Soil Stabilization using Industrial Waste Fly Ash

Miss Shikalgar Sana R.[1] Ms. Rupali T Gadekar[2] Mr. Pankaj S Vedpathak[3] Ms .Shubhangi S Zarekar[4]
[1]Assistant Professor [2,3,4]Student
[1,2,3,4]Department of Civil Engineering
[1,2,3,4]Adarsh Institute of Technology (Polytechnic), Vita, Maharashtra, India

Abstract— The project deals with stabilization of soil using industrial waste. Unsuitable highway sub grade soil requires stabilization to improve its properties. Fly ash is used as raw materials when the sand can no longer be reused in the industry, it is removed from the industry and is removed from the industry and is termed as industrial waste sand. Fly ash was bought from locally available industries fly ash is used with variable percentage i.e., (10%, 20%, and 30%). For optimum percentage of fly ash within this that percentage of fly ash is used in sub base for stabilization. The project are planned to conduct various experiment like Specific gravity, sieve analysis, proctor compaction test, unconfined compressive strength and direct shear test to increase strength properties and behavior of sub base. Then the results and graphs of various mixes are compared to see their effects in sub base stabilization. The stabilization technique has an additional benefit of providing an environment friendly way to deal with fly ash.

Key words: Soil Stabilization, Fly Ash

I. INTRODUCTION

The sub-base is an important layer in both flexible and rigid pavements. It mainly acts as a structural layer helping to spread the wheel loads so that the sub-grade is not over-stressed. It also plays a useful role as a separation layer bet. The projecten the base and the sub-grade and provides a good working platform on which the other paving materials can be transported, laid and compacted. It can also act as a drainage layer. The selection of material and the design of the sub-base will depend upon the particular design function of the layer and also the expected in-situ moisture conditions. Stabilized sub-bases can be used for both flexible and rigid road pavements, although the reasons for doing this can vary. In order to identify the benefits of stabilizing sub-bases, it is necessary to examine the role of the sub-base for each pavement type. A stabilized, and therefore stiffer, sub-base provides greater load spreading ability and hence reduces stresses imposed on the subgrade. When stabilized the sub-base provides much of the structural rigidity in the pavement, and also assists during the compaction of the upper granular layers and hence increases their ability to withstand deformation.

II. MATERIAL USED

A. Soil

In this study the material soil chosen is collected in undisturbed manner. Undisturbed samples with core cutter are collected from the selected study area from different sites. The soil samples collected are Red soil and Pale brown soil. The soil sample is chosen which having high plasticity index. For that purpose, firstly the test for Atterberg's limit is carried out and from that plasticity index is found and from the results of that the soil with high plasticity is chosen for project purpose.

B. Fly Ash

Fly ash is generally captured by electrostatic or other particle filtration equipment before the flue gasses reach the chimney In the past fly ash was generally realized into the atmosphere fly ash is generally stored at coal power plants or placed in land fills

Fly ash material solidifies oil suspended in the exhaust gases fly ash particles are generally spherical in shape and range in size from 0.5 to 300u.m

III. EXPERIMENTAL STUDY

A. Laboratory Tests

Following laboratory tests have been carried out as per IS: 2720 . The tests were carried out both on Natural soil and stabilized soil with fly ash collected from Thermal Power Plant.

1) Liquid Limit
2) Plastic Limit
3) Sieve Analysis
4) Specific Gravity
5) 5 Standard Proctor Compaction Test
6) 6 Water content

To check the adequacy of compaction, following control tests were carried out on each of the compacted layers.

1) In-site density by core cutter
2) Natural moisture content

1) Specific Gravity

Specific Gravity (G) is defined as the ratio of the weight of an equal volume of distilled water at that temperature both weights taken in air.

a) Needs:

The Specific gravity for most substances can be found in pharmacy references.

There will be times when you need to know the weight of a liquid or the volume of a solid, especially when you are compounding.

The knowledge of specific gravity is needed in calculation of soil properties like void ratio, degree of saturation etc.

b) Importance:

– Specific gravity is the ratio of mass per volume.
– Foundation of all buildings and bridged and roads bit must be determined first in order to know the physical properties how strong the soil is to make use of it for building purposes.

c) Result:

Specific gravity of soil at 2.67°C.

Unless specified, the specific gravity values of the soil will be reported at 27 degree Celsius.

The specific gravity of soil particles will be come within the range of 2.65 and 2.85 if the soil consistence of

porous and organic materials a specific gravity value of less then to will be obtained. A specific gravity value greater than 3 will be shown by soils that have heavy substances.

2) Sieve Analysis

Determination of particle size distribution in a soil, sediment or rock by measuring the percentage of the particles that with pass through standard sieves of various sizes

a) Need:

Particle size distribution helps in finding the different sizes of aggregates and helps in classification.

Fineness modulus helps in finding maximum amount of aggregates lying in one particular size of sieve of given aggregate

For better understanding of sieve analysis, graphical representation is always helpful.

b) Importance:

- To formulate a uniform dosage form.
- To prepare granular of required size.
- To separate undesirable particles.

c) Result:

Effective size

Coefficient of uniformity (Cu) = 3

Coefficient of curvature (Cc) = 0.33

d) Standard Proctor Test:

These laboratory test generally consist of compacting soil at know moisture content into a cylindrical mould of standard dimensions using compactive effort of controlled magnitude. This process is then repeated from various moisture contents and the dry densities are determined for each.

e) Need:

The proctor compaction test and its variants are used to determine optimal moisture content for soil. This test is especially useful when determining the relationship between water content and the dry unit weight of soil to establish the maximum density of a soil needed for a fill area.

f) Importance:

It helps of archive certain physical properties necessary for its behavior under loading.

It reduce the potential for excessive settlement.

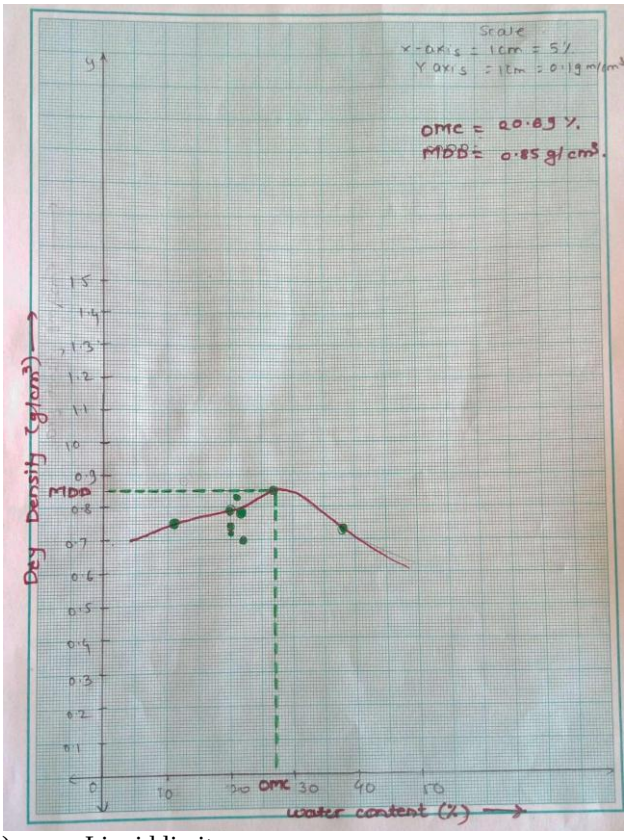
It reduce the chance of slop stability problem like land slides.

g) Result:

Optimum moisture content (OMC) =20.69%

Maximum dry density (MDD) =0.85%

it is concluded that the OMC of the soil is 20.69%, and MDD of the soil is 0.85 g/cm3



h) Liquid limit:

The moisture content at which ant increase in the moisture content will cause a plastic soil to behave as a liquid.

i) Plastic limit:

The plastic limit is the water content, in percent, at which a soil can a no longer be deformed by rolling into 3.2mm diameter threads without crumbling. in other words it is the percentage moisture content at which a soil changes with decreasing wetness fromed plastic to the semisolid consistency or with increasing wetness from the semi solid to the plastic consistency.

j) Need:

Value of liquid limit is used to classify find grained soil.

It give us information regarding the state of consistency of soil on site.

k) Importance:

These limit of soil are very important property of fine grained soil and its value is used to classify fine grained soil and calculate activity of clays and toughness index of soil.

It also give was information regarding the state of consistency of soil on site it also can be used to predict the consolidation properties of soil while calculating allowable bearing capacity an settlement of foundation.

l) Result:

Liquid limit

WL = 48.7%

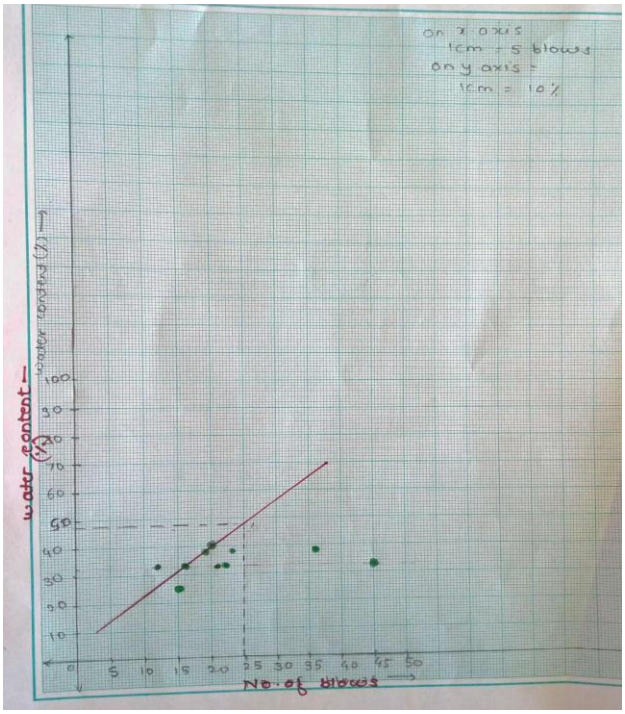
Plastic limit is the water content at which soil behaves as a plastic material.

Plastic limit of the soil sample

Plastic Limit.

average plastic limit is 37.16%.

WP = 37.16%



m) Core Cutter Test:
Core cutter method used for determining the soil. For determination of the dry density of the soil, the cutter is pressed in to the soil so that it is filled with the soil without disturbing the core contents.

n) Need:
By using core cutter method, bulk density of soil can be quickly calculated.
A high percentage of voids indicate poor compaction of soil.

o) Importance:
Core cutter method is used for finding filled density of cohesive or clayey soils placed as filled. The result of these experiments, that bulk density and water content it is shown that the soil is cohesive and clayey soils.

p) Result:
Dry density of the soil = 1.40

q) Permeability Test:
The rate of the under laminate flow condition throw the a unit cross section are of porous medium under unit hydraulic gradient is defined as coefficient of permeability.

r) Needs:
The knowledge of this property is much usefull in solving problems involving yield of water bearing strata, seepage through earthen dams, stability of earthen dams, and embankments of canal bank affected by seepage , settlements.

s) Importance:
Soil permeability is the property of the soil to transmit water and air and is one of the most important qualities to considered fish culture.

t) Result:
The average constant head permeability is 0.01004 cm/sec.

u) Direct Shear Test:
The test equipment consist of a metal box in which the soil specimen is placed. The box is spilt horizontally into two halves. Vertical force is applied through a metal platen.

v) Needs:
To determine the shearing strength of soil using the direct shear apparatus.
The value of the angle of internal friction and cohesion of the soil involved are required for the design.

w) Importance:
The importance of shear testing for a specific material depends on the type of material.
Isotropic materials are those with consistence material properties an all directions.

x) Result:
Shear strength of the soil sample is = 5.6KN/m

IV. Conclusion

Results obtained can be summarized as addition of fly ash to soil improve the gradation of soil, reduces swelling characteristics, increased the maximum dry density , reduced the optimum moisture content increases shear resistance and reduced the permeability as well. The fly ash enhances the properties of soil up to 10-15 % upper limit varying with type of soil and fly ash.

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