Characterization of topical landfill leachates from major cities in Indochina peninsular region

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Introduction

Municipal solid waste management in the developing countries is one of the existing unsolved problems for the past decades up to the present. It is a serious concern for both sanitary landfills and open dumping facilities to minimize the risk to the environment and communities. The compositions and concentration of the contaminations depend on the way of waste disposal as well as the waste extraction and classification before final covering (Duan, 1998). On the other hand, waste management approaches and public awareness should be important factors in waste reduction and contamination control. The leachate problem was worsened by the fact that many landfills lack an appropriate bottom liner or collection system – increasing the possibility of dissipation of leachate through the landfill layers to contaminate groundwater (Kanmani et al. 2013). However, heavy metals are non-degradable and their continuous accumulation forms a serious risk to human and public health (Moturi et al. 2004). The ASEAN region is facing with increasing waste production due to population growth and the rapid economical development trend.

The current study aims to investigate the MSW composition, the leachate quality, the effluent of seasonal variation as well as to assess the site condition which is highly affected to the leachate quality of the three major landfills in main cities of Indochina peninsular region.

**Material and Methods**

Site Description: Three large municipal solid waste landfills called Sainoi, Dangkor and KM-32 located in Nonthabri (Bangkok) Thailand, Phnom Penh Cambodia and Vientiane Laos respectively, were selected as primary representative sites of the region in this study. Sainoi landfill is the mature landfill started its operation since 1982 with an area of 76 ha, while Dangkor and KM-32 landfill are much younger starting to receive garbage from 2009 and 2008 with the area of 31 ha and 100 ha respectively. There were slightly different in term of operation method but they have similarity in term of context environment and climate condition.

Sampling method and classification: The sample collection for this study had been done for each time of site visit, from 2014-20016 for Sainoi landfill in Thailand, from 2015-2017 for Dangkor and KM-32 landfill. Direct leachate (DL) samples were collected from the leachate flow and leachate discharge pond (LDP) collecting from the leachate pond as in Sainoi landfill condition, while direct leachate in area B (DL.B) and area C (DL.C) classifying for Dangkor landfill as closed and active landfill. Also, direct leachate (DL) and leachate from wetland area (WL) of MK-32 landfill were identified and collected.

The analysis part of this study is consisting of in-situ and laboratory measurement, the in-situ measurement was done accordingly for each field visit mainly for basic parameter such as temperature, turbidity, pH, ORP, EC, DO, TDS and salt by using HORIBA\_U50. While at the laboratory were assessed on the biological contents and harmful heavy metals by using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectrometry).

Results and Conclusions

- The waste composition for these landfills are majorly combined of kitchen/food waste which accounted for 37-65 percent by weight see Fig.1; Sainoi landfill has the most organic amount in the wast mixture compared to Dangkor and KM-32 landfill. It is assosiated with other studies in other ASEAN countries as similar result of organic portion found in waste composition reported by Irfa et al. 2016, Nguyen Ngoc et al. 2009 and Verma et al. 2016 for Indonesia, Myanmar and Vietnam respectively. However, the other main components are plastic, wood or grass and paper waste. Besides, other compounds such as textile, glass, rubber/leather, ceramic and metal were also found to be exsisted as minority in these landfill waste.

- Fig. 2-4 show the concentration of TDS of three landfills, direct leachate (DL) samples contain higer concentration of TDS than leachate discharge pond (LDP) in Sainoi landfill while DL in area B (DL.B) samples of Dangkor landfill are also higher than DL.C. Also, at the KM-32 landfill DL from original source in landfill areas are higher than those found in wetland area. The effect of seasonal variation is also confirmed that higher concentration of TDS, salt and EC in the dry season (Nov-May) than in rainy (wet) season(Jun-Oct). On the other hands, the temperature and pH of those landfill leachates are not much change over time during period of this study. Regarding the ORP are all of DL show the negative rechage than other kinds of samples as LDP, DL.C and WL.

- Fig. 5 shows the relationship of BOD5 / COD which is quite good correlation as linear with the ratio of about 0.4, means it is slow biodegradation for both landfill Sainoi and KM-32. Fig 6 shows the relationship between Cl and TDS which is low correlation, due to some strange points have been found in those landfill because of uncertainof watse receive and the waste mixture for different period of each landfill site.

- Fig. 7 show some of the harmful heavy metal concentration of the direct leachate samples, As, Pb, Cd and Cr foun to exsisted in all samples for all landfills, and most of them are about equal or higher than the effluent standard limit of Japan. The samples from Sainoi landfill seem to be higher concentration of heavy metals than other two landfills obserbed from this study.

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Fig. 1 waste composition



Fig. 2 TDS concentration of Sainoi landfill Fig. 3 TDS concentration of Dangkor landfill

Fig. 4 TDS concentration of KM-32 landfill Fig. 5 BOD5 and COD relationship

Fig. 6 CL and TDS relationship Fig. 7 Heavy metal concentration in DL