Research on Modification Effect of Organic Soil Cement Using Slag

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INTRODUCTION

Soil cement construction method utilizes the soil on site. So the quality of completed soil cement is largely dependent upon the property of soil on the site. When an organic component is included in the soil, it hinders the cement solidification, meaning that it won't be a suitable material for soil cement construction method. But much debris flow deposit exists at sabo dam installation spots. Debris flow floats down dragging in driftwoods and surface soil with herbaceous, leading to high possibility of organic soil. So the soil on site shall need improvement before applying it as the material for soil cement. In other words, if this improvement goes well, the soil on site can be heavily used as such material. We focused on steel slag generated during steel production as the neutralizing material for organic component. Steel slag is known from of old to have high hydraulic property. By making good use of this characteristic, steel slag is widely used as the material for Portland blast-furnace cement, aggregate for building construction and many more. Our research studied how much improvement can be made upon the organic soil using steel slag. This was done by comparing the developed strength of test piece with steel slag added to organic soil and another one with crusher run added. We judged whether improvement was made using steel slag, by how much strength was developed.

REASONS TO USE SLAG AS THE IMPROVING MATERIAL

Following is understood by the research on soil cement. When an organic component is included in the soil, negative ion is created and this negative ion takes away the calcium ion within the cement, making it hard for the cement to do hydration reaction. So gypsum, lime salt and such are mixed as a countermeasure because these saturate the negative ion hindering the cement solidification. Steel slag containing much limestone (CaO) is thought to have the same effect as gypsum and lime salt. Moreover, silica (SiO_2) and alumina component (Al_2O_3) promotes the pozzolanic reaction, which contributes to the cement strength. Pozzolanic reaction also heighten the acid resistivity and freezing-thawing resistivity. This means that steel slag shall have effect on both, assisting cement solidification and raising strength through the promotion of pozzolanic reaction and we may highly expect it to be a suitable improving material for organic soil.

TESTING METHOD

1) Considered cases for the composition test

Test piece cases for the composition test are as follows: 1-organic soil only, 2-soil mixed with crusher run (40%, 70%), 3-soil mixed with steel slag (40%, 70%). Crusher run has been used to improve granularity for soil cement construction method from of old. We compared this with steel slag to check the improvement effect.

2) Chemical composition of organic soil

Fig.1 shows the amount of fulvic acid and humic acid contained in the object soil. Fulvic acid and humic acid are organic components. The object soils are the soils mixed with 40% of steel slag and 70% of steel slag. As a result, when organic soil is mixed with steel slag, the organic component that hinders cement solidification (=fulvic acid and humic acid) showed a drastic decrease. This shall mean that steel slag has a high modification effect on organic soil.

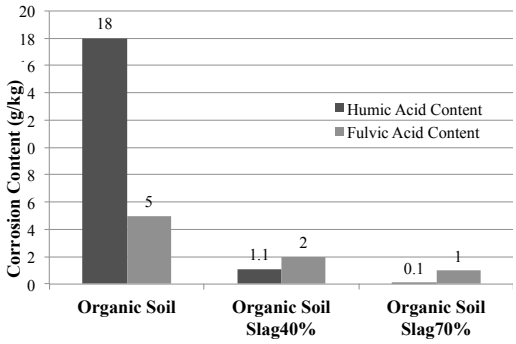

Fig.1 Corrosion content of organic soil

TEST RESULT, CONSIDERATION

1) Strength characteristics of organic soil

The peak value of organic soil couldn't be high enough even after the increase of cement input. This is due to the nonoccurrence of the hydration reaction necessary for strength development. Therefore, it can be understood that organic soil is a difficult material to use for soil cement construction method.

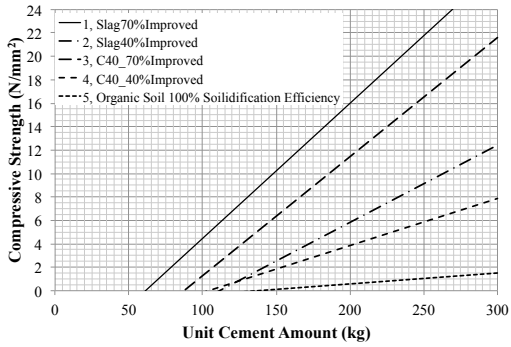

Fig.2 Unit cement amount – compressive strength (σ28)

2) Strength characteristics of organic soil with improvement using crusher run

When mixing 40% of crusher run to organic soil, enough peak value could be generated for the cement amount of 200kg or 250kg, but not for the cement amount of 150kg. This shall be suggesting that it is necessary to decrease the ratio of organic soil to the whole, which hinders the hydration reaction, to a certain amount to develop strength just by particle size control using crusher run.

3) Strength characteristics of organic soil with improvement using steel slag

Fig-2 shows the relationship between strength development and organic soil, crusher run mixed soil or steel slag mixed soil. It seems that both, crusher run and steel slag, can be used as the improvement material for organic soil, by mixing it into the soil and developing compressive strength necessary to perform its functional efficiency. And when comparing the compressive strength after 28 days, the one for steel slag is 1.3 to 1.5 times higher than that of the crusher run. This difference is the modification effect on organic soil and can be understood that steel slag shows higher effect as an improving material.

CONCLUSION

Soil cement is a very effective construction method that contributes to environmental impact and cost reduction by utilizing the soil on site. But the soil on site in mountainous regions may, with high possibility, have some difficulty to be used as the material for soil cement, due to the organic component contained in the debris flow deposits at riverbed or humus contained in surface soil. This could be one reason why soil cement cannot easily diffuse. But, we found out from this research that high modification effect could be seen by adding steel slag to organic soil through contribution to cement solidification, together with particle size control.

Key words: Soil cement, INSEM material, Organic soil, Slag, Granularity adjustment effect, Modification effect