International Journal of Research in Engineering, Science and Management
Volume-2, Issue-2, February-2019
www.ijresm.com | ISSN (Online): 2581-5792

Strength Characteristics of Soil Glycerol Mixture: Cement as Additive

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***Abstract*: Ground pollution arises from the impact of past and current industrial activity and due to improper disposal of waste generated by society. In this paper, it is concentrated on the behaviour of soil mixed using glycerol, which is a major constituent and by-product of industries. Attempts to understand the soil response to glycerol, its changes with various concentration of pollutant. The study continues by assessing the effects of various amounts of cement-soil mixture with various percentage of glycerol. The glycerol- soil samples were prepared with different percentages of a glycerol solution with 40% concentration. The results showed that the UCS strength decreased with the increase in glycerol percentage.**

***Keywords*: Contaminated soil, Glycerol, Soil-cement**

1. Materials and methodology

1) Materials

Materials used in this study are Low plastic soil, glycerol and cement.

2) Soil.

Low plastic clay for the present study was collected from Thonnakkal. Various tests were conducted for determining the index properties of low plastic clay.

Table 1
Properties of Kaolinite

Properties	Values
Specific gravity	2.63
Liquid limit (%) (IS 2720 PART 51985)	44
Plastic limit (%) (IS 2720 PART 51985)	10.757
Plastic index (%) (IS 2720 PART 51985)	17.819
Shrinkage limit (%) (IS 2720 PART 51985)	20.98
IS Classification	CL
Natural moisture content (%)	26.48
Optimum moisture content (%) (IS 2720 PART 7)	26.58
Maximum dry density (g/cc) (IS 2720 PART 7)	0.970
Percentage of clay (IS 2720 PART 4)	71
Percentage of silt (IS 2720 PART 4)	20
Percentage of sand (IS 2720 PART 4)	9
UCC strength (kg/cm^2) (IS 2720 PART 10)	1.940
Shear strength	0.970

3) Glycerol.

Glycerol was considered as the contaminating organic material. Glycerol (propane-1,2,3-triol) is an oxygenated organic compound that has been successfully and widely used in the chemical industry in the last decades. Major applications of glycerol can be found in the detergents industry as well as in drug and pharmaceutical production. In this work, a solution of glycerol with a concentration of 40% was used.

Fig. 1. Kaolinite clay

Table 2
Properties of Glycerol

Properties	Values
Assay(ex-density)(%)	98
Wt. per ml at 20 degree C	1.255-1.260
Ash content(%)	.02
20% Aq. Solution	Neutral – litmus
Chloride(%)	0.001
Sulphate(%)	0.001
Lead(%)	0.05

B. Methodology

The samples that were used consisted of natural soil, soil-cement, soil contaminated with glycerol, and soil contaminated with cement. In preparation of the samples contaminated with glycerol, the degree of contamination was specified as the percentage weight of contaminant with respect to mixture of air-dried soil with contaminant. The degrees of contamination of 1% and 2% were considered for preparing the contaminated samples. The calculated weight of glycerol with 40% concentration with degrees of contamination of 1% and 2% was sprayed on 8 kg of soil. The soil was poured in flat layers with thickness of about 50 mm in a tray. A prespecified volume of fluid was sprayed on each layer and mixing was done carefully. The soil was then flattened and the next layer with the same thickness was added on it, and spraying and mixing was repeated. This procedure was repeated until the last layer. After that, all layers were mixed and covered with a nylon to prevent from evaporation. y. The mixture was then kept in sealed plastic

bags for one week so that the soil and glycerol came to an equilibrium condition. Standard compaction tests were conducted on these mixtures. . The maximum dry unit weight and optimum water content were determined for each of the materials. The samples for the UCS were prepared at their respective optimum water content that were obtained from a standard compaction test.

2. Results

A. Effect of glycerol on low plastic clay

On adding glycerol, the UCS value of low plastic clay showed a decrement. This decrement is greater when the number of curing days and percentage of glycerol is increased.

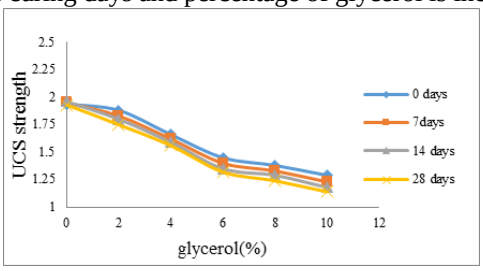

Fig. 2. Variation of UCS of soil + glycerol

B. Effect of cement on soil-glycerol mix

On adding cement on glycerol added soil, the UCS value of low plastic clay showed an increment. This increment is greater when the number of curing days and percentage of cement is increased.

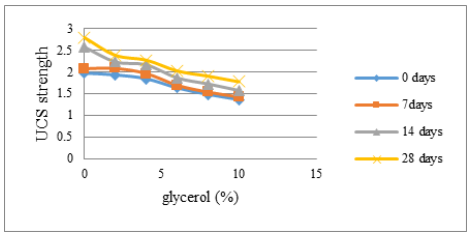

Fig. 3. Variation of UCS of soil + glycerol +6% glycerol

3. Conclusion

Based on study and experimental investigation following conclusions were drawn

- It was observed that with the addition of glycerol in low plastic soil, the unconfined compressive strength (UCS) values of the soil glycerol mixture decreases.
- The unconfined compressive strength (UCS) decreases as number of days of curing increases.
- It was also observed that with the addition of 6% cement on glycerol mixed soil, the U.C.S value increases.
- The maximum increment in U.C.S is shown for 28 days curing of glycerol cement and soil mix and also at 6% glycerol.

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