CHAPTER 5

CONCLUSIONS

Most of the wastes received in Sabak Bernam Landfill were typical agro-based industrial wastes (65%), which comprises mainly of coconut, rubber and oil palm plantation wastes. This landfill also receives about 20% MSW which is mainly from small industries and household activities.

It was observed that the moisture content of soil samples from Sabak Bernam landfill area at different depths ranged between 66 to 141 %. The pH values of the soil samples at all three sites ranged between 6.8 to 7.9 which can be attributed to the methonogenic condition of the landfill. Based on the narrow range of the pH values at different sites, it is unlikely that it will cause any significant variation in the metal concentration at these three sites. In this study, the soil samples collected from different boreholes were found to contain clay (42-57%), silt (37-48%) and (0-14%) sand. It was also observed that the percentage of clay at site BH1 decreased with depth. The percentage of silt was found to be increasing with depth at BH1 and BH2. However, the respective particle sizes of sand, silt and clay at all the three sites do not vary significantly.

The elevated concentrations of numerous elements in the surface soil indicate that substantial portion of the elements remain within the topsoil. At the subsoil level, the concentration of Pb, Cd, Cu and Ca were highest at the landfill site followed by the concentration at the ex-landfill site (BH2). Such a distribution is usually explained by the anthropogenic influences, which lead to the accumulation of metals in the subsoil.

The increased disposal of solid waste in the landfill has given rise to high concentration of toxic metals such as Cu, Zn, Ni, Cd, Pb, Ca and Fe and other organic compounds. Vertical distribution of the heavy metal from the Sabak Bernam landfill study revealed that heavy metals (Cu, Zn, Ni, Cd, Pb, Ca and Fe) are heterogeneously distributed in and around the landfill. Total metal concentration decreased substantially below surface soil for Ca, Pb and Ni. Cu and Cd did not show any specified trend with soil depth. A significant correlation between organic matter and the presence of Cu, Zn, Pb, Ni and Cd suggests that these metals have strong affinity with organic matter and are present mainly in the surface horizon as a result of greater organic matter content in the upper part of the soil column than in the deeper areas.

An analysis of the lateral distribution of the heavy metals indicates that the concentration of Ca and Pb were higher at the landfill site BH1 soil. However, the concentration of Zn and Pb were high at landfill site

(BH1) and ex-landfill site (BH2). Ni and Cu were found to vary in a narrow range among the three sites, whereas Cd was highest at landfill site (BH1). It was observed that the concentrations of Ca and Pb at all three borehole sites decreases with increasing depths while that of Fe, Zn and Ni increases with increasing depths. The concentration of Cu at all three borehole sites appears to be almost constant. Very large concentration of Ca (10-20 mg/L), far exceeding the Malaysian guide levels of 7.5 mg/L was found at the landfill site BH1. The concentration of Ca at all three borehole sites indicated a generally decreasing trend with increasing depth. It is observed that the total concentration of Pb in the soil samples increased from the lower depth to the topsoil layers (0.1 to 0.6 mg/L). It was also observed that the Fe concentration was higher at depths ranging from 20-30m in sites BH1 and BH2 (25 mg/L), compared to site BH3 (10 mg/L). It was found that Cu concentration does not show much difference at different depths of the soil at all three sites (varies between 0.010 to 0.017 mg/L). The results obtained for Zn concentration from the different sites showed increasing trend with depth. In the upper portion of the soil (2m), Ni content was comparatively higher than at the deeper anoxic zone.

The average values of the BOD and COD in the leachate samples are found to be 726 and 1250 mg/L, respectively which were higher than the limit stipulated in the EQA (1974) for industrial effluents. Also, the

TSS (111.58 mg/L), Mg (55.3 mg/L), Fe (8.56 mg/L) and Zn (1.36 mg/L) concentrations in the Sabak Bernam leachate were above the limit stipulated in the EQA (1974) for industrial effluents. The high concentration of Fe and Zn metals in the leachate is reflected in the presence of both the metals in the soil.

The leachates from Sabak Bernam landfill contained higher concentrations of the major cations Ca (437.86 mg/L), Mg (55.3 mg/L), Na (1287 mg/L) and K (540 mg/L) than Kalana Jaya landfill leachate. The leachate samples from Sabak Bernam landfill had higher Cl concentrations of (420 mg/L) compared to Kalana Jaya leachate Cl concentrations (23-20gm/L). The differences are mainly due to differences in the composition of waste disposed into these landfills.

The significantly concentrated leachate from Sabak Bernam landfill could pollute the soil, groundwater and surface water since there is no geotextile membrane at the base of the Sabak Bernam landfill.