WASTEWATER SLUDGE TREATMENT USING RICE HUSK

(*PENGOLAHAN LUMPUR MENGGUNAKAN SEKAM PADI*)

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ABSTRAK

Peningkatan jumlah limbah yang dihasilkan oleh industri sangat erat kaitannya dengan penambahan jumlah industri itu sendiri, terutama limbah Bahan Berbahaya dan Beracun (B3). Bagaimanapun, masalah pengolahan limbah B3 merupakan masalah yang sangat krusial. Sampai saat ini masih terjadi keterbatasan fasilitas pengolahan limbah B3 sehingga sebagai alternatifnya adalah perlunya peningkatan-peningkatan cara pengolahan limbah tersebut melalui penelitian dan pengembangan. Dalam penelitian ini Pemadatan/Penstabilan (S/S) digunakan sebagai salah satu cara untuk pengolahan lumpur yang berasal dari industri automobile (PT. Hicom Teck See). Tujuan penelitian ini adalah untuk membuktikan bahwa (S/S) merupakan salah satu cara pilihan untuk pengolahan limbah, membandingkan dan menilai tingkat efektifitas penggunaan semen (GGBS) dan sekam padi, mengukur dan membandingkan nilai kadar resapan air lindi dengan menggunakan metode JLT-13. Sebelum pengolahan, hasil konsentrasi logam berat yang tertinggi pada sampel ini adalah Na (44.2 mg/l) diikuti oleh Fe, Mg, As, Zn, Al, Mn, Cu, Pb dan Ni dan konsentrasi Fe dalam hal ini berada di atas ambang batas Environmental Quality Act (EQA). Hasil penelitian ini juga menunjukkan bahwa S/S merupakan salah satu alternatif metode yang dapat diterapkan untuk mengolah B3. Sekam padi juga efektif untuk menekan laju konsentrasi logam berat sebanyak 50%. Hasil Uji kekuatan (Compressive Strength) dari limbah ini menunjukkan nilai 414 kPa.

Kata Kunci: Pemadatan, Penstabilan, Sekam padi, JLT-13

INTRODUCTION

Industrial wastes are very varied. They may be classified by physical form (solid, liquid and sludge) and by properties (inert and non-flammable, potentially combustible or biodegradable and those which require special care in handling and disposal). Not all wastes from an industry will be related to the processes in use; a significant portion is similar to municipal waste coming from offices and canteens (food scraps, plastic, bottles etc) and is referred to as non-process industrial waste (Chan, *et al,* 2000a)

The typical waste management strategy is more focused on pollution control, that is waste removal, treatment and disposal added on to the end of the manufacturing processes. Indeed, the wastes are not eliminated but merely transferred from one medium to another medium. As an example, air pollution control equipment prevents or reduces the discharge of air pollutant into the air but at the same time produces a solid waste problem. Thus, such an approach merely provides short-term solutions to an ever increasing problem.

Although it is almost impossible to achieve zero waste discharge, wastes can be minimized to a practicable and sensible extent through re-engineering the design of industrial processes and increasing process efficiencies. Therefore, an anticipative preventive approach is essential in industrial process design. The study presented here is to tackle the problems outlined above with the use of S/S method as an alternative option to manage the hazardous waste, particularly from automobile industry.

The objective of this paper is to study the solidification/stabilization of the wastewater sludge as an ultimate treatment and disposal option, for an automobile industry waste. The efficiency of solidification was tested using JLT-13 and the solidified matrix was also tested for compresive strength.

MATERIAL AND METHOD

Sample Preparation

Wastewater sludge was obtained from Hicom Teck See Sdn. Bhd in Shah Alam. The sludge was homogenized for three minutes with cement using a blender. Water was added slowly into the wastewater sludge to promote hydration. The mixture was then mixed at high speed for three to four minutes upon attainment of the pre-determined water:cement ratio. The resulting waste-loaded grout paste was transferred to moulds of specific dimensions. The moulds were covered with Lucite sheets and left undisturbed for 24 hrs at room temperature (27-34^{0}C) and relative humidity 92%. The specimens were removed from the moulds and further cured for 27 days under dry condition to stimulate the curing condition as normally praticed before landfilling. Ground Granulate Blast Furnace Slag (GGBS) with or without Rice husk (RH) was used in this research.

The Japanese Leaching Test 13 (JLT-13)

The Japanese Leaching Test 13 (JLT-13) was carried out on the samples after 28 days of curing. The solidified waste matrixes (demoulded from the paper cup) were crushed manually by using a mortar to obtain particle size that is smaller than 9.5 mm. An extraction buffer of hydrochloric acid and sodium hydroxide with pH 6.00 ± 0.05 was prepared. The ratio of extraction liquid to crushed particle used was 20:1. The buffer was added to the crushed waste matrixes in a HDPE container and agitated mechanically at a speed of 200 rpm in the incubation shaker (News Brunswick), for 6 hours continuously in the leachant, to achieve uniform mixing. Subsequently, the extraction buffer was filtered using 0.45µm cellulose membrane. The pH of the leachant was analyzed using the Hanna Instrument Membrane pH meter. The leachant was then collected in 60 ml bottles and acidifed with 1ml of nitric acid and stored in a refrigerator at 4°C. The heavy metals in the extract were determined by an Inductively Couple Plasma- Atomic Emission Spectroscopy (model Perkin Elmer, Optima 3000) (Irwan and Agamuthu, 2003a). The results of this extraction test are expressed in terms of the percentage of leachable fraction *f,* for each element, which is defined asthe amount of a particular heavy metal extracted relative to the amount originally present in untreated dust.

Compressive Strength Test

This test was carried out according to the American Standard Testing Material (ASTM) Test Method for Compressive Strength of Hydraulic Cement Mortars C190/C 109M-95. The test is to determine the strength formation characteristics of the solidified waste-cement matrix. The waste-cement matrixes were solidified in 50mm x 50mm x 50mm steel cubes (Chan, *et al*, 2000b; Kim *et al*, 1992).

The strength measurements of the cubes were performed using a calibrated hand operated hydraulic compression apparatus (model ELE) on the 7th, 14th and 28th days of curing. The test was not performed on the first day, as the cubes were not totally cured, some were still in paste form. The total maximum loads were recorded at the point of fracture on the cubes. The loads were calculated from the equation below:

$fm = P / A$

where:
fm = compressive strength in psi or MPa
P = total maximum load in lbf or N
A = area of loaded surface in in^2 or mm^2

RESULTS AND DISCUSSION

JLT-13 Results

In Figure 1 the percentage of leachable fraction for Fe reduced when cement loading increased. It was similar in Figure 2 when the waste was mixed with cement and additives (rice husk).

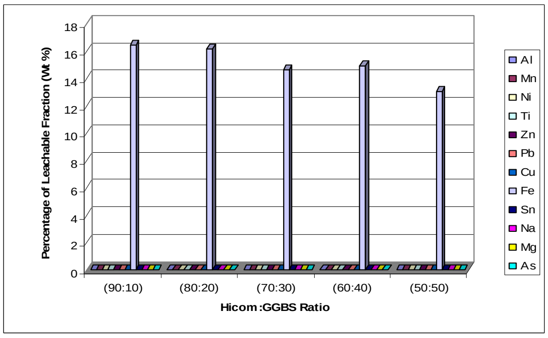

Figure 1. Percentage of leachate fraction of the heavy metals of concern in the JLT leachate from Hicom wastewater sludge treated with GGBS.

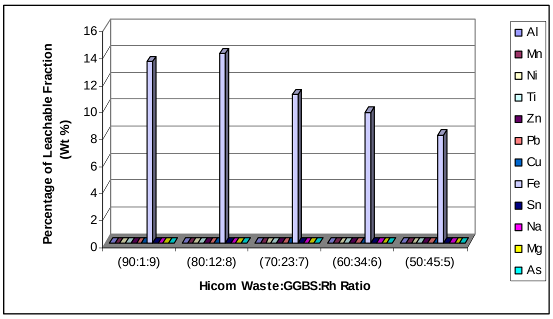

Figure 2. Percentage of leachate fraction of the heavy metals of concern in the JLT leachate from Hicom wastewater sludge treated with GGBS-RH.

Compressive Strength

The physical test comprised of two tests which were the hardening time and unconfined compressive strength. Both the results indicate the time taken for the waste matrix to harden and also determine the strength of the solidified waste matrix.

The compressive strength for Hicom Teck See solidified with GGBS alone was between 3.2- 6.1 MPa, and was found to be between 2.1-3.7 MPa when RH was added (Figure 3). It means that solidified matrix of GGBS with RH was weaker than GGBS alone.

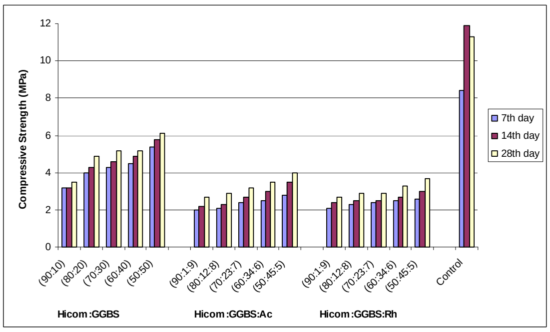

Figure 3. Unconfined Compressive Strength of Solidified Sludge after 7th, 14th and 28th days of solidification with GGBS

Generally it was observed that the compressive strength was found to be increasing as the cement loading increased and as the curing time progressed. According to Zain *et al*., (2004) the lower strength could be attributed to the retardation of cement hydration due to the presence of heavy metals in wastewater sludge. This might have effectively increased the amount of cement available for binding the fine and coarse aggregates required to provide adequate strength.

CONCLUSIONS

RH increased the efficiency of heavy metal retention. The JLT-13 results showed that GGBS reduced heavy metal concentration from waste type. RH increased the efficiency of heavy metal retention by 50% respectively. Compressive strength of solidified waste matrixes exceeded the ASTM C39 standards guidance value of 414 kPa.

ACKNOWLEDGEMENTS

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