CHAPTER 5 GENERAL DISCUSSION

5.1 WASTE AUDIT

According to the survey, not many background information was available, because it was not their normal operating practice to prepare the document and some of documents were not revealed due to confidentiality. The epoxy waste only comes from coupling process. The other type of waste are not hazardous and most of them are sold for recycling. Basically no treatment is carried out for solid waste. A simple treatment is carried out for the waste water. This treatment is to reduce the high pH of the water. Beside that some of the heavy metals and other element also reduced in this treatment. No waste recovery or waste minimization program implemented in this company. Lately the company had started to look into waste minimization. Environment, Health & Safety Officer has been appointed to plan the program. More research needs to be carried out to investigate the possibility for waste recovery.

5.2 SOLIDIFICATION / STABILIZATION

5.2.1 Results of TCLP

Percentage of Leachable Fraction

The TCLP results revealed that OPC and white cement were able to immobilize the heavy metals to certain extent, depending on the cement loading. Among the heavy metals of concern, Ba and Ti contributed the highest percentage of leachable fraction. Ba showed a descending trend as the cement loading declined, ranging from 25.9% – 53.0% for OPC and

28.4% – 55.3% for white cement treated samples respectively. This could be due to the presence of barium hydroxide in cement.

The percentage of leachable fraction for Ti increase as the waste loading increase from 51.1% - 62.7% for OPC and 51.8% - 62.1% for white cement treated samples respectively. This is because the waste contains high percentage of titanium oxide. On the other hand, the percentage of leachable fraction of the rest of the heavy metals (Zn, Pb, Cu and Fe) were comparatively lower, which was in the range of 41.6% - 12.0% for OPC and 40.7% - 11.7% for white cement treated samples respectively.

The result also revealed that the addition of activated carbon to cement reduced the leaching of the heavy metals considerably as compared to those treated by cement alone. The greatest reduction of 14.2% - 25.5% for OPC treated samples was observed in the leachable fraction of Ba. While for Ti the reduction was 24.9% - 31.8% for OPC treated samples.

The pH of TCLP Extract

The final pH of the TCLP extract for untreated waste, OPC, white cement and cement-based samples were basic, indicating an appreciable acid neutralization (buffering) capacity in the samples that offset the initial pH of the TCLP extraction fluid. In particular, the final pH of TCLP extract for the OPC and white cement treated samples, increased drastically from initial pH of 4.91 – 4.95 to 10.50 – 12.40. The pH value showed a descending trend in both cement and cement with activated carbon treated TCLP extract as the cement loading decreased.

5.2.2 Results of ANS 16.1 (Modified)

Leaching Rate

Rapid loss of heavy metals was observed on the first day of the leaching test, this was probably due to the surface wash off. For the OPC and white cement treated samples, Ba and Ti showed the highest leaching rate among the heavy metals studied, and the leaching rate slowed as time progressed. Lower leaching rate was observed as the cement loading decreased. The leaching rate of Ti increased as the waste loading increased.

The heavy metals in cement with activated carbon treated samples demonstrated similar leaching trend but at lower leaching rate. Ba and Ti showed the highest leaching raet, followed by Zn and Pb, whereas the leaching rate of Cu and Fe were lesser as compared to Ba, Ti, Zn and Pb and approximately the same among them.

Cumulative Fraction Leached (CFL)

The linear relationship between cumulative fraction leached and square root of leaching time in all samples indicated that diffusional process is the main transport phenomenon for the leaching of the heavy metals. In all the samples, Ba and Ti contributed the highest CFL among the heavy metals of concern. The CFL of Ba declined as the cement loading decreased whereby the CFL of Ti increased as the waste loading increased. On the other hand, the CFL of other heavy metals decreased as the cement loading decreased. The CFL of Ba has reduced by more than 55% and Ti has reduced 22% after addition of activated carbon. CFL of other heavy metals declined as well, but less pronounced

Leachability Index

All the leachability indices exceeded the guidance value of leachability index of 6 and ranged from 7.4 – 9.5, clearly indicating that heavy metals were well retained in the solidified specimens. Despite small differences in L_i values for all the heavy metals, there is a correlation that the $L_i$decreased as the waste loading increased. While higher L_i was obtained for cement with activated carbon treated samples as compared to OPC and white cement treated samples. This indicates better retention capability of the heavy metals by the activated carbon. However retention capability declined as the waste loading increased.

5.2.3 Physical Characterisation

Generally the hardening time was 15 to 40 hours. The untreated was took longer time to harden, 25 to 40 hours, whereas the cement-based binder solidification was only 15 to 30 hours. The compressive strength of the cement-based solidified samples were in the range of 68 – 78 Mpa. While for the cement with activated carbon treated samples the range was 70 – 82 MPa. However the compressive strength reading for both cement and cement with activated carbon treated samples were far above that of the control from day one to 28 days.