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Particle Size Distribution Effect on Unconfined Compressive Strength of Sand-Slag-Fiber

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ABSTRACT
Particle Size Distribution (PSD) is one of the important factors affecting the behavior of soils. This study in combination of such an effect and soil stabilization. In this study, sand mixed with slag a fiber exposes to UCS testing. The mixture has been stabilized with very high fiber percentage 20% , the slag was varied from 5%-15% . The results showed that UCS values changed by PSD variations.

Key Words: PSD, Slag, Fiber

1. INTRODUCTION

The investigation of the behavior of the soil is one of the important factor in our managing the stresses into a firm ground. Of those literature, readers can be referred to [1-14]. The stress investigation was conducted in different aspect as an example, numerical modelling of stresses and it application in pavement engineering [4], anisotropic matters in [5], liquefaction stresses in [9] or a cyclic one [12].
The fiber application is relevant to this study and being applied in shear, permeability and compressive strength [15-23]. The application of fiber not limited to direct shear testing, compaction, UCS, permeability testing and triaxial testing.
The by- product application such as flyash being investigated in literature and some of them can be access in [24-30]. The usage of fly-ash helps the community not only removed them from land fill but also use them effectively in geo-project. Another popular by-product is slag which being applied in soils in different occasions. [31-34]. The bentonite also being applied to stabilize and being used in cut-off walls [35-36].
The further application of tyre is also studied in literature [37-42]. Very limited study has considered a very high fiber dosage along with slag.

This study is a continuation of research in Curtin University. The study is considering effect of slag into fiber-clay compressive strength. This work is continuation of stabilization research on soil in Curtin university.

2. MATERIALS

This study aimed to consider the mixture of clay, fiber and cement. The following sections show the used materials:

2.1 Clay

Three soils with different PSD curves but all sandy type were selected to do this research. The PSD s are presented in Figure 1.

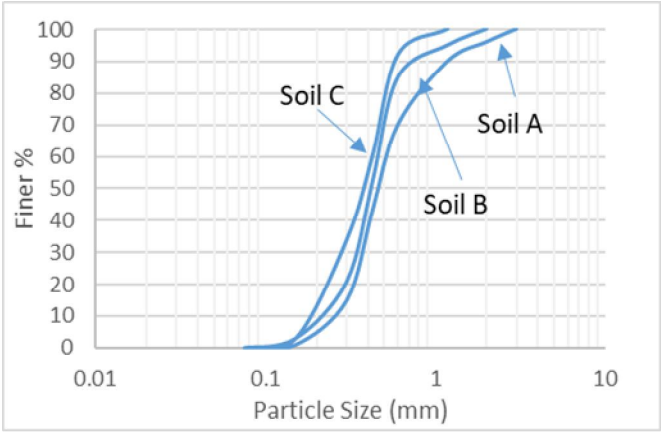

Figure 1: PSD curves of the employed soils

2.2 Slag

The slag properties can be found in the table 1. The slag was sourced from Perth supplier.

Table 1: Slag properties

Item	Characteristics/values
pH	12
Appearance	Grey
Specific Gravity	2.5

2.3. Fibre

The fiber was sourced from Western Australia supplier with the width of 0.8 mm and length of 2mm.

2.4. Fillers

Tyre and fly ash was used as filler at constant 0.5%.

3. TESTING PLAN

The compressive strength of mixture was evaluated using the UCS device. First, the mixture were prepared as combination of soil A/Soil B/Soil C and slag and fiber. The slag percentage was varied from 5 to 15%. The fiber had dosage of 20%. The fiber kept constant to reduce the complexity of testing. The UCS testing were planned as presented in Table 2.

Table 2: Testing program utilized in this study

Sample ID	Slag (%)	Soil PSD	Fiber (%)
S-5SL-20F	5	A,B,C	20
S-10SL-20F	10	A,B,C	20
S-15SL-20F	15	A,B,C	20

4. TEST RESULTS

4.1. Compaction Results

Table 3 displays the compaction features of the used mixes. As can be referred, addition of slag (SL) increased the OMC and reduced MDD value of the mixtures. Table 3 represents the values of compaction for soil A. Table 4 indicates the compaction results for soil B. Table 5 shows the results of compaction for soil C.

Table 3: Results of compaction tests for Soil A

Sample ID	Slag (%)	OMC (%)	MDD(gr/cm3)
S-5SL-20F	5	15.1	1.63
S-10SL-20F	10	17.3	1.58
S-15SL-20F	15	17.6	1.52

Table 4: Results of compaction tests for Soil B

Sample ID	OMC (%)	MDD
S-5SL-20F	14.9	1.61
S-10SL-20F	17.2	1.57
S-15SL-20F	17.5	1.5

Table 5: Results of compaction tests for Soil C

Sample ID	OMC (%)	MDD
S-5SL-20F	14.8	1.6
S-10SL-20F	16.8	1.55
S-15SL-20F	17.4	1.49

4.2. Unconfined Compressive Strength

The results of UCS tests can be seen for different soils (i.e. soil A,B,C). Figure2 shows the UCS values for Soil A,B, C. The results show the soil A has the highest value of UCS while the soil C shows the lowest.

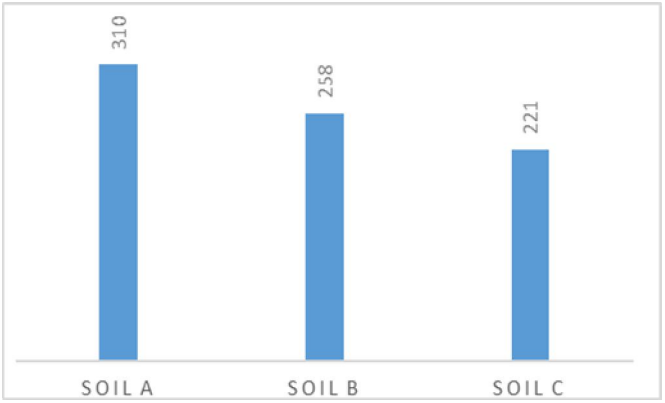

Figure 2: UCS results for sample S-5SL-20F

Figure 3 represents the values of UCS relevant o soil A,B and C for slag percentage of 10%. Once again, soil A represents the highest UCS values. Same trend of higher value of soil A noticed in slag dosage of 15% as can be seen in Figure 4.

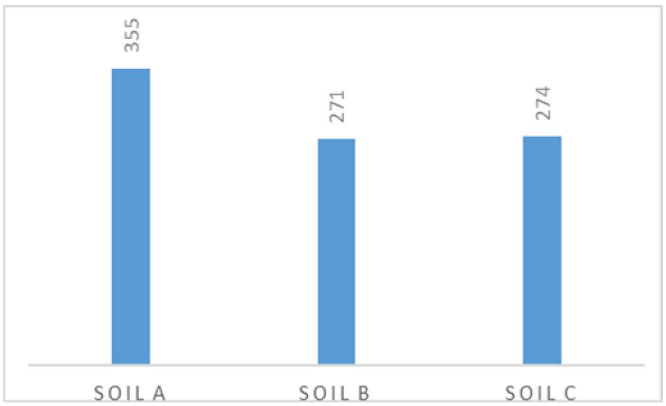

Figure 3: UCS results for sample S-10SL-20F

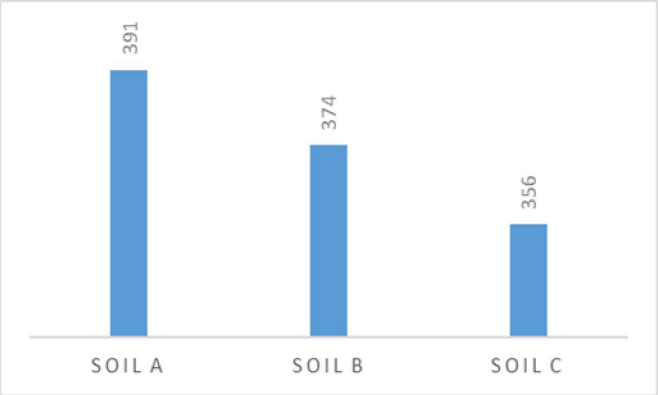

Figure 4: UCS results for sample S-15SL-20F

The slag effect can be seen in Figure in regards to soil A,B,C. Figure 5,6,7 show the effect of slag dosage in UCS values of soil A,B and C.

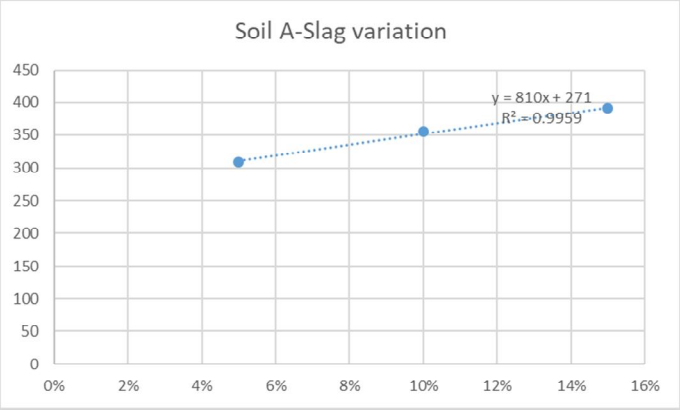

Figure5: UCS results for soil A in different slag dosage

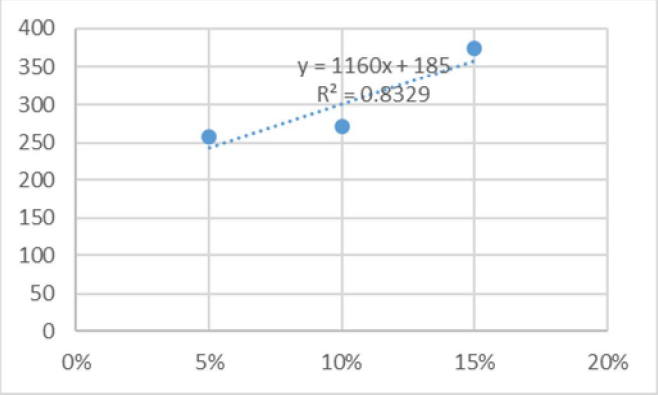

Figure 6: UCS results for soil B in different slag dosage

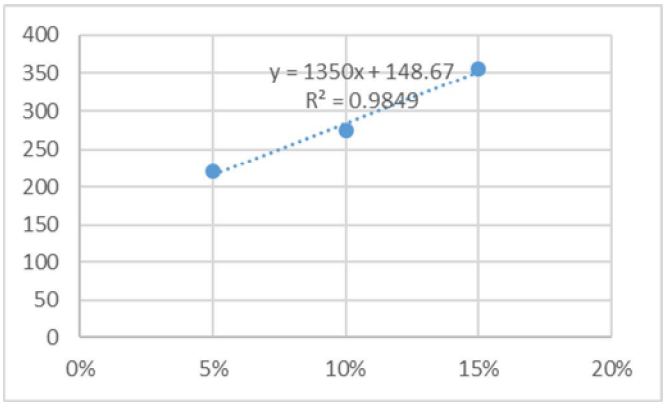

Figure 7: UCS results for soil C in different slag dosage

5. CONCLUSION

The conclusion supports that increasing in slag dosage OMC increased and MDD decreased. The soil C showed less UCS compare to soil A. The soil B also showed less value compare to soil A. The effect of slag on the UCS of mixtures was linear and R-square of the line was very close to 1.

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