

Study on Application of Coal Ash to Constructed Soil for Improvement of Acidic Soil without Soil Erosion on Slope Face

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1. Introduction

The development of inland areas has caused the disposal problem of excavated soils as well as acidification of the soils at working face in Japan. The amendment of excavated soils and covering of a working face with improved soils can help solve both problems. On the other hands, the demand for reusing coal ash including fly ash and bottom ash has been increased in Japan. The coal ash can improve soil texture and soil pH; therefore, the utilization of coal ash to excavated soils as soil amendments is highlighted in this study. However, as improved soils are applied as covering materials on slope face, soil erosion should be considered. In addition, the change of soil texture and soil pH by mixing coal ash in soils may change the erodibility of soils according to past studies. In this study, the application of coal ash to excavated acidic soils is discussed in terms both of improvement of acidic soils and prevention of soil erosion on slope face.

2. Materials and Methods

Soil was prepared by mixing decomposed granite soil and bentonite based on the soil texture in Ishikawa where the surface layer collapsed by rainfall due to acid soil. The soil pH of the soil was set at 6.0, followed by preparing acidic soils by immersing in sulfuric acid solution. The soil pH was set at pH 2.0, 4.0, and 6.0. In addition, 2 types of coal ash, which were named as bottom ash (BA) and fly ash (FA) (Table 1 shows the soil texture of the samples), were mixed in the simulated soils showing different soil pH at different mixing rate from 0 to 30%. An artificial rainfall test was conducted with the prepared soil samples in order to understand the soil erosion behavior as well as improvement of acidic soils and the change of liquid limits (W_L).

Table.1 Soil texture.

	Sand (%)	Silt (%)	Clay (%)
Soil	13.4	61.4	25.2
BA	80.4	5.0	14.6
FA	0.3	19.3	80.4

3. Results and Discussion

Figs. 1 and 2 show the change of soil erosion of BA and FA mixing soil at different mixing rate and soil pH. Fig. 1 shows that soil erosion is reduced by mixing BA into the simulated soil at any soil pH. This is due to the increase of permeability and the reduction of surface runoff with the increase of sand content after mixing BA. On the other hands, Fig. 2 shows that soil erosion is reduced when 10% of FA is mixed into the simulated soil at soil pH 4.0. According to the change of W_L in Fig. 3, the increase of W_L at 10% FA mixing soil at soil pH 4.0 attributes to the reduction of soil erosion. Based on the pH-Eh diagram of Fe, the precipitation of Fe^{3+} can be formed at 10% FA mixing soil at soil pH 4.0 due to neutralization effects of FA, meaning that the precipitation affects the W_L of FA mixed soil. Consequently, BA and FA can be utilized to improve acidic soils without soil erosion by focusing on the different effects as discussed above.

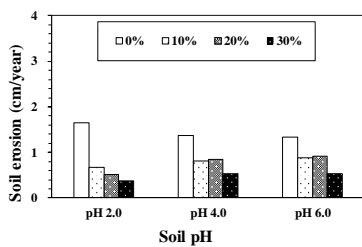


Fig. 1 Soil erosion of BA mixing soil.

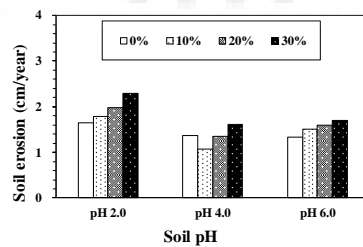


Fig. 2 Soil erosion of FA mixing soil.

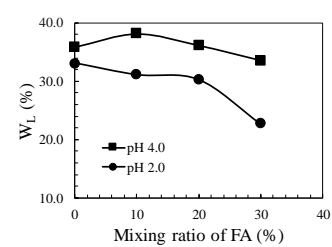


Fig. 3 Liquid limits (W_L) of FA mixed soil.