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Quarry Dust for Strengthening Subgrade Soil

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Abstract - *Nowadays, a lot of quarrying activities are going on around us. Rocks of vivid sizes are made from the quarries. During the making of these rocks, a lot dust is produced. This dust is called quarry dust. Quarry dust is a by-product produced during the quarrying activities. But this quarry dust is formed as waste and hence they are treated as a useless material. It also acts as air pollutant. As a solution to this problem, quarry dust can be utilized in construction purposes. This will reduce the cost of construction and also resources can be conserved. Quarry dust can be effectively used as ground improvement technique. It stabilises the soil compressibility, permeability and shear strength. Thus, it can be used during pavement construction. In this project, soil is partially replaced by different proportions of quarry dust.*

1. INTRODUCTION

For a country, transportation plays an important role in proper functioning and economic development. For safe and smooth transportation of goods and services, the pavement should be of good strength. It should perform well and should have a better lifespan. For the better performance of the pavement, the subgrade soil should have good load bearing capacity. Strength of Subgrade determines the pavement design. If the soil is of poor quality, it should be removed and replaced with good strength soil and thus improves the lifespan and performance of the pavement.

In quarries, where rocks are crushed into various sizes, a large amount of quarry dust is produced. They are formed as waste and causes harm to the environment and health hazards. It makes the air polluted. This waste can be utilised in construction works and hence can reduce construction cost. Soil stabilization of subgrade soil can also be done using quarry dust. It increases the engineering properties of soil such as permeability, compressibility and shear strength. Thus, it can be used in pavement construction. By using quarry dust for construction, construction materials can be saved and can make the work economic. Quarry dust is considered as a cost-effective method for ground improvement for weak soil.

2. METHODOLOGY

Soil sample is collected for testing. Quarry dust is collected from the quarry for partly replacing the soil. The collected soil sample is cleaned, and its index properties are determined. Quarry dust is added to the soil at different proportions of 0%, 5%, 10% and 15% and various tests are conducted for determining the strength of soil. The strength of soil itself and that of soil mixed with quarry dust of different proportions is determined. Optimum percentage of quarry dust added is obtained from the tests. The following tests are conducted.

Classification of soil by sieve analysis as per Indian Standard of Soil Classification System (ISSCS).

1. Moisture content is determined by oven drying.
2. Plastic limit and liquid limit is determined.
3. Unconfined compression test.
4. California bearing ratio test.
5. Direct shear test.
6. Standard proctor test.

3. RESULTS AND DISCUSSIONS

The following tests are conducted to determine the strength of soil sample mixed with different proportions of quarry dust.

3.1 Atterberg's limits

The liquid limit and plastic limit of soil sample increases with the addition of quarry dust. Then it reduces at 15%. The optimum percentage of quarry dust added is obtained as 10%.

Table -1: Plastic Limit and Liquid Limit of Soil Reinforced with Quarry Dust

Concentration Of Quarry Dust Added	Plastic Limit (%)	Liquid Limit (%)
0%	23	48
5%	26	52
10%	30	56
15%	28	54

3.2 Standard Proctor Test

In this test, the graphs of optimum moisture content and maximum dry density are plotted. The optimum moisture content and maximum dry density is obtained at 10% of quarry dust.

Table -2: OMC and MDD of Soil Reinforced with Quarry Dust

Concentration Of Quarry Dust Added	OMC (%)	MDD (%)
0%	15	1.16
5%	16.4	1.25
10%	17.8	1.542
15%	17.3	1.435

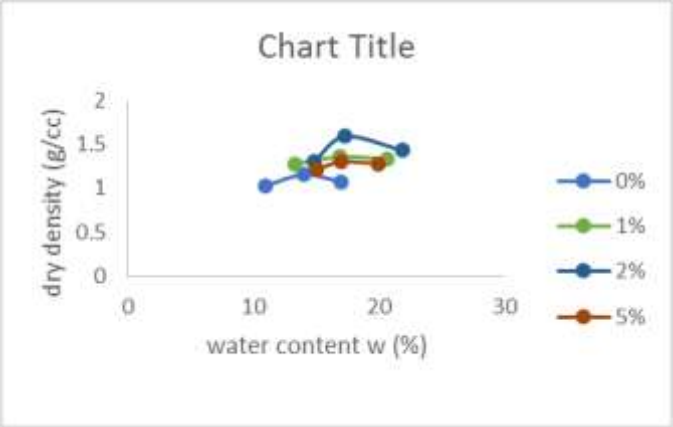

Fig -1: OMC and MDD of Soil Reinforced with Quarry Dust

3.3 Unconfined Compression Test

As the concentration of quarry dust increases, the compressive strength of soil also increases. The maximum value is obtained at 15%.

Table -3: UCC of Soil Reinforced with Quarry Dust

Concentration Of Quarry Dust Added	UCC (kN/m^2)
0%	124.5
5%	155.3
10%	178.8
15%	197

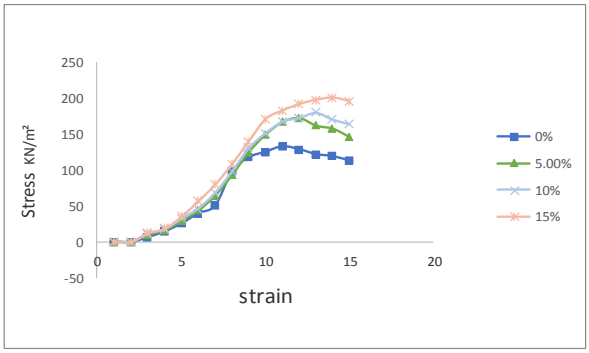

Fig -2: UCC of Soil Reinforced with Quarry Dust

3.4 Direct Shear Test

Shear strength of soil increases first and then decreases at 15% of quarry dust. Optimum percentage of quarry dust is obtained at 10% of quarry dust. Beyond this, quarry dust begins to replace the soil.

Table -4: Angle of Internal Friction Soil Reinforced with Quarry Dust

Concentration Of Quarry Dust Added	Angle of internal friction (°c)
0%	63.2
5%	79.7
10%	81.4
15%	80.9

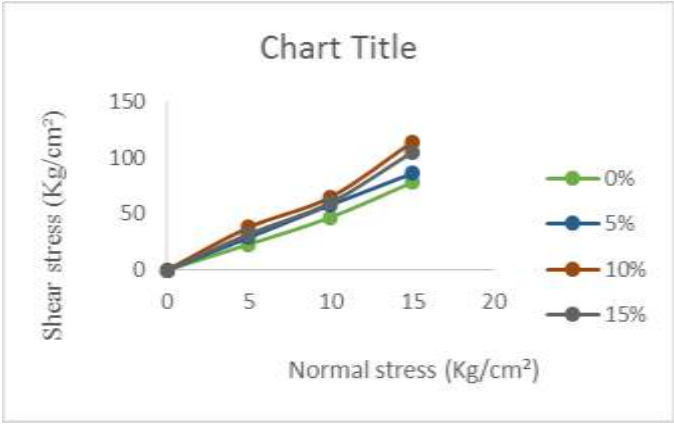

Fig -3: S Angle of Internal Friction Soil Reinforced with Quarry Dust oil Reinforced with Quarry Dust

3.5 California bearing ratio test

As the concentration of quarry dust increases, the CBR value also increases. The maximum value is obtained at 15%.

Table -5: CBR Value Soil Reinforced with Quarry Dust

Concentration Of Quarry Dust Added	CBR Value
0%	45.2%
5%	46.05%
10%	47%
15%	48.55%

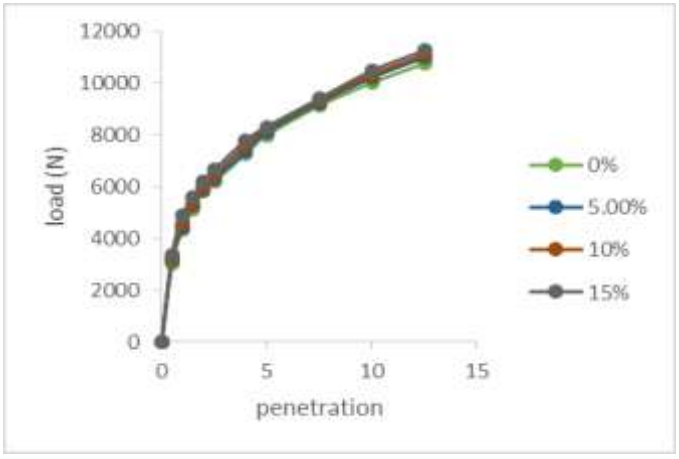

Fig -4: CBR Value Soil Reinforced with Quarry Dust

4. CONCLUSION

By conducting the above tests, the optimum percentage of quarry dust is obtained as 10% to 15%.Hence Quarry dust can be used for soil stabilization and can be adopted as an effective method for waste management and economic construction.

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