Methods for Evaluating Leaching Behavior of Naturally-Contained Arsenic in Sediments

Mutsumi Hori

Key Words: Marine sediments, JLT46, Up-flow column test, Column percolation test, Sequential extraction

1. Background and objectives

Marine sediments containing non-anthropogenic heavy metals and metalloids may be generated in large volumes from construction works. Because of the potential contamination risk from such soils, batch leaching tests such as, the Japanese regulatory leaching test method (JLT-46), are often performed to evaluate the soil leaching potential. However, the conditions of this test do not simulate actual contact of the soil and percolated water. Therefore, up-flow column test is also commonly used to evaluate the mobility of chemicals; however, the flow direction and saturated conditions are also different from actual phenomenon. This study evaluates the effects of drying of soil samples and a pore size of membrane filter used for solid-liquid separation on the soil leaching behavior by JLT-46, and leaching behavior under both upflow-saturated and downflow-unsaturated conditions. In addition, existing forms of chemicals were also assessed by the sequential batch extraction test.

2. Materials and methodologies

The experiments were conducted using naturally contaminated soil excavated from a seashore area in Japan, and at a depth of approximately 10 meters. The leaching behavior of the soil was evaluated with JLT-46, up-flow column test, water-drop column test, and sequential batch extraction method.

3. Main achievements

The main results obtained from this study are discussed below:

(1) For the turbidity, the results of JLT 46 with different pore size of membrane filter (MF), it was observed that the fine soil colloids couldn't be completely filtered by 0.45 μm MF (Table.1).

(2) Soil wet/dry condition influenced the turbidity. It was observed that turbidity increased for sand (dry-soil condition), and clay (wet-soil condition). However, the leaching of heavy metals was not affected by the wet/dry soil condition, but was dependent on place of excavation.

(3) Comprehensive evaluation of the results of up-flow column test and JLT 46, heavy metals such as iron, do not exhibit much change in elution behavior and therefore are overestimated, while elution behavior of arsenic, and aluminum are underestimated when using JLT 46.

(4) The leaching behavior of arsenic from both up-flow column test and water-drop column test were complex, however, when comparing cumulative amount of elution, both tests exhibited similar trend. It was observed the up-flow column test results reflect dissolution behavior in the real environment.

(5) In the current issue of JLT 46, it is not possible to grasp the dissolution behavior over time, it may lead to overestimate or underestimate. Therefore, it was observed that the combination with up-flow column and water-drop column test is desirable.

Table.1 Turbidity characteristics of leachate

Turbidity (NTU)	0.45 μm MF		0.10 μm MF	
	Wet	Dry	Wet	Dry
HS	0.96 ± 0.03	0.04 ± 0.00	0.05 ± 0.01	1.33 ± 0.22
HC	8.93 ± 0.91	0.06 ± 0.02	0.06 ± 0.01	26.2 ± 2.85
YS	0.02 ± 0.00	0.02 ± 0.00	0.02 ± 0.00	0.03 ± 0.01
YC	1.32 ± 0.03	0.05 ± 0.00	0.02 ± 0.00	0.17 ± 0.01