

ABSTRACT

The brake lining device is designed to slow/to stop the movement of a mechanism or an automobile for our convenience and safety purposes. However, the use of asbestos as a major component in the brake lining manufacturing process, particularly the waste generated, posed high risk both to the environment and human health. This project is focused on waste audit and recycling possibility of the brake lining dust, as well as the laboratory studies on Solidification/Stabilization (S/S) disposal of brake lining dust.

Audit on manufacturing of brake lining showed that the grinding process contributed the highest percentage of weight loss (10.64 - 13.03%). Cutting the billet into smaller sizes contributed the biggest amount of brake lining dust, which was approximately 30%, followed by drilling (2.17 - 6.87%) and chamfering (0.49 - 1.07%).

The performance test on the brake lining samples made from brake lining dust indicated that the brake lining samples containing 10% recycled brake lining dust showed greater potential for recycling than the samples with 5% brake lining dust.

The Toxicity Characteristic Leachability Procedure (TCLP) results revealed that cement was able to immobilize the heavy metal BA, Zn, Pb, Cu and Fe. The percentage of leachable fraction of the heavy metals were in the range of 15.69 - 33.82%, except for BA (34.76 - 51.50%). Addition of activated carbon to cement reduced the leaching of heavy metals by 4 - 24%. Polymeric resins, Polymal and Hetron reduced the percentage of leachable fraction of the heavy metals to less than 15% and 16% respectively.

The final pH of TCLP extract for untreated dust, cement and cement with activated carbon treated samples increased drastically from 4.92 - 4.95 to 10.49 - 11.87, whereas only a slight increased in pH (5.98 - 5.19) was observed in the polymeric resins treated TCLP extract.

The results of ANS 16.1 (modified) revealed that Ba in cement treated samples showed the highest leaching rate, followed by Zn, Pb, Cr, Cu and Fe. The leaching rate of heavy metals slowed down as time progressed. The heavy metals in cement with activated carbon treated samples demonstrated similar leaching trend but at a lower leaching rate. In polymeric resins treated samples, the leaching of Zn, Ba and Pb only can be detected. The detected heavy metals demonstrated a lower leaching rate as compared to the cement-based treated samples.

The linear relationship obtained between cumulative fraction leached (CFL) and square root of leaching time in all cement-based and polymeric resin treated samples indicated that diffusional process is the main transport phenomenon for the leaching of heavy metals. The Leachability Indices, L_i , obtained (7.5 - 10.0) exceeded the guidance value of the leachability index of 6, clearly indicating that heavy metals were well retained in the solidified specimens. The L_i for polymeric resins treated samples were higher than the L_i obtained for cement-based treated samples.

The cement-based binder took 30 - 96 hours to harden, whereas hardening time was reduced to 1.5 - 12 hours for polymeric resins. Hardening time reduced as the amount of MEK initiator increased. Polymeric resin solidification presents greater compressive strength (53 - 68% Mpa) than the cement-based solidification (1 - 12 MPa) as the days progressed over 28 days.

Polymeric encapsulation was superior than the cement-based solidification in both heavy metals retention efficiency and compressive strength of the solid. Polymal showed better performance on heavy metals retention capability, whereas Hetron exhibits higher compressive strength.