

Effect of Crude Oil Contamination on Black Cotton Soil

Lincy Francis Cardoz, Sera Baby, Swetha Prasannan
UG Students,
Department of civil Engineering,
Christ Knowledge City,
Muvattupuzha, Ernakulam.

Er. Neenu Joy
Asst. Professor,
Civil Engineering department,
Christ Knowledge City,
Muvattupuzha, Ernakulam.

Abstract—The leakage of petroleum products through moving vehicles on road leads to contamination of soil which may affect the geotechnical properties of soil. The paper aims to study the effect of contamination on black cotton soil from Palakkad Chittoor region. The contamination is done at different percentages of diesel. The tests done include specific gravity, atterberg's limit, standard proctor test, permeability test and California Bearing Ratio Test.

Keywords—Black cotton soil, diesel, MDD, OMC, Specific gravity, Atterberg's Limit

I. INTRODUCTION

The spilling of hydrocarbons into soil is commonly due to human errors. Pollution of environment is one of the major effects of technological advancement. Contamination of crude oil is referred to as crude oil pollution and it is estimated that 80% of crude oil pollution are results of spillage. Currently, about 80% lands are contaminated by products of petroleum origin.

Expansive soil is always problematic for engineering structures due to its swelling and shrinkage behavior. So the effect of contamination is much more for such soil. It is this vein that the geotechnical engineers are faced with increasing challenges as a result of petroleum product pollution and hence the need for laboratory studies in order to understand engineering behavior, for such soils. This paper deals on geotechnical index properties of diesel contaminated black cotton soil.

Recently some engineers and researchers studied the effect of crude oil contamination on lateritic and sandy soils and its influence on geotechnical properties. The degree of contamination is defined as percentage of volume of oil with respect to dry weight of soil. It is observed that presence of oil in the soil leads to reduction in values of liquid limit, plastic limit, shrinkage limits, UCS, void ratios and the increase in the values of compressibility and coefficient of consolidation. The value of optimum moisture content increases with increase in crude oil content which shows the adverse effect of properties of soil. This study will be useful for engineers or researchers in recycling or re-using of contaminated soils.

II. MATERIALS AND METHOD

1. Materials

A. Black Cotton Soil

The soil was procured from Chittoor region of Palakkad district at a depth of one meter from ground.

B. Diesel

The petroleum product Diesel was used as contaminant. The soil was contaminated in the laboratory with varying percentage of Diesel. The contaminated soil was packed in plastic bags for 5 days curing period.

2. Methods

A. Sampling

The soil sample were collected from one meter depth from Chittoor, Palakkad district. The soil was kept in the oven for 24 hours for drying. The sample for contamination and testing was collected from oven dried sample by quarter sampling method. Diesel was mixed separately with the samples in different content. The amount of contamination calculated as a % by weight of the dry uncontaminated soils and then mixed with the predetermined weight of the dry soil samples.

B. Procedure for sample preparation

The soil collected from field was oven dried and hand sorted to remove the pebbles and vegetable matter, if any. The soil was then be contaminated by Diesel in varying percentage by weights of black cotton soil and allowed to cure for 5 days period before testing and then tested to determine their geotechnical properties.

III. TEST PROGRAM

Test conducted for different conditions are shown in Table1.

TABLE 1. TEST PROGRAM

Soil	Black cotton soil
% Diesel	0,3,6,9,12
Curing Period	5 days
Tests	Specific gravity Standard Proctor Atterberg's limit CBR Permeability

IV. RESULTS

The atterberg's limit, specific gravity, standard proctor tests, California Bearing Ratio, and permeability test were conducted on pure and contaminated soil sample with varying percentages of diesel. The tests were done and results are shown below in Table 2.

Table 2. Results for various percentage of crude contaminated soil

TABLE 2. TEST RESULTS

Sl No	Property of Soil	Diesel				
		0%	3%	6%	9%	12%
1	Specific gravity	2.60	1.95	1.91	1.88	1.83
2	Liquid limit	53	57.129	59.352	61.84	62.89
	Plastic limit	27.3	4	9.89	31.46	34.81
3	OMC	18.5	13.79	12.66	12	11.01
	MDD	1.74	1.71	1.70	1.625	1.618
4	Permeability	3.7* 10 ⁻³	3.6* 10 ⁻³	2.49*1 0 ⁻³	1.84*1 0 ⁻³	1.81*1 0 ⁻³
5	CBR	455	368	119	98.45	74.32

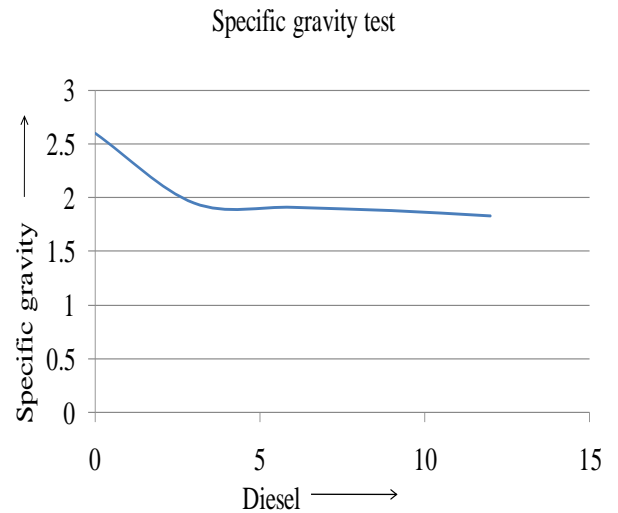


Fig 1. Specific Gravity Test Result

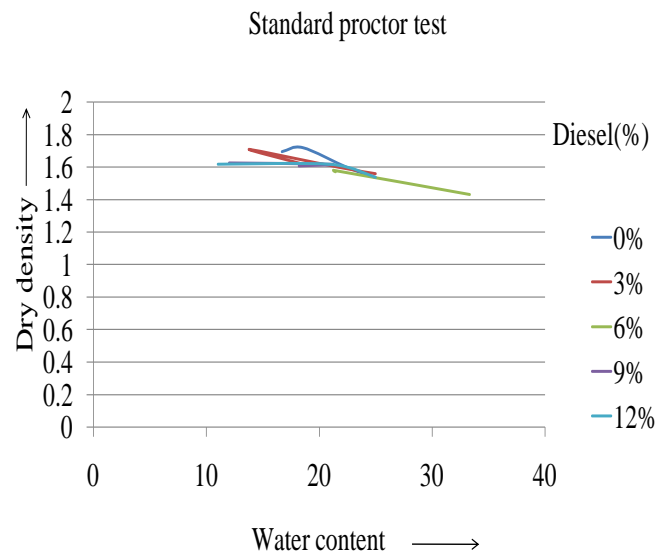


Fig 2. Standard Proctor Test Result

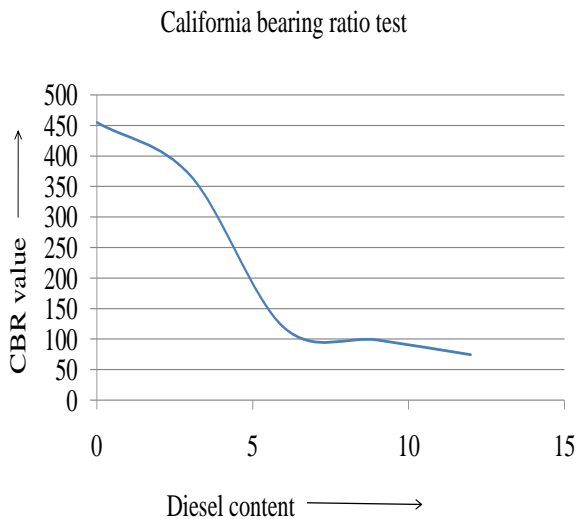


FIG 3.CALIFORNIA BEARING RATIO TEST RESULT

V. CONCLUSION

Diesel contamination on black cotton soil is studied and it is observed that specific gravity, maximum dry density, optimum dry density, permeability and California bearing ratio decreases with increase in contamination. But Atterberg’s limit increases with diesel contamination.

As a remedial measure we are doing a study for diminishing the effect of contamination of soil by adding

chicken manure on to the soil such that effect of contamination may be reduced.

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VII. REFERENCES

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