Analysis of zinc (Zn) leaching from stabilized/solidified sample containing rubber sludge waste treated using Ordinary Portland cement and rice hush ash

A L Abdul Rani[1,*], N A Rashid[2], M A H Abdullah[2], M F Omar[2]

[1] Faculty of Chemical Engineering Technology, Universiti Malaysia Perlis, Kampus UniCITI Alam Sungai Chuchuh, Padang Besar, 02100 Perlis, Malaysia.
[2] Faculty of Civil Engineering Technology, Universiti Malaysia Perlis, Kampus UniCITI Alam Sungai Chuchuh, Padang Besar, 02100 Perlis, Malaysia.

*Corresponding author's email: latifrani@unimap.edu.my

ABSTRACT: Rubber sludge from industrial biological wastewater treatment plants containing Zinc (Zn) has become a serious problem as the waste generation reached almost 240 tonne each year. Severe pollution may occur to the environment as if this waste has not been disposed correctly in a secured landfill. Zinc has been characterized as harmful toxic heavy metals and capable of causing a carcinogenic effect to humans and other living creatures. An attempt to treat the rubber sludge using ordinary Portland cement and rice husk ash using the stabilization/solidification technique has been performed in this study. The objective of this study is to evaluate the effectiveness of ordinary Portland cement and rice husk ash mixtures in reducing the leachability of zinc in stabilized/solidified specimens. Based on the findings, it is revealed that zinc from leaching of sample batches prepared (i.e. OWR1, OWR2 and OWR3) have successfully reduced as compared to the control batches. The combination of ordinary Portland cement and rice husk ash were able to reduce the leaching of zinc into the leachant below the acceptable limit of zinc concentration in drinking water at 5 ppm.

Keywords: *Zinc leaching; Rubber sludge; Stabilisation/solidification*

1. INTRODUCTION

The increment of industrial rubber sludge waste generation each year have increased the handling and disposing cost each year to the related industry. The waste has been classified as scheduled waste by Malaysian Environmental Quality Act (EQA) 2005 under code SW 321 [1]. However, problem arise from the leaching of heavy metals originally zinc elemental which exist within the waste composition have driven the collaboration of research with the industry in order to find possible treatment to reduce the leaching.

Leaching of zinc from this raw waste can occur from direct contact between the waste and water which might be originated from water run-off during raining [2]. This contaminated water run-off eventually leads to more severe environmental problem associated with the pollution towards groundwater and surface water contaminations. The long-term zinc excessive intakes can prone to most common effects have included sideroblastic anaemia, hypochromic microcytic anaemia, leukopenia, lymphadenopathy, neutropenia, hypocupraemia and hypoferraemia associated with the exposure ranging at minimum of 150 mg/day [3-4]. It is also reported that zinc is capable to be absorbed into the human body through the openings of sores and wounds [4].

2. METHODOLOGY

The research for this study was conducted according to Fig 2.1.

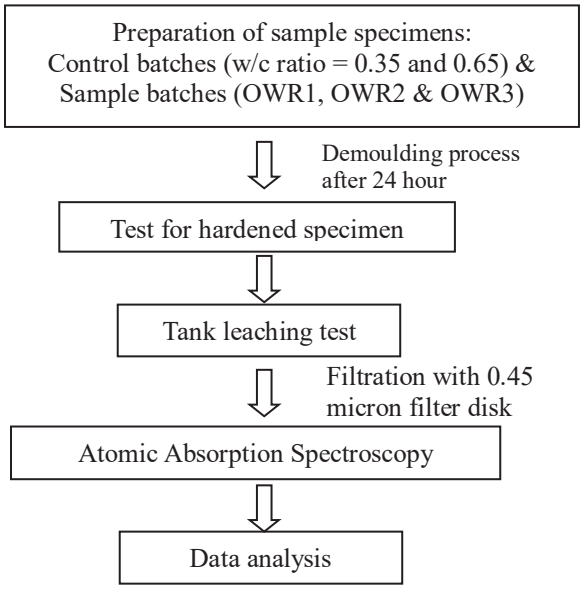

Figure 2.1: Research flow chart

2.1 Materials and methods

Ordinary Portland cement from Cement Industries Malaysia (C.I.M.A) Blue Lion was been used as main binder for this study. Rice husk ash was collected from local rice mill processing nearby Perlis. Raw rubber sludge waste was collected from local rubber gloves manufacturing nearby Perlis.

Sample specimen for control and sample batches were prepared according to cube size of 5 mm x 5 mm x 5 mm dimension [5]. The test specimen used for the leaching test was 28 day sample age cube. The tank

leaching test was performed according to EA NEN 7375:2004 method. Leachant used for the tank leaching test was deionised water at 625 mL whereby the same volume has been replenished for each specific duration of the leaching test [6]. The collected leachant was filtered with 0.45 micron filter disk prior to heavy metals analysis using Perkin Elmer Atomic Absorption Spectroscopy (model: AAnalyst 700).

Table 2.1: Control batch composition

Code	Formulation	water/cement ratio
CB01	OPC + H_2O	0.35
CB02	OPC + H_2O	0.65

Table 2.2: Sample batches composition

Code	Formulation
OWR1	80% OPC+ 10% Waste + 10% RHA
OWR2	75% OPC+ 10% Waste + 15% RHA
OWR3	70% OPC+ 10% Waste + 20% RHA

3. RESULTS AND DISCUSSION

The summary of leaching analyses are summarised in Fig. 3.1.

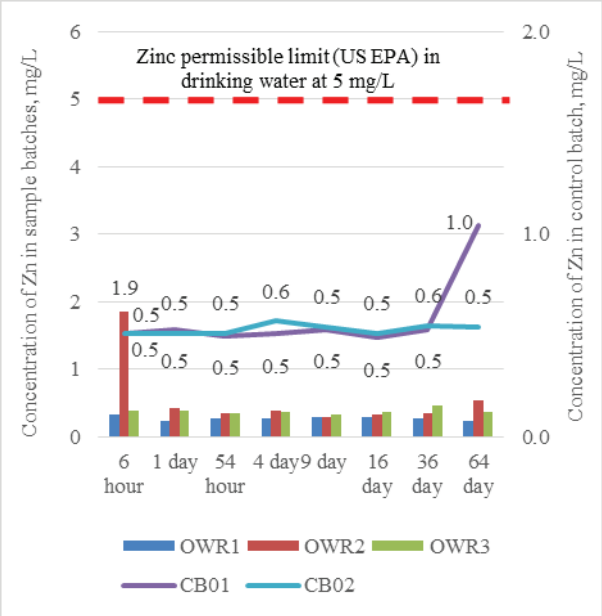

Figure 3.1: Zinc leaching analyses using Atomic Absorption Spectroscopy

According to the analyses, the leaching of zinc in all three sample batches was found to be below 0.5 ppm. However, there a small fluctuation occurred in OWR2 at 6 hours leaching sample whereby zinc concentration was found to be at 1.9 ppm due to surface wash-off and the existence of small cracks on the sample immersed in the leachant. This is also supported by close to the same occurrences in zinc leaching [7]. Comparison with the control batches zinc leaching revealed almost the same leaching pattern with a range of 0.5 to 1.0 ppm. This corresponds with the composition of control batches without the rice husk ash which functioed as the activated carbon for the absorption of heavy metals.

4. CONCLUSION

Based on the findings, it can be concluded that zinc leaching from the rubber sludge waste can be successfully reduced by incorporating ordinary Portland cement and rice husk ash below the permissible zinc limit at 5 ppm.

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