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Dispersive Characteristics of Soils

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***Abstract*: Soils that are dislodged easily and rapidly in flowing water of low concentration are called dispersive soils. Structures such as embankments, channels and other areas are susceptible to severe erosion, when such soils are used for construction. Hence it is essential to test the erodability especially during conditions of high surface flow. Two soils, lithomargic and laterite were investigated using double hydrometer, to determine the rate of dispersion. Laterite is a soil and rock type rich in iron and aluminium and is commonly considered to have formed in hot and wet tropical areas. Lithomargic soil constitutes an important group of residual soils under lateritic soils. Laterite soil is non-dispersive in nature, whereas lithomargic is dispersive in nature.**

***Keywords*: Laterite, Lithomargic, Dispersion, Double hydrometer test.**

1. Introduction

In Earlier days clays were considered to be non-erosive and highly resistant to water erosion, however recent studies on clays found that highly erosive clay soils also exist in nature. The tendency of the clays to disperse or de-flocculate depends upon certain factors such as mineralogy, soil chemistry and also on the dissolved salts in the pore water and the eroding water. Many earth dams, hydraulic structures and other structures like road way embankments have suffered serious erosion problems and have failed due to the presence of the dispersive soils. Though the problem has been identified in many parts of the world in recent times, design advances and technical preventive measures are yet to be fully developed and practised.

2. Literature Review

Anand B et al. (2015) aims on the characterization of dispersive soils. Dispersive soils which occur in many parts of the world are easily erodible and deflocculated in water causing serious problems of stability of earth and earth retaining structures. Earth dams constructed on dispersive soils have suffered internal and surface erosion. This paper deals with the best possible evaluation of test methods for confirming and characterizing the dispersive soils. Crumb test gave the visual identification on soil dispersivity. Pinhole and double hydrometer test was more reliable.

Dinesh et al. (2011) tell that visual classifications, atterberg limits and particle size analysis do not provide sufficient basis to differentiate between dispersive clays and ordinary erosion resistant clays. Pinhole test and double hydrometer test are the only two test that are vogue to identify the dispersive soils.

Civenlekoglu. B (2009) deal with the performance of the gypsum as an additive for the treatment of the expansive clay soils by means of swell potential and strength. Optimum water content for the best compaction of the bentonite was first determined by standard compaction test. Several percentages of gypsum were added to bentonite and compacted in optimum water content.

Bhuvaneshwari. S et al. (2007) studied on Stabilization and microstructural modification of dispersive clayey soils. The soil chosen for the study was highly dispersive. The addition of lime and lime+flyash caused significant decrease in the dispersive nature of the soil. The percentage of dispersion by double hydrometer for the soil alone was 71% which decreased to 9.5% after the addition of lime. The soil was classified as ND4 by the pin hole test, the addition of optimum percentage of additives changed it to ND1. The crumb test and chemical tests were also in conjunction with the above result. The mineralogical and micro structural changes studied by SEM analyses clearly show the alteration in the fabric and pore spaces due to the chemical reactions initiated by the additives.

3. Materials

A. Lithomargic Soil

The soil used in this study is collected locally from Neyyattinkara, Thiruvananthapuram district. The properties of the soil are studied using standard procedures and the results are tabulated in table. From the test results, the soil can be classified as CL according to Indian Standard Classification system.

Fig. 1. Lithomargic soil

Table 1
Properties of lithomargic soil

Properties	Result
Specific gravity	2.75
Liquid limit (%)	32.8
Plastic limit (%)	19.8
Plasticity Index (%)	13
Clay (%)	53
Silt (%)	41
Sand (%)	6
Optimum moisture content (%)	25
Maximum Dry Density(Kn/M^3)	16
Indian Standard Classification	CL

B. *Laterite Soil*

The soil used in this study is collected locally from Neyyattinkara, Thiruvananthapuram district. The properties of the soil are studied using standard procedures and the results are tabulated in table 2. From the test results, the soil can be classified as MI according to Indian Standard Classification system.

Fig. 2. Laterite soil

Table 2
Properties of laterite soil

Properties	Result
Specific gravity	2.41
Liquid limit (%)	45.5
Plastic limit (%)	31
Plasticity Index (%)	14.5
Clay (%)	23
Silt (%)	60
Sand (%)	17
Optimum moisture content(%)	24
Maximum dry density (kN/m^3)	16.57
Indian Standard Classification	MI

4. Methodology

The index properties of soil were determined as per the respective IS Codes. The double hydrometer test also known as soil conservation service laboratory dispersion test was performed to identify the dispersiveness of soil. The particle size distribution of the soil is first determined using the standard hydrometer test where the soil is dispersed in distilled water with strong mechanical agitation and chemical dispersant. A parallel hydrometer test is then made on a duplicate soil specimen but without mechanical agitation and without a chemical dispersant.

The percent dispersion is the ratio of the dry mass of particles smaller than 0.005mm diameter of the second test to the first expressed as a percentage. The value of greater than 50 is highly dispersive.

5. Results and Discussions

A. *Identification of dispersive soil*

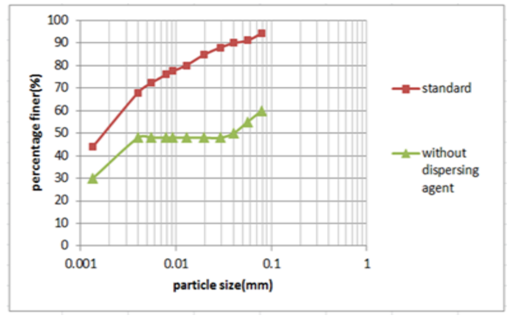

Fig. 3. Double hydrometer test of lithomargic soil

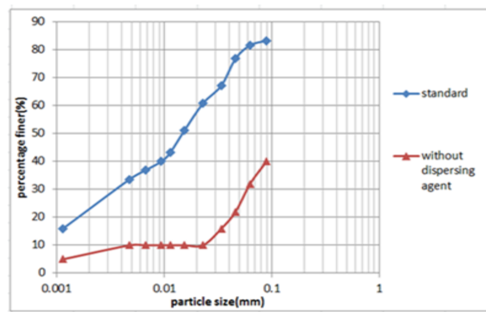

Fig. 4. Double hydrometer test of laterite soil

From fig. 3, the rate of dispersion of Lithomargic soil is 67% which is greater than 50%. So the soil is dispersive in nature and it needs to be remediated. From fig.4, the rate of dispersion of laterite soil is 28.5% which is less than 30%. So the soil is not dispersive in nature.

B. *Remediation of dispersive soil*

Once a dispersive soil is exposed to water, clay particles may disperse and remain as suspended particles in water. In appearance the dispersive clays are like normal clays that are stable and somewhat resistant to erosion. But in reality they can be highly erosive and subject to severe damage or failure. These soils are highly susceptible to piping failure. In this study lime is used as an additive to decrease dispersivity.

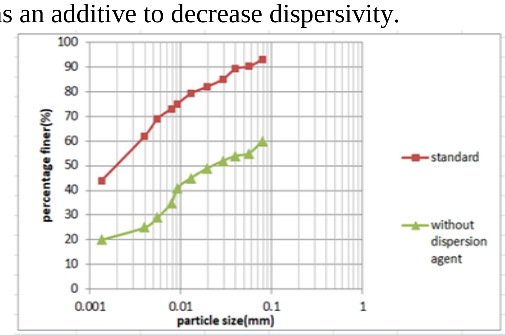

Fig. 5. Double hydrometer test for Lithomargic soil+2% lime

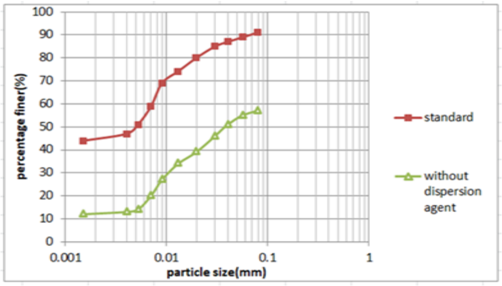

Fig. 6. Double hydrometer test for Lithomargic soil+4% lime

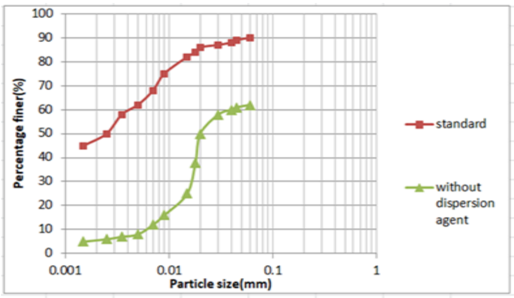

Fig. 7. Double hydrometer test for Lithomargic soil+6% lime

From fig. 5, the rate of dispersion for Lithomargic soil+2% lime was 41.17%. From fig.6, the rate of dispersion for Lithomargic soil+4% lime was reduced to 26% and for Lithomargic soil+6% lime was reduced to 12.9% (fig. 7). The mechanism in which the dispersive property is controlled by the addition of the lime is by the process of chemical reactions. The beneficial changes are attributed to the ion exchange and cementation reactions (Bhuvaneshwari, S. 2007)

6. Conclusion

From the test results it was noted that:

- The percentage of dispersion by the double hydrometer test for Lithomargic soil was 67% which was greater than 50%. So it was necessary to remediate the soil.
- The percentage of dispersion foe laterite soil was 28.5% which comes under non-dispersive category.
- For remediating dispersive soil 2%,4% and 6% lime were added
- By adding 6% lime the percentage of dispersion reduced from 67% to 12.9%.

References

[1] Anand B., Chitra R., Singh N. and Vyas S., “Characterization of Dispersive Soils- A Comparative Evaluation between Available Tests” International Journal of Innovative Research in Scientific Engineering and Technology, vol. 4, pp. 12908-12918, 2014.
[2] Bhuvaneshwari S., Soundra B., Robinson R. G., Gandhi S. R, “Stabilization and micro structural modification of dispersive clayey soils”. First International conference on soil and rock engineering, 2007, Colombo, pp 5–11
[3] Civelekoglu B. and Yilmaz I., “Gypsum: An additive for stabilization of swelling clay soil”, Journal of Applied Clay Science, vol. 44, pp. 166-172, 2009.
[4] Dinesh S. V., Sivapullaiah V. P. and Umesh T. S., “Characterization of Dispersive Soils”, Materials Sciences and Applications, Science Research, vol. 2, pp. 629- 633, 2011.
[5] ASTM D 4221-99, Standard test method for dispersive characteristics of clay soil by double hydrometer, ASTM international, West Conshohocken, 2005.