

Calcium Leaching Properties of Lime-treated Soil by Infiltration of Tidal River Water

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ABSTRACT

At present, the leakage is found in foundation of the dike constructed 20 years ago. The dike is constructed along the river in which directly connect to the Ariake Sea surrounded by a vast flat coastal area with very large tidal range. The Ariake clay and lime admixture were used as a main material for the foundation of the dike. The sludge material was found on the surface of lime-treated soil at the leaking point. This condition could weaken the treated soil in the foundation, and subsequently reduce the stability of the dike. In this study, in order to verify the cause of sludge materials leach from lime-treated soil, both water quality analysis in the field and two leaching test (solvent: NaCl and H_2O_2) at the laboratory were performed. There is tendency of Ca^{2+} leach from lime-treated soil due to the high concentration of NaCl and H_2O_2 solvent. The results indicated that the infiltration of tidal river water to the lime-treated soil induces increasing in the leaching of Ca^{2+} in which could reduce the strength of the treated soil.

KEY WORDS: Quicklime, Ariake clay, Soil stabilization, Tidal river, Leachate

INTRODUCTION

A dike plays a very important role in surroundings of drainage basin to protect the residents area from flooding due to heavy rain. This study focused on the dike that the lime-treated Ariake clay has mostly been used in the dike of foundation. The river connects to the Ariake Sea located in Kyushu Island, Japan, which has very large in tidal range. At present, 20 years from construction of the dike, leaking from the lime treated soil layer have found at the toe of dike and form swamps in the surrounding area. This leakage problem would give the negative impact not only in water quality as the salt water intrusion could infiltrate into the groundwater, but also could affect the slope stability of the dike. The lime-treated soil has considered stable for a long period due to the hydrate generated by pozzolanic reaction (I.Bozbey, E.Guler. 2006). However, there are some reports about reducing in the strength of the lime and cement treated soil (Kamon et al. 1996, Hayashi et al. 2004). The infiltration of river water cause leaching of chemical component in the lime-treated soil and reduce the strength of the dike foundation. In

this study, the field investigation was carried out to observe the condition of the lime-treated soil at the dike, and the laboratory test was conducted to verify the effect of river water on the leaching property of lime-treated soil.

FIELD INVESTIGATION

Distribution of Leakage Point

The investigation in the field was conducted in drainage basin of the river. Figure 1 shows the distribution of leakage points along the study area. The river that investigated in this study is a tidal river with very large tidal range. The concentration of NaCl in the river depends on the distance from the estuary. Figure 2 shows relation between NaCl concentration and distance from the river mouth. The leakage and sludge points were concentrated near the estuary, and few were found in the upstream. Moreover, it is considered that the lime-treated soil sludge was influenced by the concentration of NaCl in tidal river water.

Observation of Leakage Point

The schematic illustration of leakage and sludge point of the dike is shown in Fig 3. Surface excavation at the lime-treated soil layer was carried out at the sludge leaking point at the toe of dike. Figure 4 shows the photograph of typical cross section of leakage and sludge point. On the excavation point, a bistered colored leachate was observed that might be affected by Fe_2O_3 . This might be due to the Fe_2O_3 produced by oxidation of pyrite in Ariake clay.

Water Quality of Leachate

Water quality analysis both the leachate and tidal river water were performed. As shown in Figure 1, three leakage points (1~3) where the remarkably leaking points were selected to analyze. Lime-treated soil and sand mat were used for foundation material of the dike. In order to investigate the change of water quality by infiltration of river water into the dike, the river water and leachate was collected to analyze. The two types of foundation material were observed in this study such as the leakage point from lime-treated soil material (upstream and downstream) and at the leakage point from sand mat material. The