Review on Road construction over Soft soil by enhancing its properties using Granite Dust

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Abstract

Now a days the transportation is available everywhere to make feasible to reach all over world without any issue. But still there is some places where the soil is really not feasible for road construction over it. For such type of soft soil (clayey soils) comprises swelling behavior when it experience water which causes highway pavement loss. To eradicate such situation some chemical additives is added to improve the property of such soil. In this paper granite waste dust is added to soil with different percentage (0%, 4%, 8%, 12%, 16%, 20% by weight) and evaluate the property enhancement of soil by finding the Atterberg limit, particle size distribution, dry density, bearing capacity and shear strength of soil. As per the result the most preferable replacement is taken in account to add the granite to make road over such soil.

Keywords: *Clayey Soil; Geotechnical Properties, Stabilization; CBR; Strenght*

Highlights

- The findings revealed that the geotechnical properties of clayey soils are enhanced considerably by the adding of deposited granite dust.
- The results have shown that mixing the clayey soil with the granite dust m improved the maximum dry density. Adding content of 8% of the granite powder to the untreated soil attains the best results.
- There is a great development in the strength of modified soil made with granite dust. The result showed that the values of CBR of treated soil increased as the percentage of the granite powder in the sample increased. The optimum granite dust content was 8%.
- The direct shear test showed that there was a noticeable indication of shear stress enhance as shear strain. Also, the study found that normal stress gets higher as the shear stress elevates. The shear strength of modified soils with granite dust is 3 times better than untreated soils

Graphical Analysis

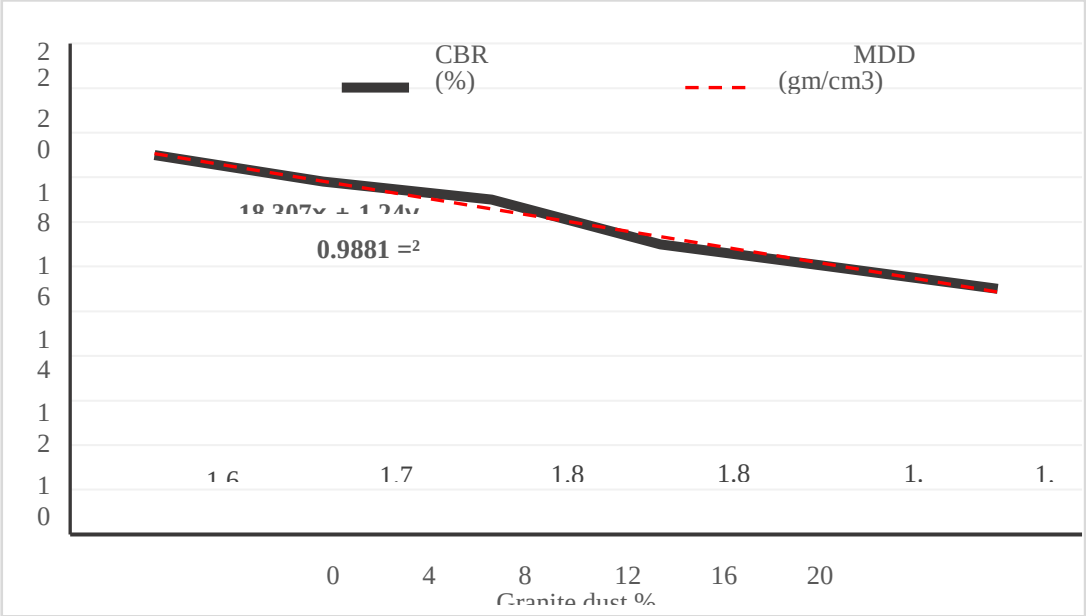

Fig. 1: The effect of granite dust on CBR, MDD, and OMC

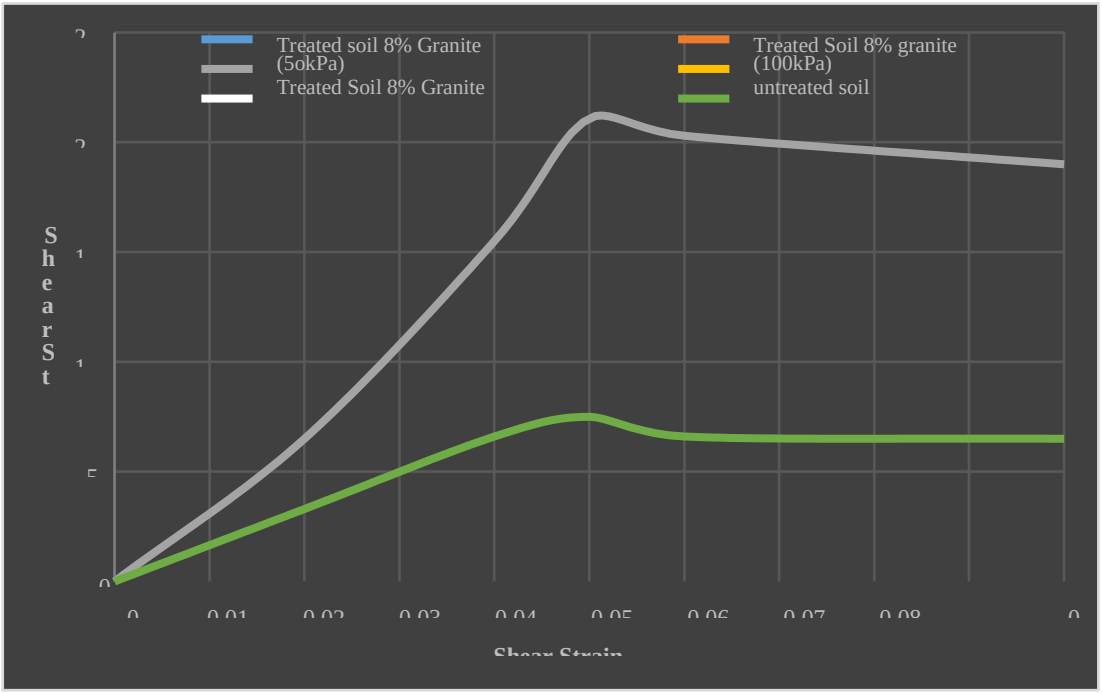

Fig. 2: The relationship between shear stress vs. shear strain on treated soil and natural soil

Reserch Objectives

The flexible pavement is highly dependent on the performance of underlying layers, particularly the subgrade (1-3). Several studies have recently been done to enhance the engineering properties of clayey soils. Therefore, this research aimed to improve the properties of subgrade. This experiment investigates the effect of granite dust on high-plasticity clay soil. The parameters examined were bearing capacity, MDD, OMC, particle size distribution, and shear strength. The performance of these parameters with a changing amount of the granite powder was utilized to evaluate the efficiency or otherwise of granite powder in enhancing the engineering properties of soft soils.

Several CBR tests, standard proctor tests, and direct shear tests were done on several soil samples mixed with different contents of granite dust (0%, 4%, 8%, 12%, 16%, and 20% by total weight of soil). This research aims to obtain the optimum content of granite dust that produces the best values of CBR, MDD and shear strength

Methodology

The materials used in this project were deposited granite powder and clayey soil. The granite dirt was obtained from a local factory. The natural soil utilized in this experiment was obtained from near the military airport of Elmarj. In preparing the soil for the tests, several preliminary tests were done. The preliminary tests were sieve analysis, Atterberg limits, and chemical analysis of soil. From the AASHTO Classification System, the natural soil is classed as A-6 (very plastic clayey soils). The liquid limit, plastic limit, and plasticity index of soil were 39.3%, 22.4%, and 16.9% respectively. According to the chemical analysis, the main constituents of granite dust are SiO_2 (silica) (72.9%), $AlsO_3$ (alumina) (15.3%), and K_2O (4.53%).

To prepare the samples for testing, various amounts of granite powder (4%, 8%, 12%, 16% and 20% by the weight of soil) were blended to the soils. The direct shear experiment was conducted on several samples with changing the amount of granite dust. The degree of loading was kept at 0.5 mm/min. The specimens were subjected to various rates of standard stresses. The CBR test was executed to determine the bearing capacity of the natural and modified soils. The Proctor compaction experiment was performed to ascertain the dry density of soils and OMC. Figure 1 exhibits the results of MDD, OMC, and CBR for all samples. While Figure 2 manifests the result of direct shear strength.

Results

The MDD of the soft soil improved with the heightening of the content of granite powder in soil. It is revealed in Figure. 1 that the highest value of MDD is 1.88 gm/cm3, which characterizing the treated soil with 9 % granite powder. On the other hand, the MDD of the natural soil 1.599 gm/cm^3. Therefore, it can be concluded that the MDD of soil was increased by about 16 %.

Figure1 shows that as the percentages of granite dust in the soil elevate, the ratios of CBR increase. The highest ratio of CBR reached was 15.8 %, that is corresponding to the treated soil with 8.00% granite powder. The lowest value recorded was when the soil is untreated with granite dust (CBR was 3.65%).

From Figure 2, the shear stress rises as shear strain escalates. the rise of the shear stress was extremely reliant on the rise of its normal stress. From Figure2, the untreated soil achieved its greatest shear strength with 18.33, 39.23, and 75.36 kPa subjected to stresses of 50, 100, and 200 kPa, respectively. On the other side, the soil mixed with 8% of granite dust powder attained its highest shear strength with 50.2, 118.72, and 221.76 kPa for stresses of 50, 100, and 200 kPa, correspondingly

Findings

The improvement in MDD and CBR indicates that waste powder operates as a greasy film on the exterior side of soil grains, reducing the absorption of water, and this eases the compaction, thus improving the connecting of soil grains along with MDD and CBR. Also, it can be concluded that mixing soil with 9% of granite dust powder improved the shear strength nearly 3 times higher than untreated soil. This result is consistent with previous researches (4-12) done on soils mixed with igneous rock i.e. marble dust. However, the previous studies have not investigated using other types of igneous rock such as granite

Refferances

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