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Stabilization of Subgrade Black Cotton Soil using Quarry Dust and Foundry Sand

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Abstract*: *Soil stabilization can be explained as the alteration of the soil properties by chemical or physical means in order to improve the engineering excellence of the soil. The main objective of the soil stabilization is to raise the bearing capacity of the clay soil, its opposition to weathering method and soil permeability. The long-term performance of any construction project depends on the reliability of the underlying soils. unsound clay soils can create considerable problems for pavements, Therefore soil stabilization techniques are essential to ensure the good constancy of clay soil so that it can successfully uphold the load of the superstructure specially in case of clay soil which are very active, also it saves a lot of time and millions of funds when compared to the technique of cutting out and replacing the unsound soil. In this Study deals with the entire analysis of the enhancement of black cotton soil properties and its stabilization using Quarry Dust and industrial Foundry sand. The basic tests were carried out on soil, quarry dust and foundry sand are Atterberg's Limit, Modified Proctor Compaction and CBR Test with addition of 5%, 10% and 15 % of Quarry Dust to soil sample after result analysis, obtained keeping Quarry Dust 15% constant and addition of Foundry sand 5%, 10%, 15% and 20%. After test results the maximum CBR Value found at 15% Quarry Dust and 15% Foundry Sand. Dumping of these waste materials is necessary as these are causing dangerous effects on the surroundings. With the same purpose literature review is undertaken on consumption of solid desecrate materials for the stabilization of soils and their performance are discussed.

Keywords* : *Black Cotton Soil, Expansive soil, Quarry dust, Foundry Sand, Stabilization..

I. INTRODUCTION

Soil stabilization is a technique is used to maintaining and increasing the stability of soil and chemical modification of soil to increase their engineering parameters by blending and addition materials with soil mass to develop certain strength of soil.

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Soil improvement can be used to help a huge heap of sub-grade materials from black cotton soil or expensive clays to coarse materials.

Soil stabilization main aim is improving soil mass strength and also rising resistance to reducing by water through bonding the soil particles collectively.

The other process is by improving gradation of soil particle size and also by incorporation weak soil with suitable binders which improve soil engineering properties which achieved by mechanical stabilization, stabilization with lime, cement, bitumen industries waste and chemicals etc.

Here, in this project, soil stabilization has been carried out by the using of foundry sand waste and quarry dust. Both of these products are desecrate products and their dumping is a worry for whole world. By utilizing these industries desecrate materials in soil stabilization we can decrease the problem of their dumping and get a better sub-grade soil for highway construction.

II. SCOPE AND OBJECTIVES

The main issues with presence of expensive soil, which has swellings and shrinkage properties. The expensive soil or black cotton soil which change its volume, when it come in contact with moisture or water, because expensive soil contain Montmorillonite clay mineral, which cause volume change under change of water content. Due to this property soil Highway pavement or other structure may go under differential settlement and splitting in structure. Hence, scope of the this investigation is shortly explained below

(i) To study the engineering properties or Index properties, compaction properties and CBR of expensive soil mixing with various percentage of Quarry dust to find out optimum percentage dosage and also comparing change in Engineering properties with natural expensive soil.

(ii) To study the engineering properties or Index properties, compaction properties and CBR of expensive soil by keeping quarry dust optimum percentage in mix with various percentage of Foundry sand waste to find out the optimum percentage dosage of foundry sand waste and also comparing change in engineering properties with natural expensive soil.

(iii) To develop the rational approaches for the use of quarry dust and foundry sand waste for geotechnical purposes. Hence, increasing the rate of utilizing the quarry dust and foundry sand waste more effectively for construction purpose and to reduce the disposal problem and minimize the environmental hazards.

III. MATERIAL AND METHODOLOGY

A.Materials

1. Black Cotton Soil

Table 1: Physicalsproperties of used Blackscotton soil

Properties of the soil	Black Cotton soil
Color	Black
Specific Gravity	2.57
Grain Size Distribution	Well graded
Atterberg's Limit Liquid Limit in (%) Plastic Limit in (%) Plasticity Index in (%)	 60.33 21.46 38.54
Compaction Characteristics. Maximum Dry Density (g/cc) Optimum Moisture Content (%)	 1.48 19.47
CBR VALUE in (%)	4.76

2. Quarry Dust

Table 2: Physical properties of used Quarry Dust

Properties	Quarry Dust
Color	Grey
Specific Gravity	2.68
IS Classification	SP
Grain Size Distribution Coefficient of Uniformity (Cu) Coefficient of Curvature (Cc)	 3.053 1.18
Compaction Properties OMC (%) MDD (g/cc)	 12 2.01

3. Foundry Sand Waste

Table 3: Physical properties of used Foundry Sand

Properties	Foundry Sand
Color	Black
Specific Gravity	2.56
Grain Size Distribution Coefficient of Uniformity (Cu) Coefficient of Curvature (Cc)	 1.88 0.98
Compaction Properties OMC (%) MDD (g/cc)	 9.5% 1.77 gm/cc

B.Methodology

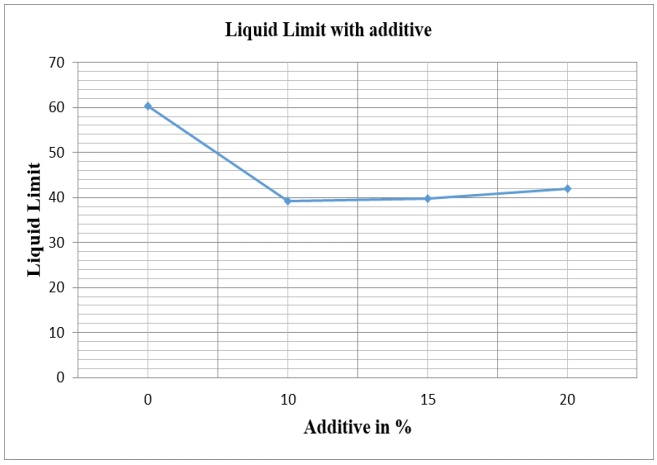
The methodology includes the basic and essential tests like sieve analysis test for grain size distribution, specific gravity, Engineering properties tests like Atterberg limits, compaction and CBR for untreated soil sample, with addition quarry dust and foundry sand waste which are conducted as per procedure given in IS Codes and MoRTH specifications.

The study is to find out the variation in the soil properties by adding the quarry dust in soil sample at 5%, 10%, and 15% of weight of soil sample, and conducting different test as per IS and MoRTH specification to obtain optimum percentage of dosage of quarry dust which gives more strength. Thereafter soil mixed with foundry sand waste at 5%, 10% 15% and 20% with keeping optimum dosage of quarry dust in sample mix, same tests are performed on the soil mixed samplesto find outsoptimum dosage of foundry sand waste. This help in identifying the optimum combinationsof quarry dust and foundry sand waste in sub-grade soil stabilization.

IV. TEST RESULTS ANALYSIS

Table 4: LiquidsLimit Test withaDifferent % Quarry Dust

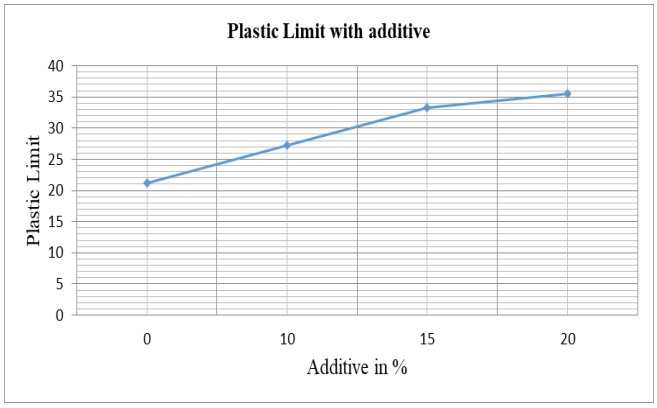
% of Quarry Dust	Liquid Limit
0	60.33
5	39.2
10	39.7
15	42.0



Graph 1: Liquid limits with additive

Table 5: PlasticsLimit Test withaDifferent % Quarry Dust

% of QuarrysDust	PlasticsLimit
0	21.46
5	27.27
10	33.33
15	35.59



Graph 2: Plastic limits with additive

Table 6: ShrinkagesLimit Test withaDifferent % Quarry

Soil + % of Quarry Dust	Plastic Limit
0	23.309
5	16.471
10	15.876
15	8.043

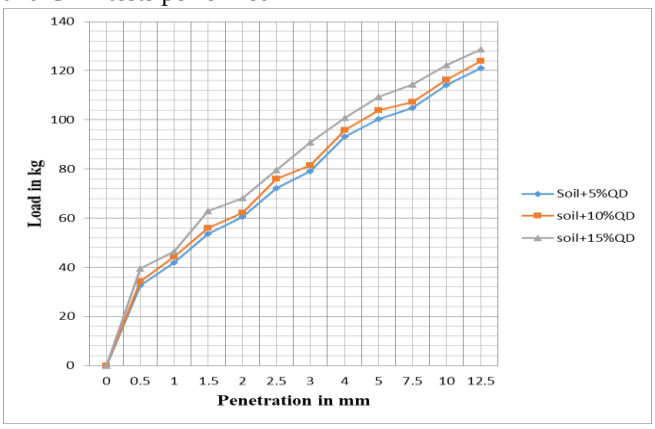
Table 7: MDD Test withaDifferent % Quarry

Soil + % of Quarry Dust	MDD gm/cc
0	1.48
5	1.50
10	1.52
15	1.54

Table 8: CBR Test withaDifferent % Quarry

% of Quarry Dust	CBR %
0	4.76
5	6.52
10	7.9
15	8.9

Now keeping 15% quarry Dust Additive in black cotton soil constant and adding Foundry sand 5% ,10% and 15% MDD and CBR tests performed



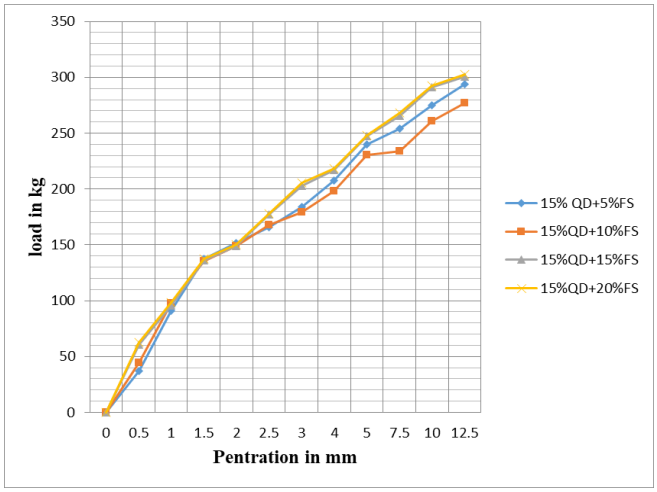
Graph 3: The Soilswith 5%,10%, and 15% QD Additive that CBR value Graph

Table 9: MDD test on BlackaCottonaSoil 15 % of QuarryaDust and Different % of Foundry Sand

Soil with Additives	MDD gm/cc	Water Content %
Soil+15% QD+5% FS	1.68	21
Soil+15% QD+10% FS	1.73	22.5
Soil+15% QD+15% FS	1.86	24.1
Soil+15% QD+20% FS	1.89	23.8

Table 10: CBR Test on BlackaCottonaSoil 15 % of QuarryaDust and Different % of Foundry Sand

Soil with Additives	CBR %
Soil+15% QD+5% FS	10.97
Soil+15% QD+10% FS	11.98
Soil+15% QD+15% FS	12.92
Soil+15% QD+20% FS	13.05



Graph 4: The above graph for CBRsvalue at 15% QD and Varying % FS

V. CONCLUSION

The basis on present experimentalsstudy, conclusions are drawn:

1. There is substantial increase in MDD with increase in addition of Additives up to 15% by the weight of soil.
2. There is substantial decrease in OMC with increase in addition of additives.
3. Shrinkage limit values decrease with increases percentage additives.
4. CBR of the soil obtained as 4.76 % and it increased to 12.93% after stabilizing it with optimum percentage of Quarry Dust and Foundry Sand.
5. The percentage increase in CBR value after stabilizing it with optimum percentage of Quarry Dust is 15% and optimum percentage of Foundry Sand is 15.0%.
6. The California bearing ratio of the soil alone obtained and their substantial increase CBR value by adding of Quarry Dust and Foundry Sand till optimum Content (15% QD + 15% FS) and beyond which not that much increasing in CBR value .
7. From above the investigation, can be concluded that the addition of Quarry Dust and Foundry sand in Black cotton soil decreases the swelling behavior, shrinkage limits, increases the MDD of soil, decreases plasticity index, increases the Plastic-limit, and improves soil CBR value..

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19. MoRTH – SECTION 400 for Subgarde, subbase and Base Course of pavement.

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