Abstract

Application of iron and steel slags has been a promising approach to reduce many environmental and economic burdens. They have been utilized in various application areas such as road base materials, cement production, fertilizer manufacturing, soil improvements and so on. Using the slags can reduce not only the disposal amount of industrial waste but also required amount of natural resources to be extracted. One of their applications is using as additives to improve properties of dredged soil. Marine dredged soils are generating in large amount every year in all over the world with major purposes of developing ports and harbor infrastructures as well as to make water ways navigations. Those soils were managed by dumping in offshore areas ages ago, till significant environmental consequences for marine environments were recognized. Therefore, it has been encouraged to reuse those soils after improving their physical and chemical properties by mixing with additives. Many studies have focused on using iron and steel slags to enhance the properties of dredged soil and utilizing them. In this dissertation, fundamental investigation for properties improvement of dredged soil with different iron and steel slags, and the applicability of the soil–steel slag mixtures in marine environments were discussed.

Primarily, improvement of physical and chemical properties of the dredged soil by using two different iron and steel slags which are generated from different generation stages were studied. Strength development and immobilization of arsenic were focused by conducting unconfined compression strength and batch leaching tests. The mixtures of specimens were prepared by mixing Kasaoka clay either with blast furnace slag or steelmaking slag. Three mixing ratios of slags: 10, 30, and 50 wt.% were considered. It was observed that strength of the soil was enhanced significantly when it is mixed with steelmaking slag. There was no strength development when the soil is mixed with blast furnace slag. From the perspective of immobilization of arsenic, the leaching concentration of As was notably reduced by mixing with any slag.

Then, the research has continued to focus about application the dredged soil and steel mixtures in marine environments. Although dredged soil–steel slag mixtures have been used in constructions at coastal and marine environments, their long-term performance has not yet been fully discussed. Deterioration mechanisms of the mixtures were considered in this study by immersing specimens in seawater and Mg-solutions with

different concentrations because Mg^{2+} is considered as a major influencing element on strength of cementitious materials. Leaching of contaminants from the mixtures were also examined. Needle penetration tests and batch leaching tests were conducted to evaluate the deterioration mechanisms and leaching of contaminants.

In conclusion, this study presents evaluation on the applicability of iron and steel slags in enhancing the properties of dredged soil and utilizing soil and steel slag mixtures in marine environments. The experimental design and results from the preliminary study of soil and the slags mixtures help to understand the genuine performance of the slags on soil improvement. The results and findings from the investigation of immersion the mixtures in different seawater can be used to estimate service life of the mixtures in marine environments by understanding the effects of deterioration by seawater intrusion.