Environmental Effect of Adding Zeolite and Sawdust on the Unconfined Strength of Stabilized Soil by Cement

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Abstract

Nowadays unlike decades ago, environment plays decisive role for using materials in construction. For example, one considerable part in a project is exploring environmental aspects as a preparatory topic. Chemicals such as cement have been used for decades in construction projects, however chemicals will lead to health catastrophe for both environment and human consequently. One considerable hitches in human life is waste materials such as sawdust which will jeopardise environment. One solution to alleviate these problems is using wastes in construction projects as substitution for cement. In this research, sawdust and zeolite were used to decrease cement use on sandy soil's improvement. Amount of materials are as follows: 4% cement (base on main soil weight), 0,1,3 and 5 % sawdust with two different sizes include powder and fibers (as supersede by cement) and 0, 10, 30 and 50 % zeolite as a supersede by cement. Results showed that zeolite and sawdust increase OMC but decrease MDD. Zeolite meets its optimum in 30% and powdered and fibrous sawdust in 3 and 1% subsequently. Finally, rupture strain will experience a sharp increase by enhancing amount of sawdust. Overall it can be concluded that longer sawdust is more effective than short one.

Keywords

Sandy soil, zeolite, sawdust, Portland cement, unconfined compressive strength (UCS)

1. Introduction

Soil improvement is one of the crucial part of constructions. There are sevreal methods for this purpose, for instance using chemicals such as cement is popular among engineers.

Even though using chemicals such as cement or lime has detrimental effects on environment, these chemicals are still used in massive amounts [1-3]. Moreover, not only these chemicals will jeopardize the environment but consequently will destroy our natural habitat which will lead to

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human disease. [4]. Today, many construction projects spend a significant portion of their funding on soil improvement [5,6]. Using zeolite can be suitable as a natural mineral to improve sandy soil's properties. Moreover, abundant mines in IRAN, especially in Semnan province, can play a decisive role for using zeolite instead of cement. In addition to the problems that cement poses to the environment, another major problem in today's society is the accumulation of waste products. One solution to this problem is reusing these wastes that can be used as additives to improve soil engineering properties. One of these wastes is sawdust, which is a by-product and waste of woodworking operations such as sawing wood [7].

2. Methodology

In order to investigate the effect of zeolite and sawdust on unconfined compressive strength (UCS) of sandy soil, the amounts of cement, zeolite, sawdust with two different sizes, and curing time considered as variants that lead to a total of 87 UCS samples. In order to improve well graded sandy soil (SW), 4% by weight cement, 0, 10, 30 and 50% zeolite as a replacement with cement and 1, 3 and 5% sawdust with two sizes of powdered and fibrous sizes with 7, 14, and 28 days curing period are used. Materials, equipment and processes are shown in Figure 1.

Figure 1. making samples steps - a) zeolite, b) powdered sawdust, c) fibrous sawdust, d) PVC mold, e) compaction test equipment, f) samples' curing process, g) powdered sawdust sample at the moment of rupture, h) fibrous sawdust samples at the moment of rupture

3. Results and Discussion

According to results, 30% of zeolite replacement with cement is optimal amount. In this case (30% zeolite addition), the UCS amount during 14 days will increase from 143.49 kPa to 264.33 kPa and in 28 days curing time will be enhanced from 203.91 kPa to 316.02 kPa which shows a 2.5-fold increase in the UCS of SW soil. Also, adding zeolite to cement samples will lead to enhancement of soil's rupture strain.

adding 1% fibrous sawdust and 3% of powdered sawdust lead to maximum UCS amount of SW soil during 14 and 28 days of curing period and decreased subsequently. Results of UCS tests are shown in Figure 2.

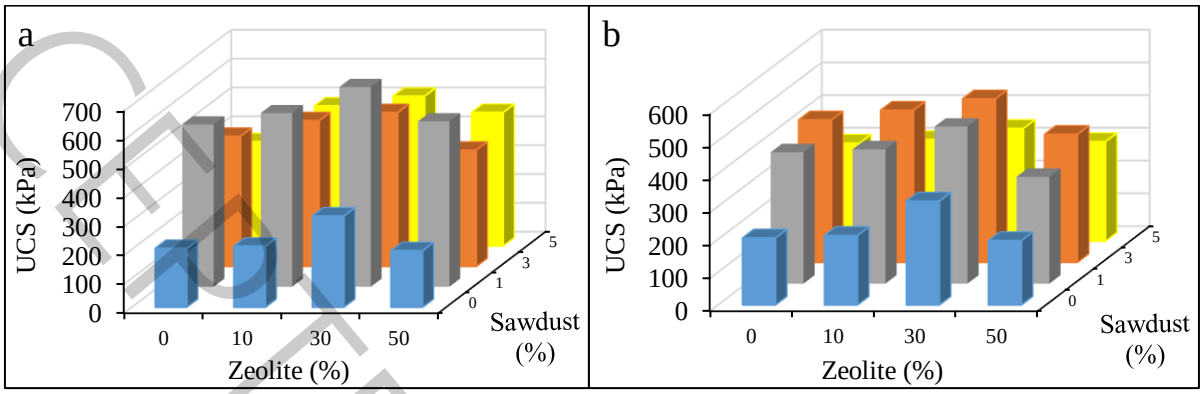

Figure 2. Results of UCS tests in soil stabilized by cement, zeolite and sawdust with 28 days of curing time, a) fibrous sawdust, b) powdered sawdust

4. Conclusion

According to the results of UCS tests, stabilized samples by cement, zeolite and fibrous sawdust will experience their maximum in 4%, 30% and 1% respectively and by adding more zeolite and sawdust, the UCS amount will drop. On the other hand, in stabilized samples with cement, zeolite and fine sawdust will meet their maximum strength in 4%, 30%, and 3% respectively. It can be derived from experiments that the use of fibrous sawdust compared to its powder state will bring much more advantages. It is due to the fact that fibrous sawdust causes the connection between distant soil particles with each other and at the moment of rupture, the long sawdust is stretched and show more strength and strain. However, using more sawdust will slump strength because it has a negative effect on the performance of cement in making cohesion between soil particles and will lead to heterogonous sample by sawdust accumulation.

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