The stability of lead in chelate-treated in MSWI mixed ash in semi-aerobic and anaerobic environments during three years

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1. Introduction

Under the revision of the Waste Management and Public Cleansing Law in 1991, it was regulated that the fly ash must be landfilled after chelate treatment or cement solidification for preventing from the heavy metal leaching. However, it was reported that Pb could be eluted again from the chelate-treated fly ash when it was left for a certain period in the landfill, especially it is caused in waste layer under the aerobic condition.

In this study, the column test simulated the landfill environments including semi-aerobic and anaerobic environments were conducted for clarifying the Pb re-elution situation and the trend of Pb concentration in leachate from both columns were monitored. Furthermore, the leaching test and the type analysis of heavy metal compound were carried out on the ashes taken from different depth waste layer of two columns after three years.

2. Material and methodology

2.1 Experimental sample and equipment

The incineration residue is treated by chelate and comes from T incineration plant. The mixed ashes of bottom ash and fly ash at the ratio of 7: 3 were filled in semi-aerobic and anaerobic columns and were left under artificial precipitation for three years. And the lead concentration leaching from the initial mixed ash was 0.01 mg/L.

The size of column made of vinyl chloride pipe is 298 mm in diameter and 980mm in height and has the drain pipe covering gravels at the bottom as shown in Fig.1. The outlet of pipe is opened to air in semi-aerobic column, besides in anaerobic the leachate is retained at the half height of column and the outlet of pipe is closed with leachate to created anaerobic condition.

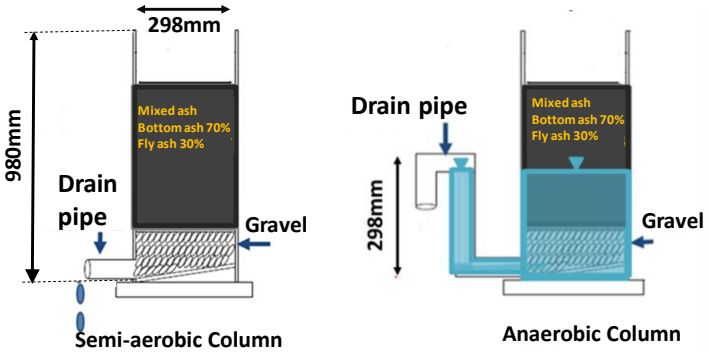

Figure 1 Experimental tanks simulating landfill environment

After three years, when two columns were disassembled, the 15 mixed ash samples was taken with a thickness of 50 mm from both columns due to the heterogeneous landfill environment in waste layer.

2.2 Experimental method

The pH, Cl-, TOC, SS, heavy metal, light metal and unreacted chelate were analyzed on leachate and the mixed ash samples initial and after 3 years according to Japan standard method for industrial waste water. The specific analysis method is shown in Tab.1.

Table 1 Sample analysis method

Analysis items	Analysis method
pH	Glass electrode rod
Cl-	Titration
TOC	Combustion-Infrared analysis
SS	1 um pore size membrane filter
Heavy metal	ICP
Light metal	Ion chromatography
Unreacted chelate	Spectrophotometry

3. Result and discussion

3.1 Changes in Pb concentration over 3 years in leachate

Fig.2 shows that, the Pb concentration in leachate in anaerobic changes slightly and the concentration of all the months are very low and close to zero. This illustrates that Pb in mixed ash is completely stable in anaerobic. However, the concentration Pb markedly increased until ten months in semi-aerobic, and exceeded effluent standard of leachate (0.1 mg/L) in after five, nine and ten months. After that it started significantly decreased, and the Pb concentration drops to zero after 22 months.

The results of Pb re-elution concentration manifest different characteristics, indicates that air is an important indicator of the Pb re-elution, especially oxygen. This phenomenon is also consistent with previous research.

3.2 Changes in Pb concentration between semi-aerobic and anaerobic

As the Fig.3 shown, the Pb concentration of leaching test both increased in semi-aerobic and anaerobic columns, and as the depth addition the concentration shows a growing trend. The highest Pb concentration of leaching test is 0.20 mg/L and 0.17 mg/L respectively semi-aerobic and anaerobic, but still below the landfill standard (0.3 mg/L).

From the results, the trend of lead concentration between semi-aerobic column and anaerobic column is identical. It indicates that the re-elution of lead concentration is less affected by the effects of semi-aerobic and anaerobic environments after a long period. And, the reasons for the changes in different depth will be discussed further later.

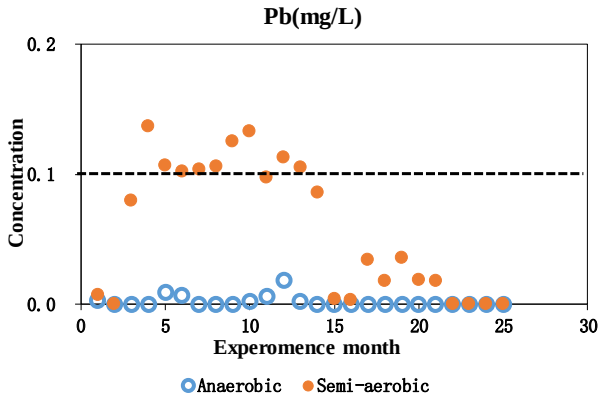

Figure 2 The concentration of lead in leachate over 3 years

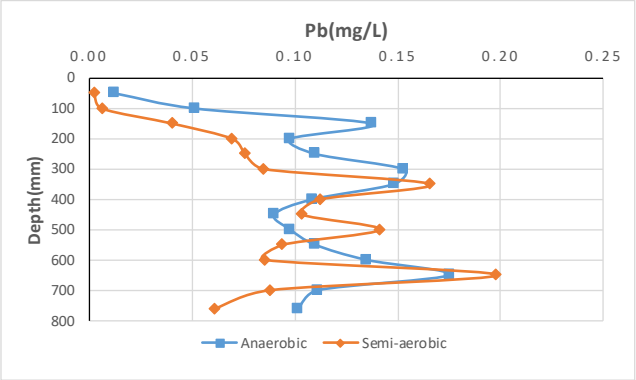

Figure 3 The concentration of lead in semi-aerobic and anaerobic tanks

4.Conclusion

The MSWI mixed ash specimen was taken from T incineration plant. The column test simulated the landfill environments including semi-aerobic and anaerobic environments were conducted for clarifying the Pb re-elution situation and the trend of Pb concentration in leachate from both columns were monitored. The conclusion can be drawn as following:

1. The Pb concentration in leachate in anaerobic changes slightly and the concentration of all the months are very low and close to zero. However, the concentration Pb markedly increased in the beginning 10 months and then gradually decreases, until 22nd months the concentration drops to zero. This phenomenon indicates that air is an important indicator of the Pb re-elution, especially oxygen.

2. The Pb concentration of leaching test both increased in semi-aerobic and anaerobic tanks, and as the depth addition the concentration shows a growing trend, due to insoluble compounds transform to soluble compounds.

3.The trend of Pb in leaching test after three years also proves the changes of Pb concentration in leachate over three years in both columns.