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Dye effluent contaminated Sub-grade

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***Abstract* –All around the world, the major mode of transportation is roadways. In civil engineering concern the roadways are well known by name called pavements which are categorised as rigid and flexible. It is a supporting medium means the roadways mode of transport. The durability and serviceability are the two major criteria to be considered in case of pavements. There are enormous number of factors which influence the durability and serviceability. For initial cost the main parameter to be considered is California Bearing Ratio - CBR) value of sub-grade soil. This is the important phenomenon which decides the thickness of cross sectional components. Even though the sub-grade, once had an adequate value of CBR, and later if it is get reduced it will also hike the repairing cost (Maintenance cost). In this experimental study, the effect of dye effluent excreted from textile industries and their effects on CBR value been analysed with a constant duration of curing and alteration with percentage of dye effluent respect to weight of soil within a range of 5 to 20. Results shows that, increase in percentage of dye contamination, reduces the CBR value of soil. Thus it reveals that dye effluent in the highway alignment area will make economical impact. In inevitable situations and unavailability of alternate highway alignment, lesser value of CBR value will attract higher thickness of cross sectional components.**

***Keywords*: Pavement, dye effluent, sub-grade, Curing, CBR Value.**

1. INTRODUCTION

At the present time, the major problem to be addressed by the global engineering society is pollution. If no solution is determined, it will make future a questionable one for the upcoming generations. The root cause for the pollution is the industrial waste materials which come out as untreated one. In this research, the main polluting agent considered is dye effluent that is excluded from the textile industries.

In Tiruppur district, located in the state of Tamilnadu - India, the major problem faced by the common man is dye effluent. It is creating big problems in their basic needs. In engineering point of view, it is polluting the environmental phases like soil, water, air, etc. The discharge of untreated dye effluent in the land surface and water bodies, pollute them and make them unsuitable for usage. The main problem faced by the geotechnical engineers in pavement construction is unsuitable sub-grades.

While designing a pavement and selecting a suitable alignment for new proposal, two things to be considered are initial cost and maintenance cost of pavement. The lacking of CBR Value of Sub-grade soil, during construction will increase the initial cost and due to external factors, reduction in CBR value after construction will increase the maintenance cost.

The failure of pavement will make the user feel uncomfortable and leads to unsafe journey. The various failures include undulations, etc are due to failure of sub-grade. The failure of sub-grade indicates the reduction of California Bearing Ratio value of sub-grade soil. As the sub-grade soil is similar to that of Foundation soil, its failure leads to entire collapse of serviceability, safety and structure.

In this research study, in a view of monitoring the modification of CBR due to dye effluent, the soil obtained at a depth similar to sub-grade has been artificially induced for pollution by subjecting them to curing with dye effluent. The tests have been conducted for short period for various dosage of dye. The curing period is kept constant one say 5 days.

Literature Review

Several research works (Ayush Mittal, R.K. Srivastava) reveals that the UCC value of soil is increasing continuously as the concentration of dye/kg increases, which shows that soil gets stabilized with dye mixing. In addition some investigators (H. N. Bhatti, S. Sadaf and A. Aleem, 2015) indicated that Sugarcane bagasse, corncobs and cotton stick biomass showed maximum removal efficiency for dyes from textile wastewater and also they were considered best option for treatment of textile effluents.

Furthermore studies (Reza Ansari*,et al 2011) reveal that, application of sawdust obtained from carpentry workshops using walnut seems to be a very economical and promising adsorbent for treatment of textile industries wastewaters.

Few other researchers (Ozlem Ceyhan and Demet Baybas, 2001) found that no sorption of textile dyes occurred on non bentonite soil. The textile dyes were strongly observed on HDTMA Bentonit

According to M.Parameswari and C.Udayasoorian, the textile and dye industrial sludges are reported to promote crop growth if added to the soil in quantities below the toxicity limits. This study was undertaken to explore the influence of textile and dye industrial effluent and sludge on the soil fertility, growth and crop yield of maize crop. The results showed that addition of effluents and sludges had a strong influence in enhancing Organic carbon content of soil. The yield attributes and grain yield of maize was higher in effluent irrigated soil amended with common effluent treatment plant sludge.

According to, Shivaraju.R,B.V. Ravishankar, H.S.Nanda, The silk dyeing impacts since the discharged wastewater contains a fairly high proportion of chemical dyes. Most of the activities of silk dyeing are practiced as household operation in residential areas. Disposing effluent from these activities are on open space, excavated pits, and small ponds etc. This is in practice from a long period of time without considering the anticipated environmental consequences. This paper presents the results of the preliminary study carried out to characterize the engineering properties of soil contaminated by the effluent from the dye industry. Soil samples are collected from excavated pits near effluent discharging sites. The effluent from silk dyeing process was collected before disposal. The soil samples mixed with different kinds of effluent separately are tested. The results obtained are compared with those results of soil samples mixed with distilled water. The preliminary investigations show that pH and index properties of the soil samples varying significantly with the addition of effluent. Hydrometer analysis shows, drastic reduction in clay content indicating conglomeration of finer particles. A decrease in Optimum Moisture Content and increase in Maximum Dry Density with the influence of effluent were observed. The unconfined compressive strength of soil samples with effluents were observed increasing to that of soil samples with distilled water. Very few studies have been made on the environmental impacts of sericulture and silk-related programs on soil and hence this investigation is significant.

2. MATERIALS

2.1 SUB-GRADE SOIL

The sub-grade soil for the research has been collected from Annur Coimbatore District, TamilNadu at a depth of 1m below natural ground. The depth preferred in such a way the soil similar to actual depth of sub-grade.

2.2 DYE EFFLUENT

The dye effluent to be used as pollutant was collected from Dyeing Unit located in Tiruppur**.**

3. PROPERTIES OF MATERIALS

Initially the properties of soil was identified in the laboratory based on Indian codal practice as recommended in IS 2720 – Methods of Test for Soils. The index and engineering properties of unpolluted sub-grade soil are listed in Table.3.01. The predominant content in the unpolluted soil is found to be clay.

Table 3.01-Properties of unpolluted Sub-grade Soil

S. No	**Properties**	**Result**
1	Specific Gravity	2.66
2	SIEVE ANALYSIS % of sand % of clay % of Silt	 15.8 % 76.9% 7.3%
3	Free swell index	0
4	ATTERBERG LIMITS Liquid Limit (W_l) Plastic Limit (W_p) Shrinkage Limit (W_s) Flow Index (I_f) Toughness Index (I_T)	71.2% 23% 27.78% 22 0
5	Optimum Moisture Content – OMC	8%
	Dry Density	0.0016 g/mm^3
6	California Bearing Ratio (CBR)	2%

2.2 DYE EFFLUENT

The dye effluent utilised in this project as pollutant collected Tiruppur is subjected to various laboratory investigations in a view of obtaining its properties. The properties of dye effluent are listed in Table3.02.

Table 3.02. Properties of dye effluent

S. NO	PROPERTIES	RESULT
1	pH	
	4.01 buffer solution	8.26
	9.18 buffer solution	8.85
2	Turbidity	42.1 NTU
3	COD	20mg/l
4	BOD	0.45 mg/l

4. EXPERIMENTAL INVESTIGATION

4.1 ATTERBERG'S LIMIT

The Experiments for Atterberg limits identification was conducted based on procedure specified in IS: 2720 (Part5) -1985 – Method of test for soils - Determination of liquid and plastic limit. **Table 4.01 and Table 4.02** show the liquid limit and plastic limit of polluted soil at various dosages of dye effluents at the end of curing period of 5 days.

Table 4.01. Liquid limit for varying % of effluent

SL.NO	**CURING PERIOD**	**PERCENTAGE OF EFFULENT**	**LIQUID LIMIT (%)**
1	5 Days	5	78
2		10	81.4
3		15	84.4
4		20	88

Table 4.02. Plastic limit for varying % of effluent

SL.NO	**CURING PERIOD**	**PERCENTAGE OF EFFLUENT**	**PLASTIC LIMIT (%)**
1	5 Days	5	20
2		10	17
3		15	13
4		20	11

4.2 CBR TEST

CBR test is the commonly utilized method for determining the load carrying capacity of sub-grade. The CBR value is the only parameter which decides the thickness of cross sectional elements of pavement like sub base, base course, wearing course. Table4.03. shows the CBR value for various dosages of effluent at the 5 days.

Table4.03. California bearing for varying % of effluent

SL.NO	**CURING PERIOD**	**PERCENTAGE OF EFFLUENT**	**CBR Value**
1	5 Days	5	1
2		10	0.9
3		15	0.8
4		20	0.7

5. GRAPHS

Fig.5.01 shows Atterberg limits for various % dosage of Dye effluent and Fig.5.01 shows the graphical representation of CBR value for various percentages of dye effluent.

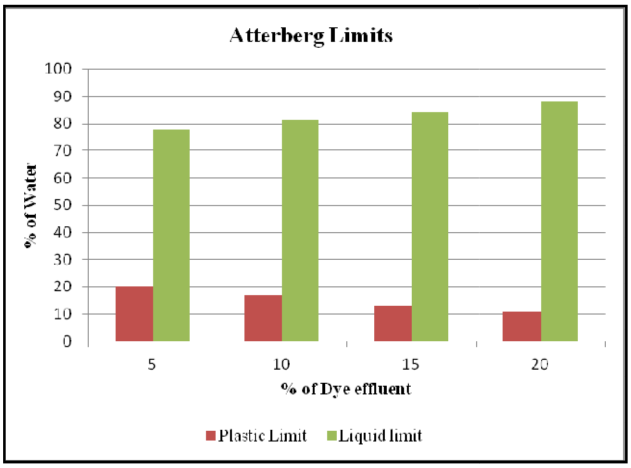

Fig.5.01.Atterberg Values for various % of dye effluent

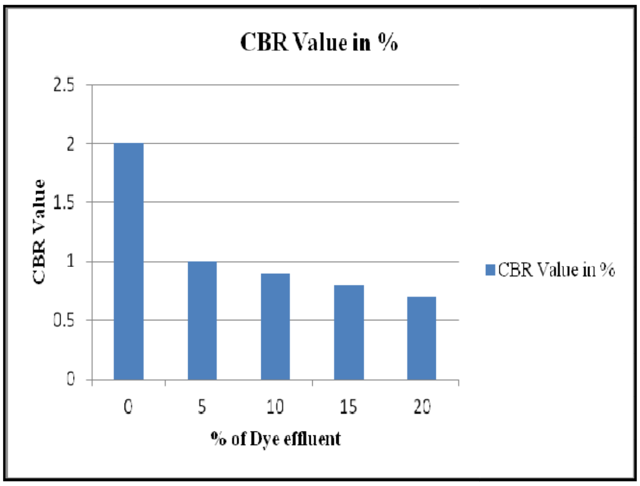

Fig.5.02 CBR value for various % of dye effluent

6. RESULTS AND DISCUSSION

The results obtained from various laboratory experiments shows that the stagnated untreated dye effluent creates negative impacts in civil engineering point of view.

- The increase in dye effluent dosage decreases the percentage of water required for change of matter of soil like Plastic state, liquid state. Hence it will leads to earlier collapse of soil for minimum moisture content.
- The increase in % of dye effluent decreases the ability of sub-grade soil – CBR Value.
- Increase in stagnation period may also create more impact in strength properties of soil.

7. CONCLUSION

From this study, it is clear that dye effluent stagnated over the soil reduces its engineering as well as index properties. Hence the effluent may be treated before letting it out for open environment.

Similarly immediate removal of effluent can also be preferred to avoid stagnation process to take place.

The above procedure also reduces the curing period, as the longer the curing greater may be impact.

8. FUTURE SCOPE

This study can be further extended for varying curing period and depth of sample extraction after curing.

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