Effects of Sawdust on Geotechnical Properties of Clayey Soils

R. Tadayyon[1] R. Dabiri[2]

1. Introduction

According to the unified soil type category system, when all of soil particles size that are less than 0.075 mm, these are located in fine soil part. If these fine soils mixed with some water and plastic properties can be observed. Therefore, these soils are included in clay type. Otherwise, fine soils become silt. Clay is a soil that has the swelling ability. So that with water content changes, remarkable mass variations can be observed. Swelling and shrinkage due to moisture and water content variations can cause serious damage to buildings and constructions. On the other hand, sawdust is produced from cutting, sanding or rubbing of wood with a sawing or other tools which consists of fine particles of wood. Generally, sawdust waste is accumulated in metropolis cities can cause serious environmental problems and health hazards. Since the production of wood waste and sawdust in unavoidable in timber factories and wood working industries and constructions, so much effort is made to use these waste products. The main idea of this study, evaluation of sawdust effect on geotechnical properties of clayey soils.

2. Materials and experimental program

For this purpose, two types of kaolinite clayey soils with different plasticity index were considered. In this research, pinewood sawdust particles with 3, 6 and nine percentage was mixed to clayey soils. For determining geotechnical properties of improvement clayey soils Atterberg limit (ASTM D4318-95a), compaction (ASTM D698), uniaxial strength (ASTM D2166), direct shear in dry and saturate conditions (ASTM D3080-11), heading fall permeability (ASTM D5084) and consolidation (ASTM D2435) tests according to ASTM standards has been performed. The clayey soils based on a unified classification system is in group CL. The grain size distribution of clayey soil and sawdust can be seen in Figure 1. Physical and geotechnical properties of materials have been proposed in Table 1.

3. Results

The results of this research showed that the optimum value of sawdust for improving clayey soil is equal to 3% (by weight). The reasons can be explained as follow:

1. When 3% sawdust was added to clayey soil specimens, minimum void ratio (e_{min}) value in kaolinite clayey soil (T1) 24% decreased. These condition outcome is compressibility and reduces water absorption. With increasing sawdust content in clayey soil, the behavior of improved specimens was changed. So that, maximum dry density went down, and minimum void ratio and water absorption increased (Figure 2 and Figure 3).

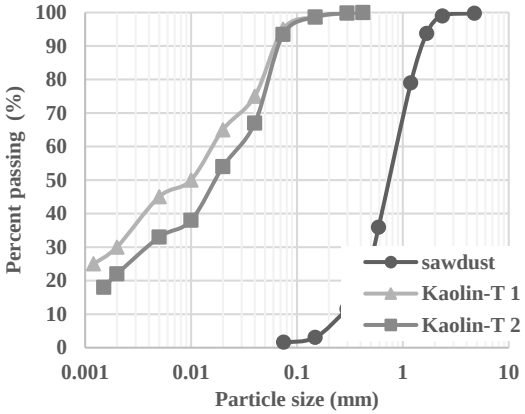

Fig. 1. The grain size distribution of materials in this study

Table 1. Physical and geotechnical properties of materials

Parameters	Kaolinite clay (T2)	Kaolinite clay (T1)
PI	11	15
Gs		
Percent of sawdust	Kaolinite clay (T2)	Kaolinite clay (T1)
0	2.65	2.62
3	2.7	2.72
6	2.52	2.65
9	2.58	2.79

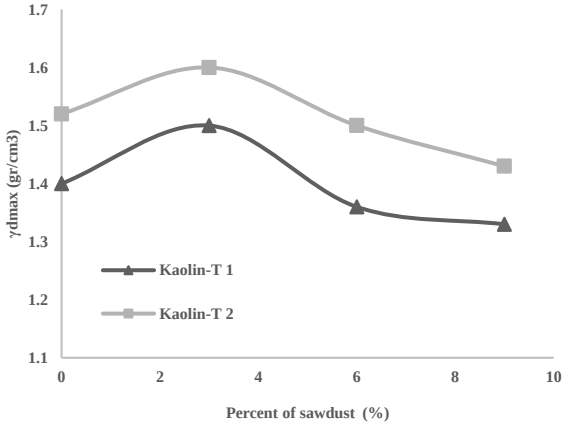

Fig. 2. Effects of sawdust content on the maximum dry density of improved clayey soils

[1] M.Sc. of Geotechnical Engineering, Tabriz Branch, Islamic Azad University, Tabriz, Iran.
[2] Corresponding Author, Assistant Professor, Department of Civil Engineering, Tabriz Branch, Islamic Azad University, Tabriz, Iran.
Email: rouzbeh_dabiri@iaut.ac.ir

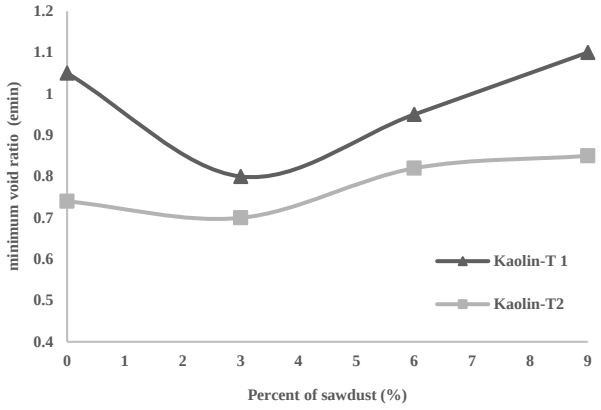

Fig. 3. Effects of sawdust content on the minimum void ratio of improved clayey soils

2. With adding 3% sawdust in Kaolinite clay (T1), cause increasing uniaxial strength (by 33%), elastic modulus (by 3.5%), shear strength (by 26.1 % in dry and 12.1% I saturate conditions). moreover, , with increasing sawdust up to 1%, bearing capacity of mixed specimens decreased.

3. Sawdust can be effective in the consolidation behavior of clayey soils. Therefore, with adding sawdust in clayey soils, the swelling index goes down. Although with mixing 3% sawdust in clayey soils, compression index achieve to the minimum value, after that with increasing sawdust content, consolidation settlement goes up. Also, sawdust content was effective on permeability values of improved soil samples. Similar to swelling potential, with increasing sawdust percentage in specimens, permeability reduced. (Figure 4).

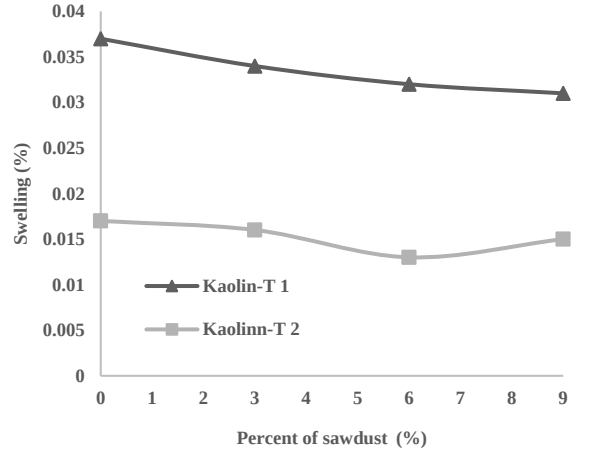

Fig.4. Effects of sawdust content on swelling potential of improved clayey soils

4. Conclusion

According to the results obtained from this research it can be explained that the behavior of improved clayey soils with sawdust is affected by minimum void ratio (e_{min}), water and moisture absorption and sawdust particles size. In unimproved condition, kaolinite clay T1, because of high plasticity properties have more minimum void ratio than kaolinite clay T2, which indicates high void, loose structure between particles and more flexibility. Also, presence of sawdust more than 3% in clayey soils causes increase void among particles and creates loose structure inter particles. In this situation, strength and bearing capacity of improved specimens go down. On the other hand, water absorption by sawdust can be effected on stabilized clayey soils. Therefore, with increasing sawdust particles in specimens, swelling potential and permeability decreases. Finally, with considering result of this study, it can be explained that sawdust particles with grain size less than 1.19mm is more effective in kaolinite clay soil with high plasticity index than clayey soil with low plasticity properties. For future research it is suggested that type of sawdust, different size of sawdust particles and application conditions (dry or ash) be evaluated.