Leaching Behaviour of Hybrid Blocks made using high Volume of Palm Oil Wastes

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Abstract

The main objective of this study is to trace the heavy metal leached from a hybrid blocks developed in this study. The hybrid blocks produced in this study was in the form of interlocking blocks produced from high volume of palm oil waste. Palm oil clinker (POC), palm oil fuel ash (POFA), palm oil clinker powder (POC), quarry dust (QD) mixed all with cement. Leach ability of the heavy metal like Aluminum, Iron, Manganese, Zinc, Cadmium, Cobalt, Cupper, and Lead were assessed using the De-ionized water leaching procedure (DWLP) the more appropriate for in situ condition. Traces for heavy metals were analyzed using Inductively coupled plasma Optical emission spectrometer (ICP-OES). Results demonstrated that the concentrations of heavy metal leached from the blocks produced in this study were within the acceptable limits according to the Malaysian Standards. It was observed that the leaching of heavy metal was increased with the increase of palm oil clinker and decrease with the increase of quarry dust. It was concluded that the blocks developed in this study was safety for the environment and doesn’t possess any threat to the surroundings.

Keywords: Leach ability, Di ionized water leaching procedure, Heavy metal concentration, Hybrid blocks

Introduction

Generally, leaching tests are categorized into the following categories: (a) tests designed to simulate toxic elements emit under a special environmental scenario like industrial acid rain leach test or toxicity leaching procedure characteristic (TCLP) (b) sequential chemical extraction tests, (c) investigations which assess the basics of the leaching parameters [1]. Many researchers have attempted to emulate the real-life scenario and suggested different leaching methods substantiating the attempts. Tests that are designed to emulate emissions under specific environmental scenarios are restricted because they mostly do not supply information on the emissions under environmental scenarios varied from the one being emulated [2]. This kind of restriction has led to a vast trial of misuse and misses explanation of TCLP findings.

Dependence on the emulation-based investigation results “pass the test” treatment processes rather than waste characteristics enhancements or decrease the leaching under a real use or disposal scenarios [3]. Leaching methodologies are predominantly classified by either the leaching fluid is a static extraction tests (single addition) or is a dynamic tests (rejuvenated). Several leaching methods can be applied to various forms of waste have been reviewed where it was observed the releasing from solid materials is almost assessed using the out comings of one or more extraction tests intended to measure the leaching from materials [4]. In spite of that more than 50 leaching tests have been specified for different purposes and materials, only a restricted number issue a range of test conditions [5].

Nidhi et. al 2017 [7] had done investigations on leaching...
The leachate analysis is one of the vital parts of the study as it determines the possible effects of using palm oil waste on interlocking blocks. As the material itself plays a vital role in exhibiting the hazardous properties to the surrounding, there is an important need to understand the concentration of the metal components that are present within the material. As discussed earlier, palm oil mills dispose palm oil fuel ash and palm oil cinder in their plantation areas as covers for potholes or natural road curbs. This would lead to possible soil pollution if substantial metal components are present [10]. As this study examines for the first time the use of palm oil by-products in interlocking blocks, a complete assessment is required to highlight the metal constituents within palm oil by-products to confirm the actual scenario in case there is hazardous materials presence. A heavy metal analysis will be carried out using inductively coupled plasma (ICP) for the material as palm oil fuel ash, palm oil cinder and quarry dust. Besides, the blocks produce in this study will also be checked for their heavy metal concentration to check if the discharge of palm oil by-products conforms to the regulation of soil discharge and water pollution.

Material and Methods

Hybrid blocks were produced in this study from high volumes of palm oil waste like palm oil fuel ash (POFA), palm oil cinder (POC), palm oil clinker powder (POCP), quarry dust (QD), and cement. Materials were firstly mixed at their dry status in the mixer and then water spraying until the mix was moistened. After that the wetted mix was poured into the compressor machine so as to compress the block. Hybrid blocks were produced using the stabilized compressed earth block machine as shown in Fig. 1, Fig. 2, Fig. 3, Fig. 4, and Fig. 5. Fifteen mixes were prepared in this study named as (A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15).

Figure 1. Mixing material in the mixer of the machine within their dry status
leaching procedure (DWLP) [7-10] as it is more appropriate for in situ condition. Block will be crushed using jaw crushed and sieve to 4.75 mm, then 10 gram of sample will be mixed with extraction fluid which is saturated de-ionized water of the pH 5.7. The flasks containing samples and extraction fluid at room temperature will be tightly closed and kept in an orbital shaker at 30 ± 2 rpm for 18 hour. The suspensions will be filtered through 40 micron membrane filter and the filtrates of heavy metals will be analyzed by Inductively coupled plasma Optical emission spectrometer (ICP-OES). Traces for heavy metals such as (Al, Fe, Mn, Zn, Cd, Co, Cu, Cr, Pb) will be investigated in (ICP-OES) because of their harmful effects on soil, crops and water. Results will be compared with international standards for heavy metal concentration. The acceptable limit of heavy metals is illustrated in Table1 according to Malaysia soil standard (M soil) and Malaysian drinking water quality system (DWQS).

Table 1. Acceptable limits for heavy metal concentration according to Malaysian Standards [10]

<table>
<thead>
<tr>
<th>Heavy metals</th>
<th>M soil (ppm)</th>
<th>DWQS (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al</td>
<td>-</td>
<td>0.20</td>
</tr>
<tr>
<td>Fe</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Mn</td>
<td>3.97</td>
<td>0.1</td>
</tr>
<tr>
<td>Zn</td>
<td>21.9</td>
<td>3</td>
</tr>
<tr>
<td>Cd</td>
<td>-</td>
<td>0.03</td>
</tr>
<tr>
<td>Co</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>Cu</td>
<td>13.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Cr</td>
<td>-</td>
<td>0.05</td>
</tr>
<tr>
<td>Pb</td>
<td>10.37</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Results and Discussion

Results on the leaching ability of the blocks developed in this study are illustrated in Fig.6 for series A which is A1, A2, A3, A4, and A5. Fig.7 shows the heavy metal traces for series A’ which is A’6, A’7, A’8, A’9, A’10. Fig.8 shows the heavy metal traces of A’11, A’12, A’13, A’14, A’15. It is obvious to observe that the heavy metal leaching from the blocks developed in this study were all within the acceptable limits as indicated in Table 1. Heavy metal concentration for magnesium and aluminum were the most significant heavy metal leached from the blocks developed in this study. However, their concentrations were significantly lower the maximum concentration of the heavy metal according to the Malaysian standards for soil and drinking water. Fig.9 shows the relationship between the magnesium concentration and the bulk composition of POC. Fig.10 shows the relationship between the magnesium concentration with the bulk composition of the POC. Obviously, Mg leaching was higher for POC as well as compared with QD as shown in Fig.9 and Fig.10. Relationship between the aluminum concentration and the bulk composition of POC is indicated in Fig.11. Fig.12 illustrates the relationship between the
aluminum concentration with the bulk composition of QD. Fig. 13 shows the relationship between the chromium concentration and the bulk composition of QD. Obviously, heavy metals leaching for both chromium and aluminum increased with the increase of POC and decrease with the increase of QD.

Conclusions

Based on the above investigations on the leaching ability of the blocks produced using high volume of waste of palm oil waste:

- Figure 6. Heavy metal traces for series A
- Figure 7. Heavy metal traces for series A’
- Figure 8. Heavy metal leaching from series A’
- Figure 9. Relationship between the magnesium concentration and the bulk composition of POC
- Figure 10. Relationship between the magnesium concentration and the bulk composition of the QD
- Figure 11. Relationship between the aluminum concentrations with the bulk composition of the POC
- Figure 12. Relationship between the aluminum concentration and the bulk composition of QD
- Figure 13. Relationship between the chromium concentration and the bulk composition of QD
• Heavy metal leached out of the interlocking blocks were all within the acceptable limits of the Malaysian standards for permissible limits of the heavy metal for soil and drinking water.
• Aluminum, Chromium and Magnesium were the most significant heavy metal leached from the blocks developed in this research.
• Palm oil clinker were linearly correlated with the Aluminum, Magnesium and Chromium concentrations.
• Quarry dust was adversely related with the Aluminum, Magnesium and Chromium concentration. Those heavy metals decreased with the increase of quarry dust.

References
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