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Compressive Strength Analysis of Dolime Fine Stabilized Diesel Contaminated Expansive Soil

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ABSTRACT: *The results of an experimental programme undertaken with an expansive soil artificially contaminated with diesel, and stabilized with dolime fine to find its, Unconfined compressive strength (UCS) at 0,7 and 28 days of curing have been discussed in this paper. UCS of the expansive soil decreased by 58.14% when contaminated with 9% diesel. After stabilization with dolime fine, the UCS value increased. There was 747.22% increase in UCS as compared to the UCS of 9% diesel contaminated expansive soil and 254.65% increase in UCS as compared to the UCS of uncontaminated expansive soil when stabilized with 9% dolime fine and cured for 28 days.*

Keywords: *Expansive Soil, Diesel, Dolime Fine, Unconfined Compressive Strength.*

I. INTRODUCTION

Expansive soil is a type of clayey soil having montmorillonite mineral which expands significantly when comes in contact with water and shrinks when water dries out. The strength of this type of soil is very low and this alternate swell-shrink behaviour damages the lightly loaded structures, which are constructed over it. It is treated as a problematic soil for construction (Nelson and Miller 1992, Gourley et al. 1993, Rao et al.2007, Sabat and Pati 2014) [9,3,13,19]. There are many ways this soil can be contaminated such as infiltration of contaminated surface water, discharge of industrial waste in to the soil, rupture of underground storage tanks, and seepage from a landfill and, leakage from underground pipe lines and septic tanks etc. Contamination adversely affects the engineering properties of soil which lead to several problems like loss in strength, differential settlement and cracks in existing foundation or structure etc. Contamination increases the problems for construction on expansive soil, which itself without contamination is also a problematic soil. One of the contaminants of soil is diesel. Diesel in different ways like, leakage from the automobiles moving on the roads, from the rupture of diesel storage tanks, or from the automobile garages during repair and maintenance work of the automobiles, comes in contact with soil and contaminates it. The effects of contamination of black cotton soil by diesel was studied by Pusadkar and Bharambe (2014) [12] and had found a decrease in maximum dry density(MDD), optimum moisture content (OMC) and unsoaked California bearing ratio (CBR) of the soil along with change in other properties. The effect of diesel on a non expansive clayey soil was also studied by Pradeepan et al. (2016) [11] and decrease in OMC, MDD and unconfined compressive strength (UCS) were observed. Stabilization is one of the techniques (Cokca 2001; Kalkan and Akbulut 2004; Sabat and Das 2009; Ogbonnaya and Illoabachie 2011; Sabat and Nanda 2011; Moses and Saminu 2012; Sabat 2012; Mir and Sridharan 2013; Sabat 2013;Sabat and Pradhan 2014; Ashango and Patra 2014 ; Sabat and Nayak 2015; Kulkarni et al.2016; Sabat and Mohanta 2016) [2,5,14,10,15,8,16,7,17,18,1,21,6,22] to improve the geotechnical properties of expansive soil. Stabilization technique can be adopted to improve the geotechnical properties of contaminated expansive soil. Dolomite chips are required for different industrial processes, which is obtained by crushing dolomite stones, during crushing a solid waste is produced it is called as dolime fine (Sabat and Mohanta 2015) [20]. It has very high percentage of CaO. Dolime fine has been recommended by IRC: 88-1984, [4] as a binding agent that can replace pure lime (Shahu et al. 2013), [23]. Dolime fines can be utilized to stabilize contaminated expansive soil. The objective of this paper is to investigate the effect of dolime fine on UCS of an expansive soil artificially contaminated with diesel, at 0, 7 and 28days of curing.

II. MATERIALS AND METHODS

Material

The materials used in the testing programme are Expansive soil, Diesel, and Dolime fine.

Expansive Soil

The Geotechnical Properties of expansive soil are: Particle size analysis :i)Sand size- 12%, ii)Silt size - 24% iii)Clay size- 64%, Specific gravity:-2.67, Atterberg's Limits: i)Liquid Limit -61%, ii)Plastic Limit- 29%, ii)Plasticity Index- 32%,Compaction Properties :i) OMC - 22%, ii)MDD-16.1 kN/m^3,UCS:- 86 kN/m^2

Diesel
Diesel used in the experimental programme was purchased from the local market.

Dolime Fine
Dolime fines used in the experimental programme were obtained, by crushing dolomite chips and those passed in 425 micron IS sieve were used in experimental programme.

Methods
Diesel was added to the expansive soil at 0,3,6.and 9% by dry weight of the soil, mixed properly and stored in an air tight container for 7 days. After that standard Proctor compaction test was conducted on diesel contaminated expansive soil to get OMC and MDD. Samples of UCS were prepared by compacting it at its OMC and MDD. The worst effect of contamination in terms of maximum reduction in UCS were found out which occurred at 9% addition of diesel. After that dolime fine was added to soil contaminated with 9% diesel, at 0,3,6 and 9% by dry weight of diesel contaminated expansive soil, by replacement of diesel contaminated expansive soil with dolime fine. Standard Proctor compaction tests, and UCS tests at 0,7 and 28days of curing were conducted on dolime fine stabilized diesel contaminated expansive soil samples. Samples of UCS were prepared by compacting it at its OMC and MDD. The procedures as given in Indian standard Codes were followed to conduct these tests. samples. Samples of UCS were prepared by compacting it at its OMC and MDD. The procedures as given in Indian standard Codes were followed to conduct these tests.

III. ANALYSIS OF TEST RESULTS AND DISCUSSION

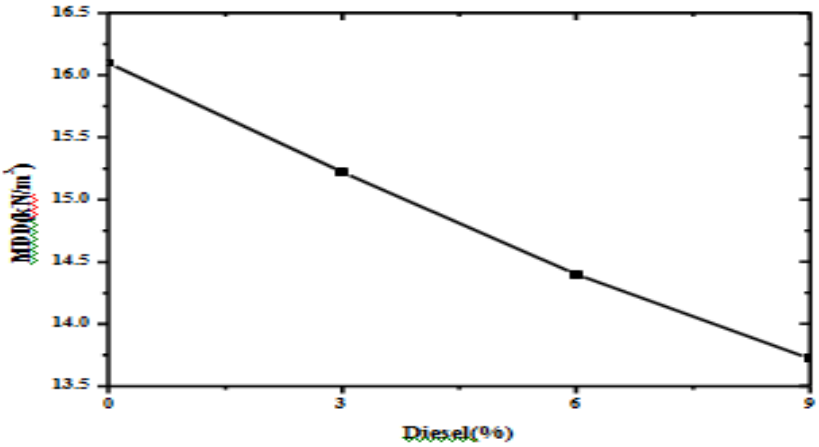

Figure 1 Effect of Diesel on MDD of Expansive soil

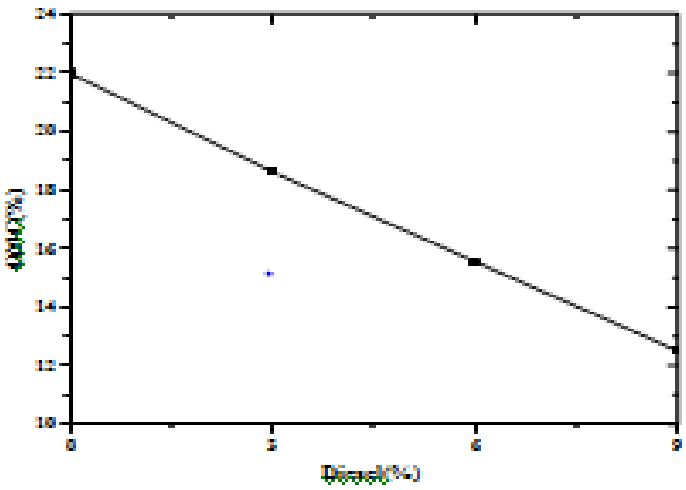

Figure 2 Effect of Diesel on OMC of Expansive soil

The effects of diesel contamination on MDD and OMC of the expansive have been shown in Fig.1 and Fig. 2 respectively. Both OMC and MDD decreased with increase in diesel addition. Similar observations were also made by Pusadkar and Bharambe (2014) [12] while adding diesel to a black cotton oil and Pradeepan et al. (2016) [11] while adding diesel to a non expansive clayey soil.

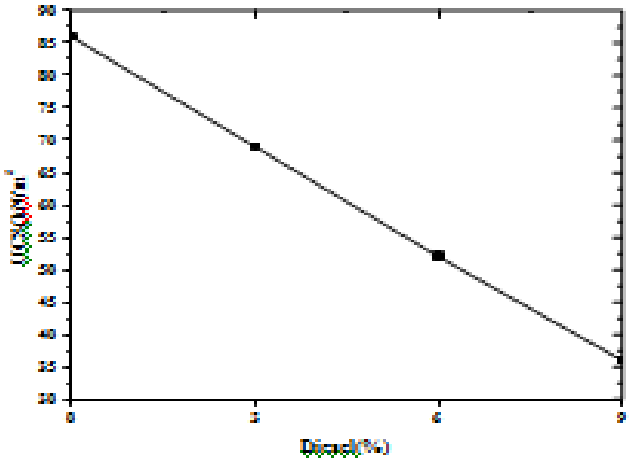

Figure 3 Effect of Diesel on UCS of Expansive soil

The effect of diesel contamination on UCS of expansive soil has been shown in Fig.3.With increase in diesel contamination the UCS value decreased. The UCS decreased to 36 kN/m^2 from 86 kN/m^2 with increase of diesel from 0 to 9%, a decrease of 58.14 % with addition 9% diesel. A reduction in unsoaked CBR value was found by Pusadkar and Bharambe (2014) [12] while adding diesel to a black cotton oil and a reduction in UCS was found out by Pradeepan et al. (2016)[11] while adding diesel to a non expansive clayey soil.

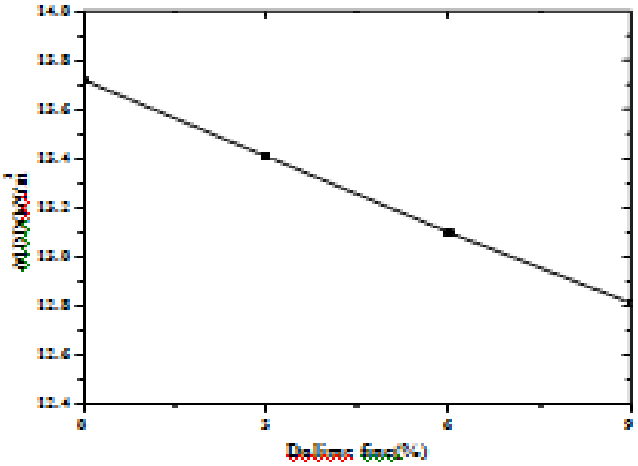

Figure 4 Effect of Dolime fine on MDD of Diesel contaminated Expansive soil

The effect of dolime fine on MDD of diesel contaminated expansive soil has been shown in Fig.4.The MDD decreased with increase in addition of dolime fine.

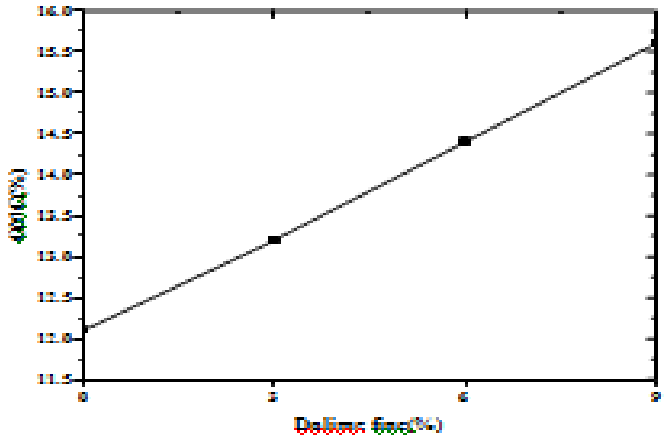

Figure 5 Effect of Dolime fine on OMC of Diesel contaminated Expansive soil

The effect of dolime fine on OMC of diesel contaminated expansive soil has been shown in Fig.5. The OMC increased with increase in addition of dolime fine

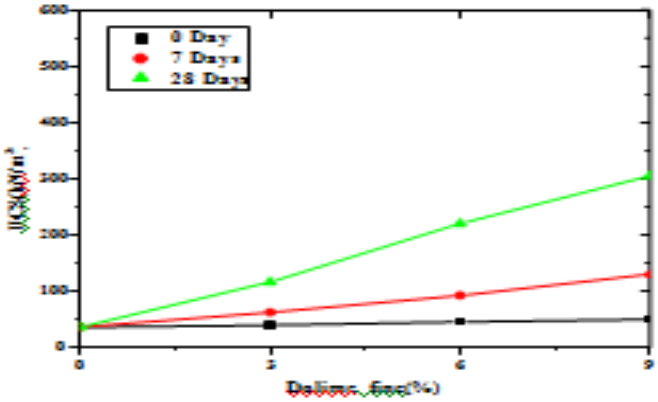

Figure 6 Effect of Dolime fine on UCS of Diesel contaminated Expansive soil

The effect of dolime fine on UCS of diesel contaminated expansive soil at, 0,7 and 28 days of curing has been shown in Fig.6.The UCS increased with increase in addition of dolime fine and curing period. The UCS increased to 305 kN/m^2 from 36 kN/m^2 at 28 days of curing and 9% dolime fine addition.

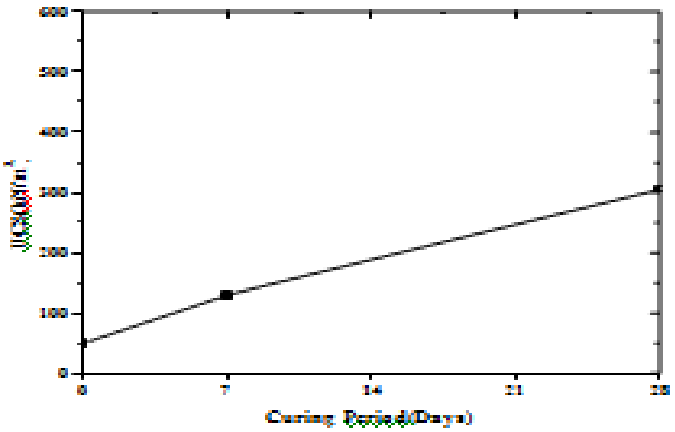

Figure 7 Effect of Curing Period on UCS of Dolime fine (9%) stabilized Diesel contaminated Expansive soil

Effect of curing period on UCS of dolime fine (9%) stabilized diesel contaminated expansive soil has been shown in Fig.8. The UCS increased to 305kN/m^2 from 50 kN/m^2 when the curing period increased to 28 days from 0-day.

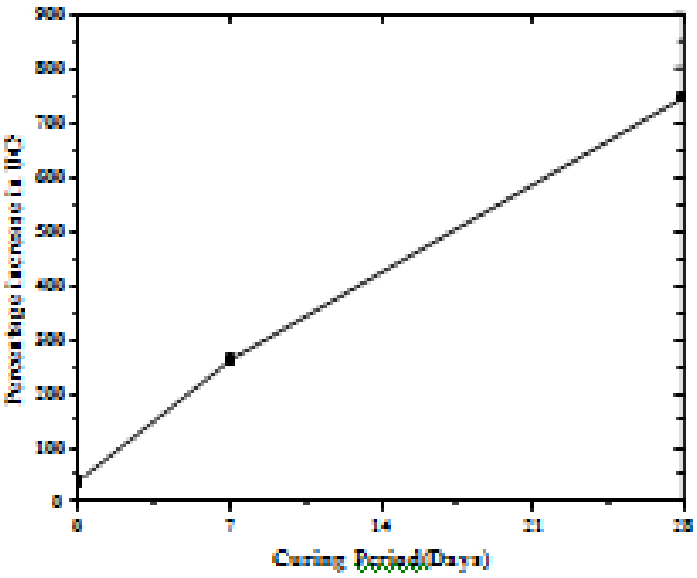

Figure 8 Variation of percentage increase in UCS of Dolime fine (9%) stabilized Diesel contaminated Expansive soil as compared to UCS of Diesel contaminated Expansive soil with curing period

Fig.8 shows the variation of percentage increase in UCS of dolime fine (9%) stabilized diesel contaminated expansive soil as compared to UCS of diesel contaminated expansive soil with curing period. The percentage increase in UCS increased to 747.22% from 38.88% when the curing period increased to 28 days from 0 day, as compared diesel contaminated expansive soil. At 28 days curing period the percentage increase in UCS value as compared to the UCS value of uncontaminated expansive soil is 254.65% .

IV. CONCLUSION

The UCS of the expansive soil decreased 58.14% by contamination with 9% diesel. The UCS of the expansive soil which was decreased due to contamination was not only regained by stabilization with 9% dolime fine but also increased by 747.22% at 28 days of curing period, as compared to the UCS of 9% diesel contaminated expansive soil and 254.65% increase in UCS as compared to the UCS of uncontaminated expansive soil.

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