ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization, Volume 2, Special Issue 1, December 2013

Proceedings of International Conference on Energy and Environment-2013 (ICEE 2013)

On 12th to 14th December Organized by

Department of Civil Engineering and Mechanical Engineering of Rajiv Gandhi Institute of Technology, Kottayam, Kerala, India

AN EXPERIMENTAL STUDY ON DISPERSIVE NATURE OF SOIL

Abhirami Suresh, Ajith K.P, Sandra Supran, Annie Joy

TIST, Ernakulam, Kerala-682313, India

TIST, Ernakulam, Kerala-682313, India

TIST, Ernakulam, Kerala-682313, India

Toch Institute Of Science & Technology, Ernakulam, Kerala-682313, India

ABSTRACT

The internal erosion has been closely linked to the soil composition and its dispersivity. Dispersivity is the property of soil by virtue of which soil break down into their component particles when wet. Once a dispersive soil is exposed to water, clay particles may disperse and remain as suspended particles in water. In appearance, 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. The common soil classification index tests do not distinguish between dispersive and non-dispersive clay soils. The recommended tests for the identification of dispersive clay soils are pinhole test, crumb test and double hydrometer test**.** This article reports the results of dispersivity tests carried out on soils collected from various locations in Kerala.

1. INTRODUCTION

The slope failure geohazard in wet tropical environment has been frequently reported to occur after rainfall to such an extent that slope failure becomes synonym with rainfall. Most of the failures occurred after prolonged heavy or antecedent rainfall. Technically there are many factors that may induce slope failure. Among them is rain water infiltration, degree of saturation, soil permeability, suction effect and prolonged effect of erosion. Impact of erosion due to rainwater infiltration can be categorized into two, which are slope surface erosion and internal erosion within the soil mass. The soil slope degradations due to surface erosion are obviously seen. However, internal erosion remains as a silent triggering factor.

The internal erosion has been closely linked to the soil composition and its dispersivity. The soils that are highly susceptible to erosion and containing high percentage of exchangeable sodium ions are called Dispersive soils. The erosion due to dispersion of soil depends on mineralogy and clay chemistry and the dissolved salts in pore water. Once a dispersive soil is exposed to water, clay particles may disperse and remain as suspended particles in water. In appearance, 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.

2. SCOPE

Using dispersive clay soils in hydraulic structures, embankments dams or other structures such as roadway embankments can cause serious engineering problems if these soils are not identified and used appropriately. It is necessary to estimate the extent of dispersiveness so that the damage potential can be estimated.

3. SAMPLE COLLECTION AND STORAGE

Samples were collected from TIST campus and Thoppumpadi. First sample was laterite and later was marine clay. Both these samples were stored in polythene covers tightly so that there was no loss of natural moisture content.

4. ENGINEERING PROPERTIES

The engineering properties of soil samples taken are given below:

TABLE 1. ENGINEERING PROPERTIES OF SAMPLES

Description	Sample No. I	Sample No.II
Moisture content(%)	35.15	75.77
Specific gravity	2.4	2.3
Liquid limit(%)	34.14	23.12
Plastic limit(%)	22.4	18.13
Shrinkage limit(%)	18.4	11.2

5. LABORATORY EXPERIMENTS

Following experiments were conducted determine the dispersive characteristics of soil.

* Crumb test
* Pinhole test

5.1 Crumb Test

This test is used to determine the dispersivity nature of soil qualitatively**.**

5.1.1 Apparatus

1. 250 ml beakers

2. Diluted 0.001M sodium Hydroxide solution

3. Soil sample

5.1.2 Procedure

The test is performed by gently placing a clod of soil about 1/4 to 3/8 inch in diameter into a transparent plastic glass partly filled with diluted 0.001M sodium Hydroxide solution. Using demineralized water or other substitutes gives misleading test results. Typical glasses have a capacity of 9 fluid ounces. The clod or crumb should be at natural water content unless the soil is very wet. Very wet soils may be air-dried To about their plastic limit before performing the test. The crumb isdropped at the edge of the glass bottom and left in the glass undisturbed for a minimum of 1 hour. At the end of the waiting period, the clod and water are observed and the presence of any colloidal cloud in the water is evaluated. A second observation is recommended after leaving the clod in the glass overnight. Some soils have no reaction after 1 hour, but have a significant reaction after the longer waiting time. A grade is assigned to the test result using the following criteria:

* No colloidal cloud develops. Even though the crumb may slake and particles spread away from the originalclod because of this slaking activity, no trace of a colloidal cloud is observed in the water.

* A colloidal cloud is observable, but only immediately surrounding the original clod. The cloud has not spread any appreciable distance from the crumb.

* A colloidal cloud emanates an appreciable distance from the crumb. However, the cloud does not cover thebottom of the glass, and it does not meet on the opposite side of the glass bottom from the crumb.

* The colloidal cloud spreads completely around the circumference of the glass. The cloud may not completely obscure the bottom of the glass, but the cloud does completely cover the circumference of the glass. In extreme cases, the entire bottom of the glass is covered by the colloidal cloud.

5.2. Pinhole Test

The pinhole test is performed in the laboratory and is a direct, or performance, test. Comparisons of field performance to pinhole test results have indicated an excellent correlation. Another important use of the pinhole test is to determine efficiency of chemical amendments for dispersive clays. Soil

samples are prepared with a range of treatment rates of a chemical additive, and the pinhole test is used to determine what rate of treatment is necessary to achieve erodibility reduction.

5.2.1 Apparatus

1. Burette
2. Distilled water
3. Split mould

5.2.2 Procedure

In the pinhole test, a sample of soil at its natural water content is compacted into a plastic cylinder. A hole is formed in the specimen by inserting a needle through the center of the specimen. Distilled water under specified heads flows through the hole in the specimen. The water is carefully observed for turbidity, and the flow rate is closely monitored to determine if the hole in the sample is enlarging by erosion. Dispersive clays will rapidly erode as water flows through the 1 millimeter hole under a small water head pressure. Rapid enlargement of the hole is reflected in an increasing flow rate and the turbidity of the collected water. Pinhole tests results are recorded and interpreted using the following system:

1. A rating of D-1 or D-2 indicates the soils are dispersive enough to require special designs if the soils must be used in the project.

2. A rating of ND-1 indicates the soil is not dispersive.

3. A rating of ND-2, ND-3, or ND-4 indicates the soils are slightly to moderately dispersive. Some defensive measures may need to be incorporated into the design.

6. RESULTS AND DISCUSSIONS

6.1 Crumb Test

As per the data obtained from description of soil by Sherad et. Al (1976A), we have concluded that both samples are dispersive in nature. And the samples are categorized under Grade 3, since those samples gave cloudy appearance at the bottom of the beaker.

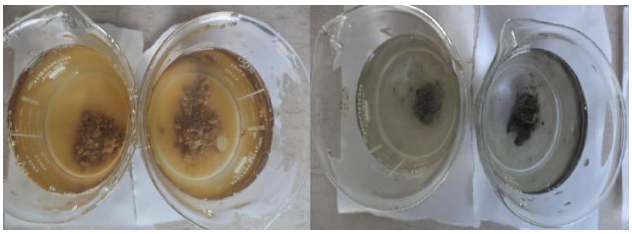

FIGURE 1.OBERVATIONS OF CRUMB TEST ON SAMPLE 1&2 AFTER 5 MINUTES

6.2 Pinhole Test

Pinhole test is a qualitative test. The results are based on the turbidity of collected water from test and increase in diameter of the pinhole after test. From test conducted it was observed that the water collected from sample 1 has moderate turbidity and has light brown color. It also showed an increase in the pinhole diameter about 0.25mm.

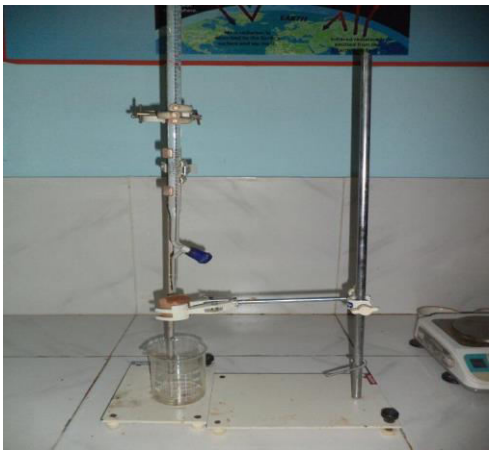

FIGURE 2.EXPERIMENTAL SETUP FOR SAMPLE 1

FIGURE 3.DIAMETER CHANGE IN SAMPLE 1

For sample 2, the turbidity of collected water is found to be more than that of sample 1. It was dark grey in color. Diameter changed from 1 mm to about 2mm.
In general both samples can be classified under D1 or D2 as per pinhole test procedure, but sample 2 has comparatively more dispersivity character than sample1

7. CONCLUSION

The study has concluded that both the samples have dispersive nature. The soil particles composition and the fluctuation in moisture content are the main factors that contributed to the grade and vulnerability of soil dispersibility. The soil dispersibility values may be used as one of the engineering index to predict the resistance to internal soil erosion.

REFERENCES

[1] Nadia Benahmed and Stéphane Bonelli, (2012), "Internal erosion of cohesive soils: laboratory parametric study", ICSE6 Paris.
[2] Fauzilah Ismail, Zainab Mohamed, Mazidah Mukri, "A Study on the Mechanism of Internal Erosion Resistance to Soil Slope Instability", EJGE.
[3] Stephen Davies, Alison Lacey,(2009) "Identifying dispersive soils", farmnote, note 387