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ANALYSING THE EFFECTS OF INDUSTRIAL EFFLUENT ON BLACK COTTON SOIL

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Abstract - *This paper explains aboutthe growth in population and rapid industrialisation which leads to waste disposal problems. One of the common modes of waste disposal is through land. Geotechnical properties such as specific gravity, density index, particle size and shear strength are expected to be modified when the effluent is mixed with the soil. The extent of modification of properties depends not only on the nature of the contaminant, but also on the type of soil. These contaminants may be inorganic or organic. The effect of dyeing effluent on the Geotechnical properties of Black Cotton Soil has to be investigated in this paper. Addition of industrial effluent inversely affects the engineering properties of black cotton soil*

Key Words: Geotechnical Properties, Black Cotton Soil, Industrial Effluent, Liquid limit, Plastic Limit, Specific Gravity.

1. INTRODUCTION

The index and engineering properties of the ground gets modified in the vicinity of the industrial plants mainly as a result of contamination by the industrial wastes disposed. The major sources of surface and subsurface contamination are the disposal of industrial wastes and accidental spillage of chemicals during the course of industrial operations. The leakages of industrial effluent into subsoil directly affect the use and stability of the supported structure.

Extensive damage to the floors, pavements and foundations of a light industrial building in Kerala State was reported by Sridharanet al.(1981)*10. Joshi et al. (1994) *11reported that severe damage occurred to the interconnecting pipe of a phosphoric acid storage tank in particular and also to the adjacent buildings due to differential movements between pump and acid tank foundations of fertilizer plant in Calgary, Canada. A similar case of accidental spillage of highly concentrated caustic soda solution as a result of spillage from cracked drains in an industrial establishment in Tema, Ghana caused considerable structural damage to a light industrial building in the factory, in addition to localized subsidence of the affected area [Kumaplay & Ishola (1985)].Therefore, it is better to start ground monitoring from the beginning of a project instead of waiting for complete failure of the ground to support human activities and then start there medial actions.

Black cotton soils have high shrinkage and swelling characteristics. In general, these soils are very much sensitive to changes in environment. The environment includes the stress system, the chemistry of pore water in the system, the seasonal variations in ground water table and temperature variations.

2. MATERIAL USED

2.1 Soil used

Soil sample is collected from the Thirumangalam . Standard test were conducted to determine the physical properties of the soil and the results are given in Table 1.

TABLE 1: Physical properties of black cotton soil

S. No	Test conducted	Result
1	Specific Gravity	2.57
2	Liquid limit	62%
3	Plastic limit	17.65%
4	Plasticity Index	44.35%
5	OMC	10%
6	MDD	2.12 g/cc
7	CBR	3.49
8	Permeability	0.00171 cm/sec

2.2 Classification of soil sample

Based upon the test performed in laboratory for soil sample and according to the results, obtained, the soil sample is classified by using the sieve analysis our soil is conformed as the mixed soil.

3. LABORATORY STUDIES

The Various tests conducted on the black cotton soil samples included determination of the physical and chemical properties of soils at their natural state. On the other hand, the testing was conducted on the soil samples mixed with different water samples collected from the dying industry.

3.1 Standard proctor test

Standard proctor is the test used to determine the compaction of different types of soil and the properties of soil with a change in moisture content. And this is also used to determine the optimum moisture content (OMC) and maximum dry density (MDD).

3.2 California bearing ratio

The CBR is a penetration test for evaluation of the mechanical strength of natural ground, subgrades and base courses beneath new carriage construction. The CBR can also be used for measuring the load-bearing capacity of unimproved airstrips or of soils under paved airstrips. The harder the surface, the higher the CBR rating.

Specific gravity is the ratio of density of a substance to the density of a reference substance, equivently. It has no unit.

4. RESULTS AND DISCUSSION

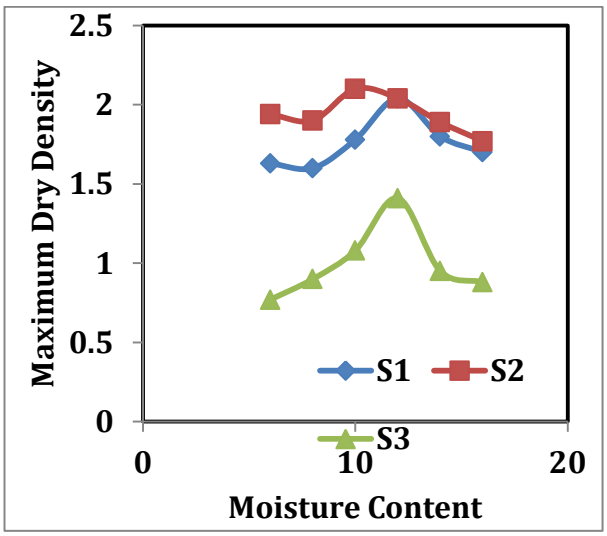
4.1 Standard proctor test (SPT)

The SPT test is conducted in the laboratory on soil sample with addition of polypropylene and sawdust ash in the different proportions. The table 2 which explains the optimum moisture content (OMC) and maximum dry density (MDD) of the different soil samples.

Table -2: SPT test result on soil samples

Additives	OMC	MDD
Soil sample + original Effluent	12%	2.04 g/cc
Soil sample + Sugarcane ash mixed effluent	10%	2.1 g/cc
Soil sample + Coconut ash mixed effluent	14%	2.249 g/cc

Chart -1: SPT GRAPH



Sample 1- S1

Sample 2-:S2

Sample 3-S3

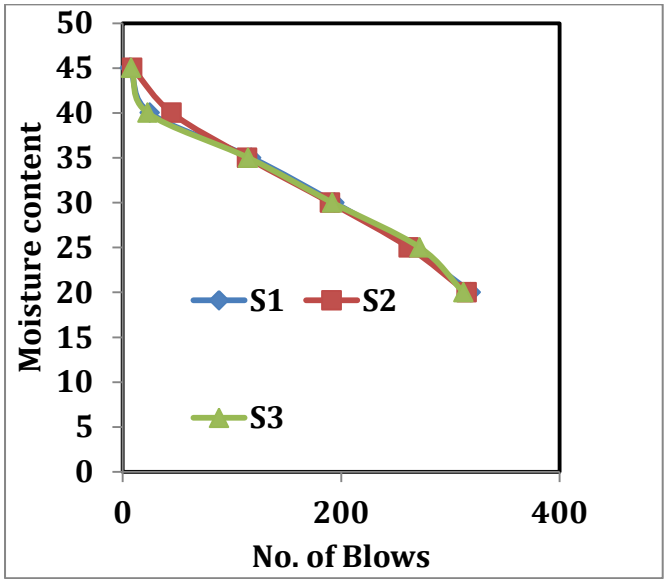
4.2 Liquid Limit of Soil

The liquid limit apparatus has a cup which is raised 1cm above a flat base and then dropped by rotating a handle. The grooving tool has a cutting edge of standard dimensions used to form a groove in the middle of the soil sample. A gauge block is used to check that the cup is adjusted to give a drop of exactly one cm. The observations are as follows.

Table -3: Liquid Limit test results on soil samples

Additives	Liquid limit	Flow Index
Soil sample + original Effluent	40	5.87
Soil sample + Sugarcane ash mixed effluent	41	3.75
Soil sample + Coconut ash mixed effluent	43	16.76

Chart -2: LIQUID LIMIT GRAPH



Sample 1- S1

Sample 2-:S2

Sample 3-S3

4.3 Plastic limit of soil

Plastic limit is the water content at which a soil will just begin to crumble when rolled into a thread approximately3mm in dia. The Observations of plastic limit is given below

Table -1: Plastic Limit test results for soil samples

Additives	Plastic limit	Plasticity Index
Soil sample + original Effluent	25%	15
Soil sample + Sugarcane ash mixed effluent	17.01%	22.93
Soil sample + Coconut ash mixed effluent	18.42%	24.5

4.4 Specific gravity

By the specific gravity, we can obtain the water absorption value of concrete, cement & pavements. Here black cotton soil. The observations are given below.

Table -1: Specific gravity test results for soil samples

Additives	Specific gravity
Soil sample + original Effluent	2.27
Soil sample + Sugarcane ash mixed effluent	2.16
Soil sample + Coconut ash mixed effluent	2.23

4.5 Permeability test

The observation of falling head permeability test which is conducted using Variable head permeameter with accessories is given below.

Table -1: Permeability test results for soil samples

Additives	Coefficient of Permeability
Soil sample + original Effluent	0.0011 cm/sec
Soil sample + Sugarcane ash mixed effluent	0.00164 cm/sec
Soil sample + Coconut ash mixed effluent	0.00132 cm/sec

4.6 California bearing ratio

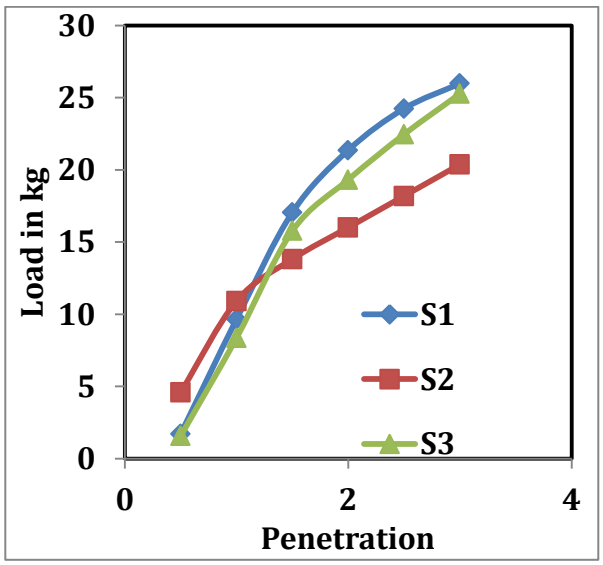
The test is performed in CBR apparatus by measuring the pressure required to penetrate a soil sample at 2.5mm & 5mm with a plunger.

The measured pressure in the dial gauge is then divided by the pressure required to achieve an equal penetration on a standard sample.

Table -1: CBR test results for soil samples

Additives	CBR value for 2.5 mm penetration	CBR value for 5 mm penetration
Soil sample + original Effluent	1.459	1.418
Soil sample + Sugarcane ash mixed effluent	1.327	1.262
Soil sample + Coconut ash mixed effluent	1.639	1.366

Chart -3: CBR TEST GRAPH



Sample 1- S1

Sample 2- S2

Sample 3- S3

5. CONCLUSIONS

Addition of industrial effluent inversely affects the engineering properties of black cotton soil.

- 35 % decreases the liquid limit.
- MDD remains constant during addition of industrial effluents
- The CBR value decreased from 3.49 to 1.459. i.e.reduces CBR value to 58%.
- The permeability of soil is decreased by 36 %.

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