

Strength Characteristics of Diesel Oil Contaminated Marine Clay Using Phosphogypsum

THARA R DAS¹, TWINKLE VINU MOHANDAS²

¹ Post Graduate Student, Department of Civil Engineering, Marian Engineering College, Trivandrum, Kerala

² Assistant Professor, Department of Civil Engineering, Marian Engineering College, Trivandrum, Kerala

Abstract- Oil Pollution is the resultant contamination of environment due to the presence of oil in excessive quantity. Oil contamination is a genuine danger to our environment and biological community and should be controlled with urgency. The oil contamination influences the geotechnical properties of soil. So it's a need to study the effect of diesel oil on geotechnical properties of soils. In this study, the variation of geotechnical properties like Atterberg limits, compaction characteristics, and unconfined compressive strength with the addition of diesel oil in marine clay was considered. The results showed that increase in the amount of diesel oil increase the Atterberg limits and decrease in compaction characteristics and unconfined compressive strength. Increasing diesel oil content will leads to decrease in strength. From the above test results it is obtained that 16% of diesel contaminated soil gives worst strength, so stabilized this oil contaminated soil with phosphogypsum [PG] in different percentage. Strength characteristics of oil contaminated soil improved maximum at 9% of phosphogypsum.

Index Terms- Atterberg limits, Compaction characteristics Diesel oil, Geotechnical properties, Oil pollution, Phosphogypsum, Unconfined compressive strength.

I. INTRODUCTION

Every kind of pollution is harmful to nature. Oil does not break up in water and hence oil normally floats on the surface of water. Oil Pollution is the resultant contamination of environment due to the presence of oil in unreasonable amount. Oil pollution is most

common in expansive water bodies like oceans and seas. Oil spills include any spill of raw petroleum or oil refined items e.g., gasoline, diesel fuels, jet fuels, kerosene, hydraulic oils, lubricating oils that can contaminate the surface of the land, air, and water environments. Oil spills occur due to the release of a liquid petroleum hydrocarbon into the environment particularly the marine ecosystem. Marine water is particularly influenced by this type of contamination. Oil contamination is basically a man-made contamination and is a result of human reckless exercises. Ships and tankers conveying crude oil over the oceans may cause deadly oil spills in marine water due to different causes, leakage being the most widely recognized one. The amount of oil spills matter when it comes to the significance of oil and water pollution. During marine accidents, the oil spills amount is enormous. Oil contamination is a serious risk to our environment and ecosystem and should be controlled with urgency.

II. MATERIALS USED

In this study the soil was artificially contaminated with diesel oil and variations in geotechnical properties was studied.

a) Soil

The study was conducted on Marine clay, collected from near Bolgatty, Cochin .From the results shows that it was high plastic clay. The geotechnical properties of marine clay are given in table I.

Table1: Properties of marine clay

Properties	Values
Specific gravity	2.5
Permeability (m/s)	1.7X10 ⁻⁹
Liquid limit (%)	72
Plastic limit (%)	32.6
Plasticity index (%)	40.8
Unconfined compressive strength (kN/m ²)	62.68
Optimum moisture content (%)	32.6
Maximum dry density (g/cc)	1.55
Clay (%)	50
Silt (%)	38
Sand (%)	12
pH	7.7
IS classification	CH
Natural water content(%)	55.2

b) Diesel oil

The diesel oil was taken from a petrol pump in Trivandrum. Diesel oil used has light brown color.

c) Phosphogypsum [PG]

Gypsum is a mineral that occurs in nature. Phosphogypsum refers to the gypsum formed as a by-product of processing phosphate ore into fertilizer with sulfuric acid.

III. METHODOLOGY

The study was conducted to determine the effects of diesel oil on Marine clay, high plastic clay. For this the contaminants are mixed in various proportions and the variations in geotechnical properties like Atterberg limits, compaction characteristics and unconfined compressive strength are analysed. The contaminants are mixed with 4%, 8%, 12% and 16% by weight of the dry soil samples. From this above tests it is obtained that particular % of diesel contaminated soil gives worst strength, so stabilized the oil contaminated

soil in that % with varying % of phosphogypsum and conducted unconfined compressive strength test.

IV. RESULT AND DISCUSSIONS

i) Variation of Atterberg limits

Fig 1 shows variation in Atterberg limits with diesel oil. It observed that liquid limit, plastic limit and plasticity index of the soil increases progressively with increase in diesel oil content. Addition of diesel oil to the soil creates a false increase in the thickness of diffused double layer, this may be responsible for the increase in the liquid and plastic limit. The plasticity index also increased with the increasing diesel oil content. It indicates that, contaminated soil become less workable.

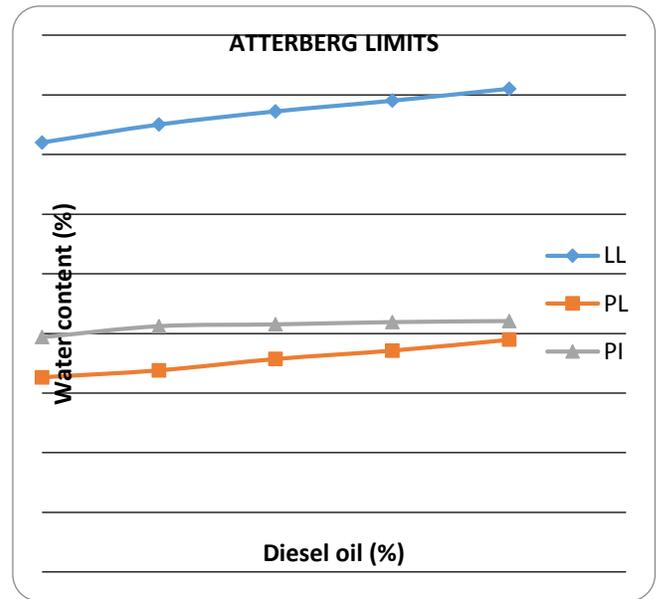


Fig 1: Variation of Atterberg limits

ii) Variation of Compaction characteristics

Fig 2 and fig 3 shows variation in MDD and OMC with diesel oil. It observed that MDD and OMC decrease with the increase in diesel oil content. It is because of the diesel oil is hydrophobic and it coats itself around individual clay particles and prevents the entry of water which interacts with clay particles.

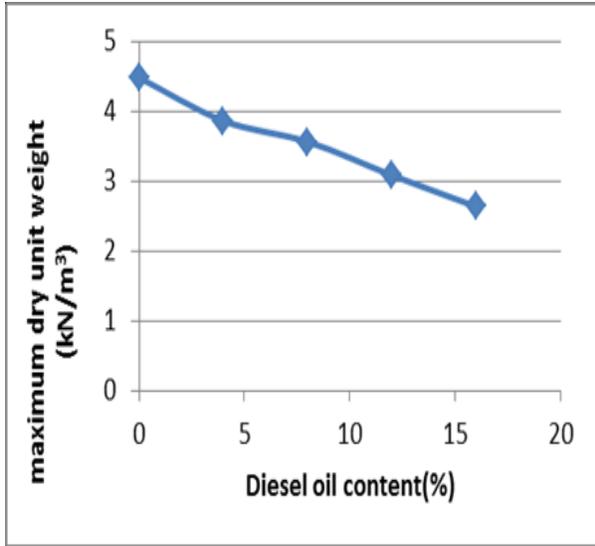


Fig 2: Variation of Maximum Dry Density

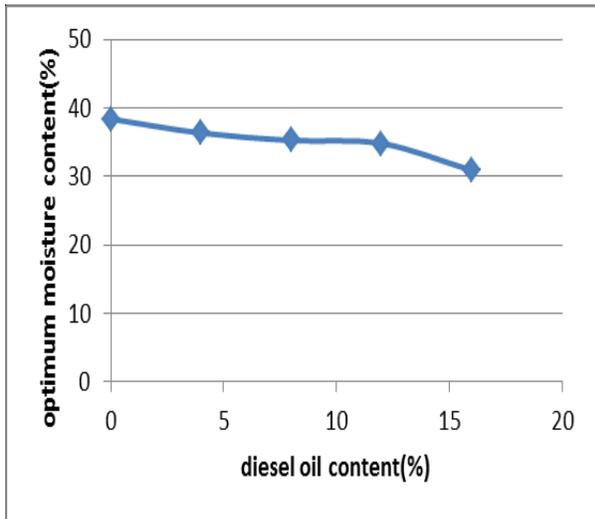


Fig 3: Variation of Optimum Moisture content

iii) Variation of Unconfined Compressive Strength

Fig 4 shows the variation of UCS with the addition of diesel oil. UCS decreases drastically with the increase in diesel oil contamination in the soil. It leads to the weakness of soil and decreases the strength.

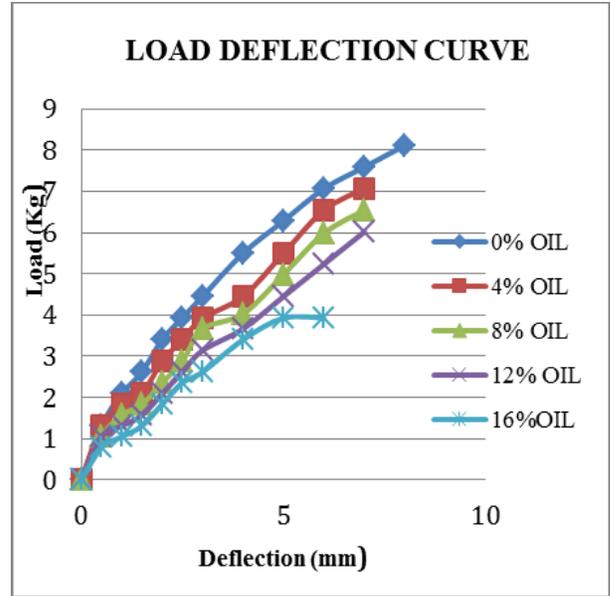


Fig 4: Variation of UCS with diesel oil

iv) Unconfined compressive strength (UCS) characteristics of diesel oil contaminated soil with phosphogypsum

Fig 5 shows the variation of unconfined compressive strength characteristics of diesel oil contaminated soil with phosphogypsum. Unconfined compressive strength increases with the increase in phosphogypsum content in contaminated soil up to 9%. Phosphogypsum increases the MDD of soil and also makes the soil particles tightly packed. Predominant content in phosphogypsum is calcium it imparts more strength to the contaminated soil it leads in increases in UCS val

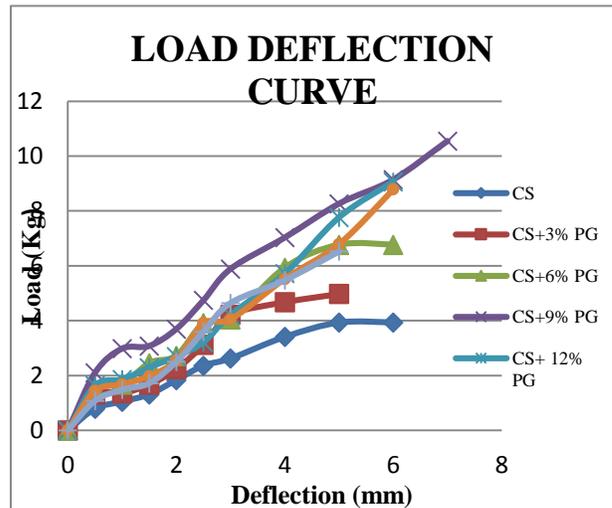


Fig 5: Oil contaminated soil with varying percentage of phosphogypsum

V. CONCLUSIONS

From the results, it was observed that diesel oil affect the geotechnical properties of high plastic clay.

- Atterberg limits increase with increasing diesel oil contamination in soils.
- Increasing of diesel oil content in soils causes a reduction of maximum dry density and optimum water content.
- The reduction in optimum water content is more in artificially oil-contaminated soil samples, indicating excess oil in the soil.
- Oil contamination induces a reduction in strength of the soil samples.
- 16% of oil contamination gives the worst strength.
- Stabilizing oil contaminated soil with 9% of phosphogypsum by unit weight of soil gives optimum results.
- Addition of PG to the oil contaminated soil increases UCS values of soil.
- From this study it is understood that Phosphogypsum is a good additive for improving the property of diesel oil contaminated soil.

clayey and sandy soils” Engineering Geology , vol. 89 ,Feb.2007 , pp 220-229

- [4] Wikipedia, Soil contamination. Accessed 17 November2017
https://en.wikipedia.org/wiki/Soil_contamination

REFERENCE

- [1] Al-Sanad , K. Eid , and F. Ismael, “Geotechnical properties of oil-contaminated Kuwaiti sand,” Geotechnical Engineering, vol. 121, May. 1995.
- [2] Gbenga Matthew and Oluwatosin Feyisetan, “Effect of Diesel Oil Contamination on Soil Natural Recharge of Groundwater,”2nd International Conference on Geological and Civil Engineering IPCBEE, vol. 80 (2015).
- [3] Mashalah Khomehchiyan, Hossein Charkhabi and MajidTajik “Effect of crude oil contamination on geotechnical properties of