23rd WEDC Conference Durban, South Africa, 1997

WATER AND SANITATION FOR ALL: PARTNERSHIPS AND INNOVATIONS

Landfill leachate treatment using copas

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HUMAN ACTIVITIES ALWAYS generate solid wastes. Solid wastes is usually handled by processes such as, collection, transportation, sorting, recycling and disposal at dumping sites. As a result, the dumping sites become concentrated with wastes and may affect the environment. Most dumping sites generate landfill leachate which could pollute the water body nearby.

Examples of chemical characteristic of leachate is shown in Table 1. It includes heavy metals such as cadmium (Cd) and lead (Pb) (Fadil, 1994 and Norhayati et al., 1994). As shown by some reports, heavy metal can be removed by activated carbon (Reed, et al.,1995).

Activated carbon also can reduce COD and metals from landfill leachate (Salim, 1992). By using the concept of activated carbon adsorption, some agricultural base materials were studied for their ability to remove heavy metals from water samples (Fadil et al., 1994).

It is the intention of this paper to present a report on the ability of carbon which was made of oil palm shell to be used for heavy metal removal from water and landfill leachate samples.

Experimental

The carbon of oil palm shell (COPAS) was simply prepared by two physical processes; grinding and heating. It was ground and sieved to 1.0 – 2.0mm particle size. Then the ground shell was heated in an electrical furnace at 420°C for a period of four hours.

The ability of COPAS to remove heavy metals (Cd&Pb) was studied by conducting two types of adsorption test on sample solutions of distilled water and COD 100 landfill leachate. The first type of the test was a batch test and the second one was a column test.

The batch test was performed by agitating 0 – 3 g of COPAS with 100ml of Cd-Pb solution of 5mg/l concentration at 120 rpm for 6 – 24 hours and at room temperature. The pH of the solution was in the range of 5.5 to 6.5. The particles and the solution were separated by vacuum filter with 0.45mm membrane. The residual cadmium and lead were analyzed by atomic absorption spectrophotometer. Freundlich isotherm was studied using the above equilibrium data.

The column test was carried out by passing the sample solution at a fixed flow rate through a bed of COPAS contained in a column until the effluent quality has degraded to a predetermined level. The same quality of solution samples as for the batch test were employed. The predetermined levels of effluent quality defined as Standard B (Malaysia, 1979), were 0.02mg/l for Cd and 0.5mg/l for Pb. A series of five columns with varied flow rates were used for distilled water sample (DWS) and another five columns were employed for landfill leachate sample (LLS). The same bed depth of each column for DWS was 0.11mm and for LLS was 0.25mm. Based on breakthrough curves, the performance of the columns were evaluated.

Table 1. Typical examples of landfill leachate quality

Results and discussion

Some of the results from the batch test are shown in Figure 1. From the batch test, it was found that the removal of Cd was less than the removal of Pb. It was about 60 per cent to 80 per cent of Cd removed, while for Pb, it was more than 90 per cent. However, the adsorption capacity was less in landfill leachate samples due to the fact that other chemicals might be adsorbed by the COPAS. The adsorp

Figure 1. Removal of Cd and Pb from water and leachate samples using varied weight of COPAS

Figure 2. A relation of empty bed contact time (EBCT) and service time of the COPAS column used for removal of Cd and Pb from water sample.

Figure 3. A relation of empty bed contact time (EBCT) and service time of the COPAS column used for removal of Cd and Pb from leachate sample

tion isotherm models were found to be in agreement with Freundlich model.

From the result of the column test, a relation of empty bed contact time (EBCT) and service time of the column was evaluated, as shown in Figure 2 and Figure 3. It was based on Bohart and Adam model (Eckenfelder, 1989). It was found that the minimum or critical contact time was in the range of 13 to 21minutes. By using Bohart and Adam model, a constant rate, K, and adsorptive capacity, N_o, for Cd and Pb in each sample solution can be determined from the plotted data in both figures. They are presented in Table 2. The values of K and N_o are useful for a design of a COPAS column which could be applied for Cd and Pb removal.

The optimum contact time was found to be about 80 minutes. There was not a significant increment of efficiency as the contact time was increased more than 80 minutes as shown in Figure 4.

Figure 4. The efficiency of COPAS column

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Table 2. COPAS constant rate and adsorptive capacity