Experimental Investigation Of Strength Characteristics Of Contaminated Soil From Dye Effluent

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Abstract— *Soil, a most common material exists over the entire earth surface, even below the water bodies. It plays a major role in the field of Civil Engineering as it is the only medium available for supporting any infrastructure. Geotechnical Engineering is the branch of Civil Engineering that deals with the engineering behavior of earth materials. Soil plays a major role in this field. The properties of soil are altered by various geotechnical methods. The addition of external agencies into the soil causes drastic difference in the characteristics of the soil. Dye water from textile industries is a major pollutant when it gets mixed with the water bodies, thereby polluting the soil. In this project, it is aimed at evaluating and inspecting the influence of dye effluent from a Textile industry on soil and thus how it has influenced the soil. The contaminated soil has been collected from nearby Dyeing Unit in Rajapalayam. The soil is subjected to initial tests and the results are gathered. The influence of dye effluent on soil is been studied and the results thus obtained after the tests are summarized to bring out the changes in soil parameters.*

Keywords — Dye Effluent, Shear Strength

1. INTRODUCTION

A dye is a coloured substance that gets in contact with which it is applied thus forming chemical bondage between them. Effluent from Dye industries is a major contaminant to the soil. They are a wide range of organic pollutants to the soil. In particular, the discharge of dye effluent into the soil is undesirable because of release of toxic, carcinogenic substances. Generally the industrial wastes are discharged either treated or untreated into soil. These industrial wastes if let over soil or in case of accidental spillage of chemical substances, it may lead to changes in soil properties, causing either improvement or degradation of engineering behavior of soil, sometimes leading to functional or structural failure of structures resting on it. For example, the low permeability of soil, it will reduce the soil strength. The test is carried out contaminated soil to determine its engineering properties and for the effluent to determine the permeability of soil. If there is degradation in soil properties, the dye effluent could be mixed with the soil for drip irrigation purpose, to ensure the flow of water in the drip. On the other hand, if there is an improvement in soil properties, the result could serve the purpose of safe effluent disposal and conservation of soil.

Several research works (Rajeswari et al (2005)) reported effects of effluent from a medium sized dye house on plant growth and soil characteristics. They found that diluted effluent enhanced the plant growth while deleterious effects were noticed at higher levels. Accumulation of various substances was also formed in the soil. In general the effect was not suitable for irrigation.

Furthermore studies (S. Ram Prasad et al 2015) reveal that, Textile industry produces considerable amount of pollutants, since it is a wet processing system. The wide variety of polluting chemicals and dye stuffs is utilized in a Textile industry. The dyeing effluent treatments are more complex than any other industrial waste water purification. Because of the fact two dyeing effluents are not like in character, nor can two effluents be purified or treated by exactly the same treatment.

1.1 OBJECTIVE OF THE STUDY

The objective of this experimental investigation is to study the reaction of contaminated soil dye effluent on the physical and engineering properties of soil.

Discharge of dye effluent into the soil is a major concern for Civil Engineers.

2. MATERIALS

2.1 SOIL

The contaminated soil sample was collected from nearby dyeing unit in Rajapalayam, Virudhunagar District, and Tamil Nadu.

2.2 PROPERTIES OF CONTAMINATED SOIL

Various laboratory tests were conducted to determine the properties of contaminated soil. The various properties of contaminated soil are given in Table 1.

Table 1: Properties

S.N0	PROPERTIES	RESULT
1	SPECIFIC GRAVITY	2.52
2	SIEVE ANALYSIS % OF GRAVEL % OF SAND % OF SILT	 28.35% 35.87% 32.54%
3	LIQUID LIMIT PLASTIC LIMIT SHRINKAGE LIMIT	35.72% 26.86% 24.82%
4	DRY DENSITY	1.72 gm/cc
5	PERMEABILITY	4.6×10^{-3} cm/sec

2.3 COMPARISION OF PROPERTIES OF SOIL

Table 2: Properties

EXPERIMENTS	N0RMAL SOIL	CONTAMINATED SOIL	RESULT
SPECIFIC GRAVITY	2.6	2.52	Decrease
SIEVE ANALYSIS % OF GRAVEL % OF SAND % OF SILT	76.9% (sand)	35.87% (fine sand)	Decrease
LIQUID LIMIT PLASTICLIMIT SHRINKAGE LIMIT	23% 71.2% 27.78%	35.72% 26.86% 24.82%	Increase Decrease Decrease
PROCTOR TEST DRY DENSITY	2.32 gm/cc	1.72gm/cc	Decrease
PERMEABILITY	8.1×10^{-3} cm/sec	4.6×10^{-3} cm/sec	Decrease

In the result of above test, the soil strength is reduced.

3.EXPERIMENTAL TESTS

STRENGTHEN BY USING **POLY VINYL ALCHOCAL**

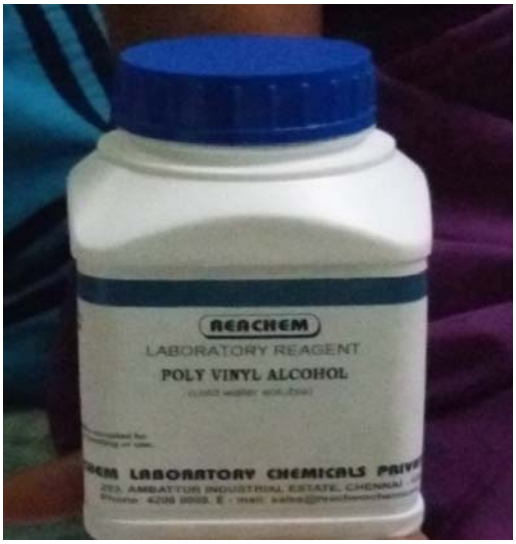

Figure : Poly Vinyl Alchocal

The table below shows the Permeability values for contaminated soil sample in addition of **Poly Vinyl Alchocal.**

Table 3: Properties

TRAIL	% OF CHEMICAL ADDED	MAX. DRY DENSITY(γd) (gm/cc)	CO EFFICIENT OF PERMEABILITY(k) (cm/sec)
1	10	2.2	6.51×10^{-3}
2	20	2.39	7.21×10^{-3}
3	30	2.50	7.70×10^{-3}
4	40	2.73	8.21×10^{-3}

3.1 STANDARD PROCTOR COMPACTION TEST

The graph attached below shows the percentage Variations of contaminated soil, and thus the optimum moisture content are obtained at every increase in percentage.

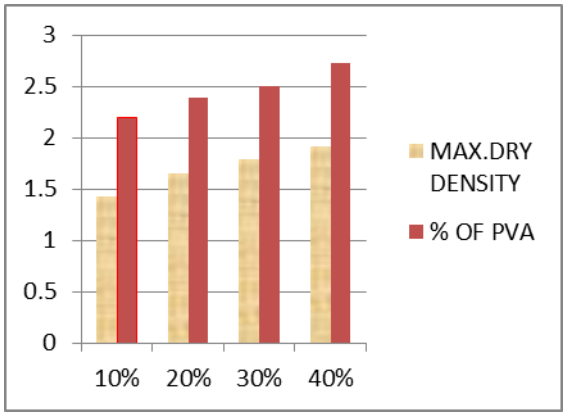

Figure 1: Max. dry density for varying % of PVA

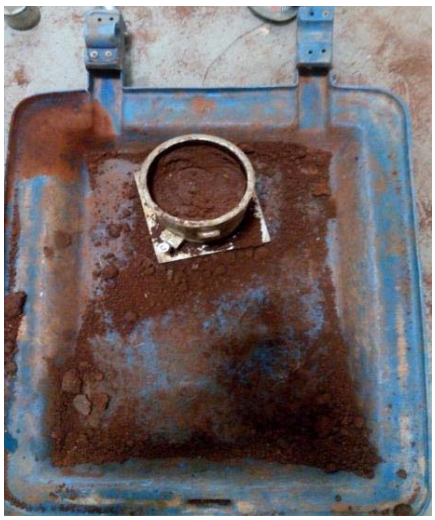

Figure 1.a: Standard proctor compactor

3.2 PERMEABILITY

The graph shows below indicates the varied values of permeability for different percentages of effluent added.

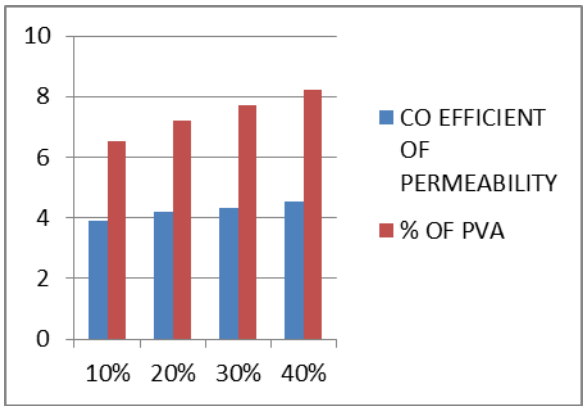

Figure 2: permeability values for varying % of PVA

Figure 2.a: Permeability

4. RESULTS AND DISCUSSION

The various test results have shown that the soil strength parameters are considerably reduced on addition of dye effluent to the soil. Especially, the contaminated soil has low permeability and the soil strength is reduced. The soil becomes totally contaminated and unsuitable for foundation aspects and also cultivation purpose.

5. CONCLUSION

The experiments undergone are taken into consideration to evaluate the variations in soil parameters. Results have shown considerable decrease in the soil strength values. But in the addition of Poly vinyl alchocal with contaminated soil have increase the soil strength and thus it could only be utilized after proper treatment of the dye effluent. The addition of Poly vinyl alchocal in a percentage of 10%, 20%, 30%, 40% the coefficient of permeability value is 6.51 x 10^{-3} cm/sec, 7.21 x 10^{-3} cm/sec, 7.70 x 10^{-3} cm/sec, 8.21 x 10^{-3} cm/sec respectively. In 40% the coefficient of permeability value is close to a normal soil.

So, we can suggest that the Contaminated Soil may be treated and proper neutralizing agent which has been mixed with the untreated soil. The soil properties are normal when the neutralization has been done.

Now, the treated soil can be used for foundation aspects and cultivation aspects.

If also increases the dry density of the soil sample also. So, we have an increase in shear strength of soil.

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