

LEACHING OF LEAD (Pb) FROM ABANDONED MINE SOIL IN COLUMN EXPERIMENT

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Introduction

Column leaching test is common tool to investigate amount of HMs leached from soils under leaching solutions. In this research, column leaching was conducted to evaluate change in total Pb concentration as well as in fractions of mine soil (upper soil) and fresh soil (underlying soil) under affecting of two leaching solution in two months and four months in laboratory.

Materials and Methods

This research was carried out on soil collected from Da-duk (DD) abandoned mine area in Jeollanamdo, Korea which was heavily contaminated with Pb. Two leaching solutions were used in this research including natural rain water (RW, pH6) and modified rain water (pH3 adjusted using HNO₃ as acid mine drainage (AMD)).

A PVC column (1 cm internal diameter and 90 cm height) was divided into 6 parts and the cellulose filters (0.2 cm layer) were inserted between parts as well as the bottom of the columns. The upper first part was an empty part. The next part was putted air-dried contaminated soil. Other last four parts were the same, filled with fresh soil (Fig. 1). Two the similar column series were made to work with two leaching solutions (AMD and RW). Leaching solutions were pumped into columns by peristaltic pumps set to flow at 9 mL/h and run 4 times/day with 15 min/time. This installation stimulated the rainfall situation in the southeast of Korea (Fig. 2). After 2 and 4 months leaching, soils were collected again and then air-dried to reach constant weight before doing the next analyses.

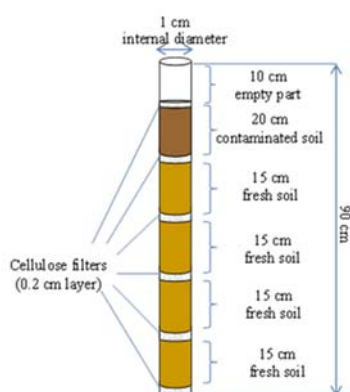


Figure 1. Structure of a column



Figure 2. Column leaching system installation

Pb concentrations in total and fractions (five fractions followed Tessier et al (1979) procedure) were determined using inductivity couple plasma optical emission spectrometry (ICP-OES).

Results

Concentrations of Pb decreased significantly after 2 and 4 months leaching. Leaching amount of Pb from mine soil in AMD (pH3) condition was greater than that for RW (pH6) condition (Fig. 3) as expected.

In fractions, concentration of Pb decreased in all fractions under AMD (pH3) leaching condition after 4 months experiment, indicating that Pb bound to fractions was leached out by AMD. In RW condition, amount of Pb in F1 (Exchangeable),

F2 (Bound to carbonate), F3 (Bound to Fe-Mn oxides), and F5 (Residual) decreased, but increase in F4 (Bound to organic matter) (Fig. 4). Zhang et al (2010) suggested that some heavy metals fractions were destabilized and re-absorbed on the organic matter. That may be the reason why concentration in F4 increased.

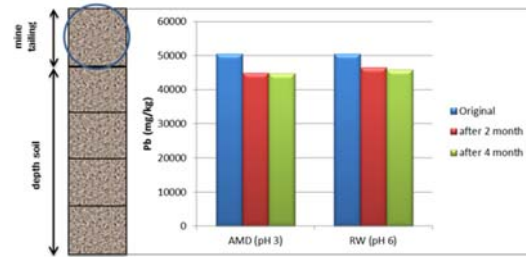


Figure 3. Amount of Pb leaching after 2 and 4 month from mine tailing with two leaching solution.

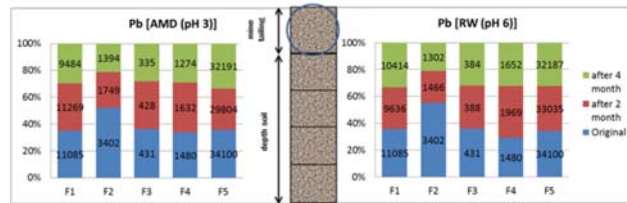


Figure 4. Change of chemical speciation of Pb in mine soil under AMD and RW leaching.

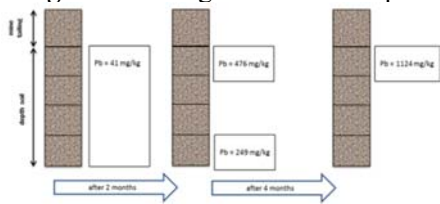


Figure 5. Cu and Pb concentrations in the depth soils under AMD leaching condition, pH 3.

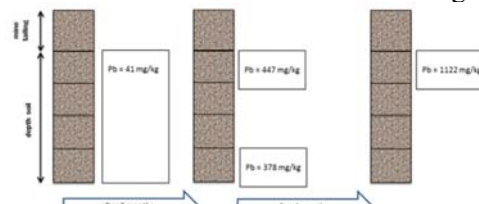


Figure 6. Heavy metals concentration in the depth soils under RW leaching condition, pH 6.

Concentration of Pb in fresh soil increased sharply in both of AMD and RW conditions after 2 and 4 months leaching experiment (Fig. 5 and Fig. 6), indicating that fresh soil captured amount of Pb leached out from top contaminated soil.

Conclusion

Concentrations of Pb decreased significantly after 2 and 4 months leaching in both of AMD and RW conditions. Pb bound to fractions decreased after 4 months, except for F4 in RW condition. In fresh soil, Pb concentration increased sharply in both of AMD and RW conditions after 2 and 4 months experiment.

References

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 Zhang, M.K.; Liu, Z.Y.; Wang, H. (2010). Use of single extraction methods to predict bioavailability of heavy metals in polluted soils to rice. *Communications in Soil Science and Plant Analysis*, 41, 820-831.