatures of 400 and 420 ° C seems to be the optimal points. Some of the results are shown in Table 2. The removal of lead was better than cadmium. It was more than 90 % for Pb in all cases, but for Cd, it was about 60 % to 80 %. However, the removal was more than 97 % by using the shell which was heated at 420 ° C.

It was also found that the adsorption follows Freundlich isotherm. The linearity of the isotherms is conformed by linear regression analysis.

Conclusion

The study shows that MOPAS has a good potential to be employed as adsorbent material in water and wastewater treatment processes which is comparable to commercial activated carbon.

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