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STABILISATION OF CLAYEY SOIL USING GRAPHENE OXIDE AND FLY ASH

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KeyWords
Clayey Soil, Fly Ash, Graphene Oxide, Unconfined Compressive Strength

ABSTRACT

In this study, the effect of Graphene oxide (G.O) and Fly Ash (F.A) on Unconfined Compressive Strength (UCS) of Clayey Soil was studied. F.A content was taken as 15%, 20% & 25% and Graphene Oxide content was taken as 0.25%, 0.5%, 0.75% & 1% by weight of soil. The study was carried out with a view to utilize waste material as construction of road embankment, earth slope or in filling of low lying area. The week soil may be utilized along with these material as due to pozzolanic action, the strength of week soil is improved upto desirable load. UCS value increased with increase in dose of Fly Ash up to 20% and afterward it decreased. Therefore, optimum dose of F.A was taken as 20%. Further UCS test was carried out by mixing Graphene Oxide and 20% F.A in soil. The UCS value increases by adding 20% Fly Ash and 0.75% Graphene Oxide (G.O) by weight of soil and was defined as an optimum dose.

Introduction

Recently, the nano-sized materials consisting of nano-particles and nano-tubes are most commonly used to improve the geotechnical properties of soil. Globally, used nano-sized materials are SiO2, graphene oxide (G.O) & carbon nanotubes (CNTs). The nanomaterials due to the high specific surface area and surface charges with fine pores, may significantly improve the physio-chemical properties of soil. Chemical stabilization of soil, is one of the techniques that improve the geotechnical behaviour of soil by adding nano-materials into it.

Graphene oxide mainly originates from graphite which is oxidized by using suitable oxidizing agents. Synthesis methods used to produce graphene oxide and degree of oxidation obtained describe the structure and properties of G.O. Moreover, the oxygen functional groups are mainly responsible for the advantageous chemical or physical interactions.

Fly ash (F.A) is a pozzolanic material. Fly ash by itself has cementitious value but in presence of moist it reacts chemically and forms cementitious compounds and attributes to improvement of strength and compressibility characteristics of soil. In this study, an attempt has been made to use above mentioned materials for improving strength parameter i.e. UCS value of soil. Addition of G.O, increases the optimum moisture content (OMC) and decreases maximum dry unit weight of stabilized clay.

Therefore, in present study the effect of g.o and f.a as a combined product, was proposed to be investigate the strength behavior of clayey soil.

Objective: To study the effect of Graphene Oxide and Fly Ash on Unconfined Compressive Strength (UCS) of Clayey Soil. To determine optimum content of G.O and F.A is the main objective of this study.

Experimental Program:

The main purpose of the study was to observe the behavior of soil with the addition of graphene oxide and fly ash in different proportions, the optimum value at which the soil mix gives maximum strength was to be determined.

Table 1: Mix Proportions Used in The Study:

S. No.	Set type	Fly Ash (%)	G.O (%)
1.	Virgin Soil	0	0
2.	S_{FA}	15	0
3.	S_{FA}	20	0
4.	S_{FA}	25	0
5.	$S_{FA+G.O}$	X	0.25
6.	$S_{FA+G.O}$	X	0.5
7.	$S_{FA+G.O}$	X	0.75
8.	$S_{FA+G.O}$	X	1

WHERE, X IS OPTIMIZED VALUE OF FLY ASH.

UCS test was performed to find out the strength of clayey soil by using graphene oxide & fly ash at different percentage.

Test Setup and Procedure:

- Specimen was placed on the lower plate of UCS machine. The machine was adjusted carefully, so that the upper plate just makes contact with the specimen. The proving ring and dial gauge were set to zero. The test was continued until the value of load decreases with the increase in strain.
- Both ends of the sample should be perpendicular to longer axis of the sample.
- The sample should be placed in a proper way between upper and lower plates of compression machine.
- The load should be applied at a constant rate.
- Proving ring reading and dial gauge reading should be adjusted to zero.

Experimental Results and discussion:

Before conducting the test, curing of samples was done for 7 days. UCS value increases with increase in content of F.A upto 20% and afterward it decreases. Therefore, optimum dose of F.A was taken as 20% as shown in Fig 1. UCS was further improved by adding G.O and 20% F.A in soil.

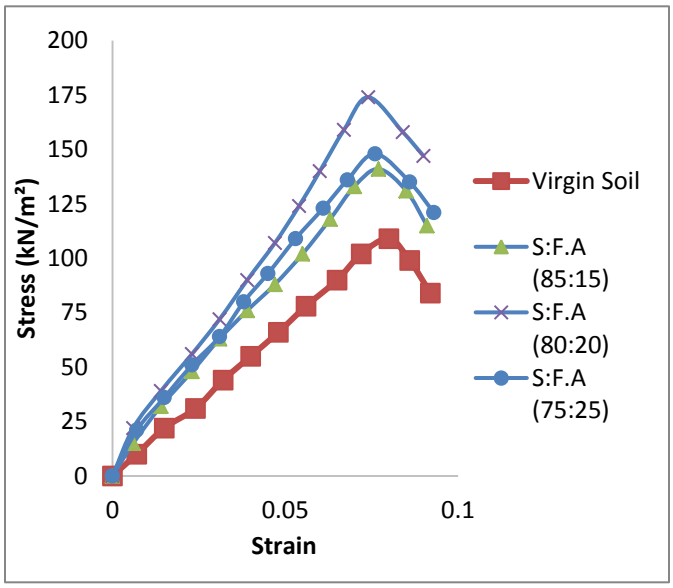

Fig 1: UCS value for different proportions of S: F.A

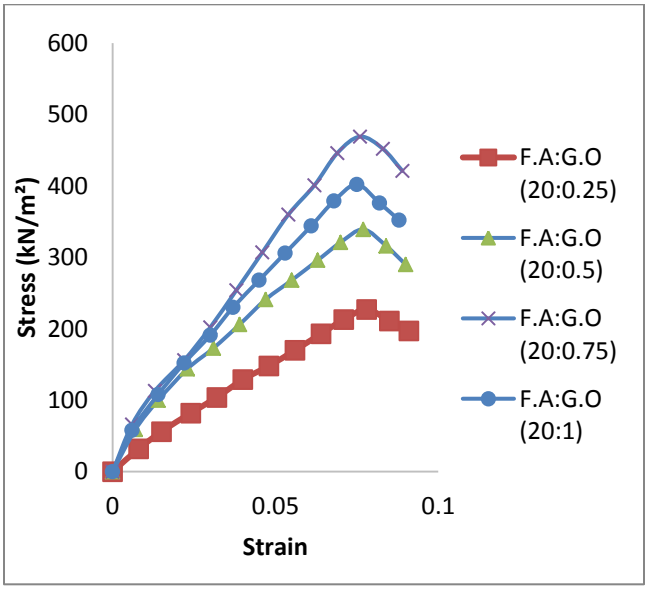

Fig 2: UCS value for different proportions of G.O & F.A

UCS value for virgin soil is 108.7 kN/m^2 and it increases by 109.47% when soil is mixed with 20% F.A and 0.25% G.O, increases by 221.36% when soil is mixed with 20% F.A and 0.5% G.O & further increases by 328.25% when Soil is mixed with 20% F.A and 0.75% G.O and then increased 270.34% when soil is mixed with 20% F.A and 1% G.O. So, the optimum ratio is Soil: F.A: G.O (79.25:20:0.75).

Conclusion

By adding 20% of F.A, the Unconfined Compressive Strength increases by 60% and by adding 25% F.A, the stress decreases, so take Soil: F.A (80:20) as an optimum value and by addition of 0.75% G.O & 20% fly ash the Unconfined Compressive Strength increases by 328.25% and beyond this ratio the increase in stress is marginal, so take Soil: F.A: G.O (79.25:20:0.75) as an optimize value. The curing time also has a significant impact on strength of soil. With 7 days curing UCS increases by 328.25%.

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