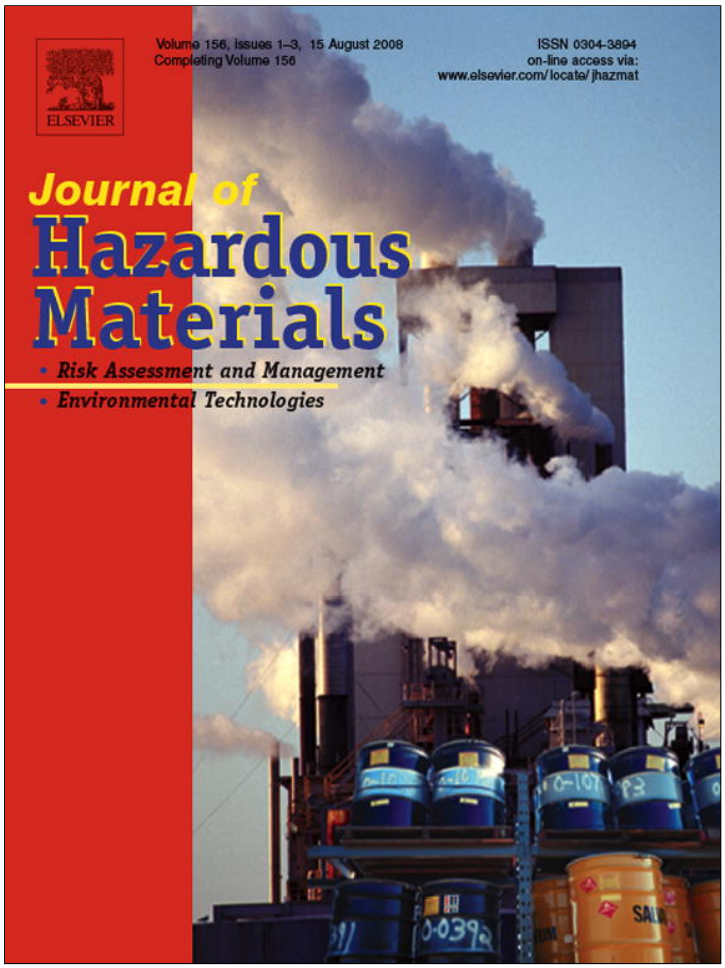

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Assessment of heavy metal contamination and its mobilization from municipal solid waste open dumping site

Tawach Prechthai, Preeda Parkpian, Chettiyappan Visvanathan *

Environmental Engineering and Management Program, School of Environment, Resources and Development, Asian Institute of Technology, PO Box 4, Klong Luang Pathumthani 12120, Thailand

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Abstract

Influence of heavy metals was investigated by conducting various tests on the samples collected from Nonthaburi dumpsite in Thailand. The heavy metal concentration in the solid waste and its mobility potential based on its binding forms was studied. The sequential extraction method was used to determine the binding forms of metals.

From the analysis, Zn was found to be highest concentrated heavy metal compared to Mn, Cu, Cr, Cd, Pb, Ni and Hg in the solid waste. From the sequential extraction, Mn, Zn and Cd mostly found in reducible form, showed its susceptibility to be leached easily. Cu and Cr were found predominantly in oxidizable form and stable under anaerobic condition. Pb and Ni were present in residual form, which is inert. The estimated individual contamination factor (C_f^i), showed Zn with highest affinity to leach. The concentration level of all the heavy metals in the leachate except for Cr was noticed to be below the National effluent standards. Though, indicated to be safe for disposal, its effect in any concentration proved toxic to the plant life from the seed germination toxicity test using synthetic chelate ethylene diamine tetraacetic acid (EDTA).

Keywords: Municipal solid waste; Dumpsite; Heavy metals; Leachate; Sequential extraction; Toxicity

1. Introduction

In Thailand, approximately 65% of Municipal Solid Waste (MSW) is disposed in open dumpsite. Nonthaburi dumpsite is one of the large sites in Thailand. This dumpsite is operating since 1982. Presently, it receives about 750 tonnes/day of MSW from Nonthaburi province and neighboring municipalities. In general, one of the major environmental impacts of solid waste disposed is influence of heavy metals in the waste.

Most of our study compares the condition of landfill with our dumpsite. The rational behind this is to explore the response of heavy metals under controlled condition and uncontrolled condition and relate results that are relevant to our study. The effects of heavy metals were found to vary with the conditions prevailing in the dumpsites and its binding forms. In the case of landfill, in an anaerobic condition, the metals that are bound to carbonate, organic compound and sulfide are more stable and retained in the landfill itself, whereas the metals bound to Fe and Mn oxide are unstable [1]. This is in contrast with the case of an open dumpsite. The open dumpsite being exposed to the atmospheric condition undergoes different effects due to oxygen diffusion. In a high redox condition, the binding of metals to Mn and Fe oxide increases, whereas binding to carbonate, organic compound and sulfide tend to decrease [2]. With more possibility of oxygen diffusion through the upper layer of dumpsite and with sufficient moisture content, the degradation rate and the acid buffer capacity of the dumpsite is highly influenced. Under this condition there is a drop in alkalinity and pH and sulfide oxidation, where heavy metals are easily available and released [3,4]. These heavy metals from the surface layer of dumpsite, creeps into the bottom layer of the dumpsite where anaerobic condition prevails. Under this anaerobic condition, the heavy metals immobilize and retain in the solid waste again. This is confirmed from the observed high concentration of heavy metal at deeper layer of landfill [5,6]. The moisture content and organic carbon are considered as the essential factor influencing the metal stability in landfill. Therefore, determination of moisture content and organic carbon in the waste from dumpsite is necessary. The heavy metals leached from the landfill are usually found in the form of free cation, dissolved organic compound

* Corresponding author. Tel.: +66 2 524 5640; fax: +66 2 524 5640.
E-mail address: visu@ait.ac.th (C. Visvanathan).

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