Stabilisation of Black Soil by Using Quarry dust and Lime Mixture

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**Abstract*:*** With the increasing of population and the reduction of available land, more and more construction of buildings and other civil engineering structures have to be carried out on weak or soft soil.In this project we are going to describe about the effect of lime and some Geo-technical properties of expansive soil stabilized with the optimum percentage of Quarry dust. Black cotton soil is one of the major soil deposits of India. These soils are very expansive in nature, these expand highly when comes contact with the water.This study is carried out with an intention to evaluate the effects of Quarry dust and lime on the geotechnical properties of the locally available expansive soil from Vaddeswaram. Tests which are to be carried out on the sample of soil dealt with specific gravity, compaction, California bearing ratio, unconfined compressive strength and shear strength. These tests are to be conducted at both non-stabilized and stabilized states by adding 2%, 4%, 6%, 8% and 10% of lime in addition with 5%, 10%, 15%, 20% and 25% of quarry dust. The results show the effect of quarry dust and lime on geotechnical properties of the soil samples strength. Also it may be estimated that this is an efficient way of reducing costs, without losing the strength gains and water sensibility

**Keywords:** Soil Stabilization**,** Black Soil,Quarry dust and Lime mixtures.

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**1. INTRODUCTION:**

Expansive soils are soils or soft bedrock that increases in volume or expand as they get wet and shrink as they dry out. In India this Expansive soil is called “Black Cotton Soil”. Colour of this Soil is reddish brown to black and this helps for cultivation of cotton, so is called black cotton swelling soil covers about 30% of the land area in India. They are also commonly known as bentonite, expansive, or Black Cotton soil. In India Black Cotton soil also known as regurs and are found in extensive regions of Deccan Trap. They have variable thickness and are underlain by sticky material locally known as “Kali Mitti”. In terms of geotechnical Engineering, Black Cotton soil is one which when associated with as engineering structure and in presence of water will show a tendency to swell or shrink causing the structure to experience moments which are largely unrelated to the direct effect of loading by the structure. The availability of buildable land is decreasing day by day in India due to population growth, rapid industrialization and scarcity of land with good natural bearing capacity. This leads to construction of buildings on poor soils which eventually lead to structural foundation failures. The expansive soils are the one which are more problematic for construction and are predominantly available in majority places in Andhra Pradesh. These soils undergo swelling and shrinkage as the moisture content changes in it. Due to high swelling and shrinkage, these soils pose lot of problems to the structures founded on them. For a safe construction, it is necessary to improve the quality of ground by adopting some suitable ground improvement techniques. For any land-based structure, the inspiration is incredibly necessary and has got to be sturdy to support the whole structure. so as for the inspiration to be sturdy, the soil around it plays a really essential role. So, to figure with soils, we'd like to own correct information concerning their properties and factors that have an effect on their behavior. the method of soil stabilization helps to attain the desired properties during a soil required for the development work.

**2. Objective:**

The objective of this paper is to study the stabilization of black soil by using ad-mixtures like Quarry dust (QD) and Lime mixture. Quarry dust is used as partial cement in different percentages of performance and strength. The demand for producing the Quarry dust as durable construction material results in the environmental pollution. [Lime is a calcium-containing inorganic mineral composed primarily of oxides, and hydroxide, usually calcium oxide and/ or calcium hydroxide. It is also the name for calcium oxide which occurs as a product of coal-seam fires and in altered limestone xenoliths in volcanic ejecta. The word](https://en.wikipedia.org/wiki/Lime_(material))*[lime](https://en.wikipedia.org/wiki/Lime_(material))*[originates with its earliest use as building mortar and has the sense of](https://en.wikipedia.org/wiki/Lime_(material))*[sticking or adhering](https://en.wikipedia.org/wiki/Lime_(material))*[.](https://en.wikipedia.org/wiki/Lime_(material))

* Order to find physical properties and Engineering properties of BC soil.
* Studying interaction behaviour of BC soil with admixtures.
* Order to develop various strength characteristics of BC soil using a different percentage of admixtures.

**3. METHODOLOGY:**

Collecting the sample of soil fromt areas an vaddeswaram performing the physical properties of the soil with the collected sample, it gives the safe bearing capacity of the soil.And stabilizing the soil by using the admixtures and recording the optimum values of geotechnical properties such as physical properties and engineering properties of the Black Soil.

LITERATURE REVIEW

OVERVIEW METHODS

BEHAVIOR OF SOIL IN DIFFERENT CONDITIONS

PHYSICAL PROPERTIES AS PER IS CODES

ENGINEERING PROPERTIES WITH IS CODES

ADD MIXTURES

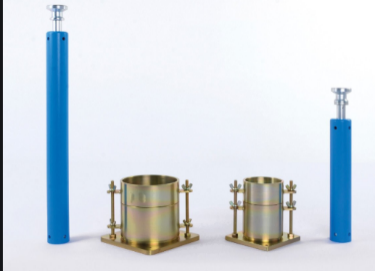
ENGINEERING PROPERTIES WITH IS CODES AFTEER ADDING ADD- MIXTURES

COMPPARISON OF RESULTS

CONCLUSIONS AND RECOMMENDATIONS

**Figure. 1 STEP BY STEP METHODOLOGY**

I S SIEVE ANALYSIS STANDARD PROCTOR



**Figure.2 Figure. 3**

UNCONFINED COMPRESSIVE STRENGTH



**Figure. 4**

**4.1 MATERIALS USED:**

As we all know very well that BC soil is available everywhere all over India. To stabilize the blackcotton soil we use various techniques in the laboratory. Along with the black cotton soil, we are using the various admixtures to stabilize the black cotton soil.

**Black cotton soil:** Rich proportion of montmorillonite is found in Black cotton soil from mineralogical analysis. High share of montomoriillonite renders high degree of expansiveness. These property results cracks in soil with none warning. These cracks might generally extent to severe limit like ½” wide and 12” deep. thus building to be founded on this soil may suffer severe damage with the change of atmospheric conditions.As malleability index and linear shrinkage minimized with the rise of lime content, a mix of each lime and cement is critical for adequate stabilization of road bases for serious wheel masses on the black cotton soils. antecedently derived results from African and Indian black cotton soils are matched with these results.



**Figure. 5**

**Quarry Dust**: Rock dust, also known as rock powders, rock minerals, [rock flour](https://en.wikipedia.org/wiki/Rock_flour), soil remineralization, and mineral fines, consists of finely crushed [rock](https://en.wikipedia.org/wiki/Rock_(geology)), processed by natural or mechanical means, containing [minerals](https://en.wikipedia.org/wiki/Minerals) and [trace elements](https://en.wikipedia.org/wiki/Trace_elements) widely used in organic farming practices.The [igneous rocks](https://en.wikipedia.org/wiki/Igneous_rock) [basalt](https://en.wikipedia.org/wiki/Basalt) and [granite](https://en.wikipedia.org/wiki/Granite) often contain the highest mineral content, whereas [limestone](https://en.wikipedia.org/wiki/Limestone), considered inferior in this consideration, is often deficient in the majority of essential macro-compounds, trace elements, and [micronutrients](https://en.wikipedia.org/wiki/Micronutrient).Rock dust is not a [fertilizer](https://en.wikipedia.org/wiki/Fertilizer), for it lacks the qualifying levels of [nitrogen](https://en.wikipedia.org/wiki/Nitrogen), [potassium](https://en.wikipedia.org/wiki/Potassium), and [phosphorus](https://en.wikipedia.org/wiki/Phosphorus).



**Figure. 6**

**Lime Mixture:** The rocks and minerals from which these materials are derived, typically limestone or [chalk](https://en.wikipedia.org/wiki/Chalk), are composed primarily of [calcium carbonate](https://en.wikipedia.org/wiki/Calcium_carbonate). They may be cut, crushed, or pulverized and chemically altered. *Burning* ([calcination](https://en.wikipedia.org/wiki/Calcination)) of these minerals in a [lime kiln](https://en.wikipedia.org/wiki/Lime_kiln) converts them into the highly [caustic](https://en.wikipedia.org/wiki/Corrosive_substance) material *burnt lime*, *unslaked lime* or *quicklime* ([calcium oxide](https://en.wikipedia.org/wiki/Calcium_oxide)) and, through subsequent addition of water, into the less caustic (but still strongly [alkaline](https://en.wikipedia.org/wiki/Alkaline)) *slaked lime* or *hydrated lime* ([calcium hydroxide](https://en.wikipedia.org/wiki/Calcium_hydroxide), Ca(OH)2), the process of which is called slaking of lime.

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**Figure. 7**

**5. Experimental Procedures:**

**5.1** Sieve Analysis: After the collection of soil sample from the selected area first we performed the sieve analysis with practice code of (IS code (IS: 2720 (Part-IV), 1965). First, we have taken the soil sample of 1000 gm and sieved in the laboratory with standard set of sieves with the sizes 4.75mm, 2.36 mm, 1.18 mm, 0.6 mm, 0.25 mm, 0.15 mm, 0.075 mm, pan. Place the required soil sample on the top sieve, close the lid and transfer stack of sieve set to a mechanical sieve shaker. Shake the soil sample for a period of 10 minutes. Remove the stack of sieves on the shaker and record the mass of the material retained on each sieve. Compute the percentage retained on each sieve by dividing the weight retained on each sieve to the original mass of the sample. Compute the percent finer by 100% and subtract the percent retained on each sieve as cumulative procedure. The results of the sieve analysis are given in table 1.

**5.2** After the performance of the sieve analysis we have done the specific gravity(As per IS (IS: 2720 (Part-HQ, 1964) for the soil sample with the sieved soil sample. After washing the density bottle record the weight of the density bottle with stopper. Take the soil sample of 50g which is passing through2mm IS sieve. Remove the entrapped air by connecting it to the vacuum pump and shake it thoroughly to remove the air bubbles in the density bottle. Immerse the bottle in the constant temperature up to the neck of the bottle. Record the temp. And mass of density bottle with water soil sample and stopper. After the completion of the specific gravity with the practise code mentioned in the above lines. The result of specific gravity is mentioned in table 1.

**5.3** Later we proposed to the next experiment named as Determination of the consistency limits (Liquid limit, plastic limit, shrinkage limit) as per IS code (2720-(PART-5)-1985). Take 200g of soil sample which is passing through the 425-micron sieve and add water to the desired amount of distilled water to the soil until the paste becomes homogenous. Apply the grease to the Casagrande's apparatus for smooth running. Using ASTM grooving tool make a particular through the soil pat this divides the soil into two symmetric parts. Rotate the handle the 2revolutions minute and count the no of blows, blown. Take 25g of the soil sample from the above soil paste and determine the water content by oven dry method. Take 20g of air-dried soil passing through 425-micron sieve. Take soil of 10g and roll it into soil threads of 3mm diameter between the palm and glass plate. If the thread is 3mm without any cracks that indicates that the water is added more than its plastic limit. Take the 2 or 3 samples and repeat the process and record the average of the soil samples. Up to here the physical properties of the soil is determined. The results of the liquid limit, plastic limit and shrinkage limit is mentioned in table 1.

**5.4** In engineering properties of soil first we are going to determine about the standard proctor test As per IS (IS: 2720 (Part VII-1980) practise code, measure the internal diameter of the mould and calculate the volume. Record the empty mass of the mould with base plate and insert the collar on the top of it. Take 3000g of soil sample passing through 4.75 mm in a wide-mouthed tray and mix thoroughly in its dry state. Apply the oil to the inner layer of the mould and compact the soil in three layers with compaction mould by imparting 25 blows for each layer using proctor hammer. Carefully remove the collar without disturbing the soil and cut the soil up to the top level of the mould with a knife. The results of standard proctor test are mentioned in table 2.

**5.5** After performing the standard proctor test we have proceeded to unconfined compressive test with the practice IS code (IS 2720 (Part -10): 1991) In this test the specimen is prepared either undisturbed remoulded or compacted. Place the specimen in the bottom plate of the compression machine and adjust the upper plate in contact with the specimen. Select an axial strain rate between 0.5% to 2.0% per minute and apply a compression load. Record the load and displacement readings at every 20 to 50 divisions of displacement gauge. Compress the specimen till the load peaks or till the vertical deformation reaches 20% of the specimen length. Take the specimen and collect 2 or 3 samples from the sample for water content determination. At last, we have performed the free swell index according to the laboratory schedule with the practice IS code(IS: 2720 part –XI) take two specimens of 10 each which are passing through 425-micron sieve and oven-dried. Pour each sample in two glass tubes separately. Pour the distilled water in one glass tube and kerosene in another glass tube of 100ml capacity and up to the mark on the cylinder; remove the entrapped air by shaking it thoroughly or stirring with the glass rod. Finally, the volume of each cylinder should be readout. The results of unconfined compressive strength are mentioned in table 2.

**6. Results Tables & Graphs:**

The strength of the soil is increased according to the percent of quarrydust added to the soil. We got the optimum value at 8% and 20% of Lime and after 8% the strength of the soil is getting decreased.

**GEOTECHNICAL PROPERTIES OF THE SOIL:**

Select the soil sample in nearby the college and collect the selected the soil sample, the selected soil is transported to laboratory in sacks. The soil sample that we have selected from the area is named as Undavalli. Later with the disturbed soil sample we have performed all the physical properties of BC soil in the laboratory and the results that are obtained, i.e. Specific gravity (2.69)As per IS (IS: 2720 (Part-HQ, 1964), I S Sieve analysis (reddish clay)As per IS code (IS: 2720 (Part-IV), 1965), Moisture content(19.68%)As per IS code (IS-2720-PART-2-1973), Liquid limit(43.28%)As per IS (IS: 2720 (Part 5) - 1985), plastic limit(28%)As per IS (IS: 2720-(PART-5)-1985), and Free Swell index(50%).

All over the completion of the physical properties, the project is further processed to the engineering properties. After the performing the engineering properties in the laboratory, the values obtained are Standard maximum dry proctor test density(1.67g/cc)As per IS (IS: 2720 (Part VII-1980), optimum moisture content(12%)As per IS code (IS-2720-PART-2-1973), unconfined compressive strength test(125kN/m2)As per IS code (IS 2720 (Part 10): 1991), and Cohesion(62.5kN/m2)As per IS code (IS: 2720 (Part 13) - 1986)these are the values of the soil sample without adding the admixtures. After the addition of coconut coir fibre and rice husk ash with 5% proportion the results are varied from the above results i.e. Standard proctor test maximum dry density (1.72g/cc)As per IS (IS: 2720 (Part VII-1980) (Table.1), optimum moisture content (12.4%)As per IS code (IS-2720-PART-2-1973) (table.1), unconfinedcompressive strength test (128kN/m2)As per IS (IS: 2720 (Part VII-1980)(table.1), and Cohesion (64kN/m2)As per IS code (IS: 2720 (Part 13) - 1986)(table.1). After the 5% proportion, the percentage of rice husk ash is increased to 10% and the percentage of coir fibre remains constant throughout the project. The results obtained are Standard proctor test maximum dry density (1.78g/cc)As per IS (IS: 2720 (Part VII-1980)(table.2), optimum moisture content (12.6%)As per IS (IS: 2720 (Part VII-1980)(table.2), unconfinedcompressive strength test (130kN/m2)As per IS (IS: 2720 (Part VII-1980)(table.2), and Cohesion (65kN/m2)As per IS code (IS: 2720 (Part 13) - 1986)(table.2). Again, the percentage of rice husk ash is increased to 15%. At 15% proportion we got the optimum values of engineering properties, Standard proctor test maximum dry density (1.86g/cc)As per IS (IS: 2720 (Part VII-1980)(table. 3), optimum moisture content (11.6%)As per IS code (IS-2720-PART-2-1973)(table. 3), unconfinedcompressive strength test (142kN/m2)As per IS (IS: 2720 (Part VII-1980)(table. 3), and Cohesion (71kN/m2)As per IS code (IS: 2720 (Part 13) - 1986)(table. 3). Again, the proportion of rice husk ash is increased to 20%(table. 4). At 20% the strength of the soil is observed decreasing compared with the above proportion (15%)(table. 3). At last the percentage of rice husk ash is increased to 25%(table. 5) it results in decreasing the strength of the soil, the values obtained at higher proportion are Standard proctor test maximum dry density (1.56g/cc)As per IS (IS: 2720 (Part VII-1980)(table. 5), optimum moisture content (15.6%)As per IS code (IS-2720-PART-2-1973)(table. 5), unconfinedcompressive strength test (104kN/m2)(table. 5)As per IS (IS: 2720 (Part VII-1980), and Cohesion (52kN/m2)As per IS code (IS: 2720 (Part 13) - 1986)(table. 5).

**Soil classification:** Reddish Clay.

* Cu (Coefficient of uniformity) = 1.56
* Cc (Coefficient of curvature) = 3.24

**LIQUID LIMIT:**

Mass of soil =300 grams

Passing sieve =425-micron sieve

Liquid limit = 45%

**PLASTIC LIMIT:**

Empty weight of Bottle (w1) =22.48g

Weight of bottle and wet soil(w2) =24.26g

Weight of dry soil (w3) =23.86g

Plastic Limit =22.6%

**SPECIFIC GRAVITY:**

Specific Gravity = 2.67

**STANDARD PROCTOR:**

MDD (maximum dry density) = 23.23g/cc

* OMC(optimum moisture content) =13.5%

**FREE SWELL INDEX:**

Free Swell Index = (Vd- Vk) / Vk

= 56%

**UCC (unconfined compressive strength):**

Unconfined compressive strength = 131 kN/m2

**COHESION(C):**

Cohesion(c) = 64.2kN/m2

**MOISTURE CONTENT:**

Moisture content = 19.68%

**Table no.1 RESULTS OF PHYSICAL PROPERTIES:**

|  |  |  |
| --- | --- | --- |
| **S.NO** | **EXPERIMENT NAME** | **RESULTS** |
| 1. | SPECIFIC GRAVITY | 2.67 |
| 2. | MOISTURE CONTENT | 19.68 % |
| 3. | LIQUID LIMIT | 45% |
| 5. | PLASTIC LIMIT | 22.6% |
| 6. | FREE SWELL INDEX | 50% |

**Tableno.2 ENGINEERING PROPERTIES OF SOIL BEFORE ADDING ADMIXTURES:**

|  |  |  |
| --- | --- | --- |
| **1** | Maximum Dry Density (MDD) | 23.23g/cc |
| **2** | Optimum Moisture Content (OMC) | 13.5 % |
| **3** | Unconfined Compressive Strength (qu) | 131 kN/m2 |
| **4** | Cohesion (C) | 64.2 kN/m2 |

**ENGINEERING PROPERTIES WITH ADMIXTURES:**

STANDARD PROCTOR TEST & UCC RESULT**:**

Table. 3 BC SOIL + 2 % Lime+ 5% Quarry dust

|  |  |
| --- | --- |
| **Test** | **Results** |
| MDD | 27.72 g/cc |
| OMC | 12.4 % |
| Qu | 131 kN/m2 |
| Cohesion | 1. kN/m2 |

Table. 4 BC SOIL + 4 % LIme + 10 % Quary Dust

|  |  |
| --- | --- |
| **Test** | **Results** |
| MDD | 29.78 g/cc |
| OMC | 13.1 % |
| Qu | 130 kN/m2 |
| Cohesion | 1. N/m2 |

Table.5 BC SOIL + 6 % Lime + 15 % Quarry Dust

|  |  |
| --- | --- |
| **Test** | **Results** |
| MDD | 31.89 g/cc |
| OMC | 13.6 % |
| Qu | 142 kN/m2 |
| Cohesion | 1. N/m2 |

Table.6BC SOIL + % Lime + 20 % Quarry Dust

|  |  |
| --- | --- |
| **Test** | **Results** |
| MDD | 34.6 g/cc |
| OMC | 15.6 % |
| Qu | 120 kN/m2 |
| Cohesion | 1. N/m2 |

Table.7 BC SOIL + 10 % Lime + 25 % Quarry dust

|  |  |
| --- | --- |
| **Test** | **Results** |
| MDD | 35.58 g/cc |
| OMC | 16.6 % |
| Qu | 104 kN/m2 |
| Cohesion | 52 kN/m2 |

**Table.8STANDARD PROCTOR RESULTS TABLE: As per IS code (IS: 2720 (Part VII-1980))**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| S.NO | WATER CONTENT  (ML) | MASS OF MOULD  (kg) | WEIGHT OF SOIL  (kg) | VACANT CAN WEIGHT  (kg) | MASS OF WET SOIL  (kg) | MASS OF DRY SOIL  (kg) | WATER CONTENT  (%) | DRY DENSITY  (g/cc) |
| 1 | 120 | 2.045 | 3.75 | 0.054 | 0.095 | 0.092 | 7.8 | 1.58 |
| 2 | 140 | 2.045 | 3.867 | 0.021 | 0.055 | 0.052 | 9.6 | 1.60 |
| 3 | 160 | 2.045 | 4.021 | 0.022 | 0.054 | 0.051 | 10.3 | 1.67 |
| 4 | 180 | 2.045 | 4.056 | 0.022 | 0.068 | 0.061 | 17.9 | 1.58 |

**Table.9UNCONFINED COMPRESSIVE STRENGTH**

**FOR RED SOIL: As per IS code (IS 2720(Part 10): 1991)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| S.NO | VERTICAL DIAL GAUGE | STRAIN (E) % | COMPACTED AREA | PROVING RING | LOAD  PRRXPRCX5 | UNCONFINE COMPRESSIVE STRENGTH | UNDRAINED SHEAR STRENGTH |
| 1 | 50 | 0.5 | 9.669 | 3.6 | 4.104 | 0.424 | 0.212 |
| 2 | 100 | 1 | 9.718 | 5 | 5.7 | 0.286 | 0.2.93 |
| 3 | 150 | 1.5 | 9.76 | 8 | 9.12 | 0.934 | 0.467 |
| 4 | 200 | 2 | 9.81 | 8.2 | 9.348 | 0.962 | 0.476 |
| 5 | 250 | 2.5 | 9.36 | 8.2 | 10.46 | 9.948 | 0.474 |
| 6 | 300 | 3 | 9.91 | 9.1 | 11.62 | 1.046 | 0.532 |
| 7 | 350 | 3.5 | 9.96 | 10.2 | 12.54 | 1.16 | 0.58 |
| 8 | 400 | 4 | 10.02 | 11 | 12.54 | 1.24 | 0.62 |
| 9 | 450 | 4.5 | 10.07 | 11 | 12.54 | 1.245 | 0.62 |
| 10 | 500 | 5 | 10.12 | 11 | 12.54 | 1.25 | 0.625 |
| 11 | 550 | 5.5 | 10.18 | 11 | 12.54 | 1.233 | 0.616 |
| 12 | 600 | 6 | 10.23 | 11 | 12.54 | 1.22 | 0.613 |

**Table.10UNCONFINED COMPRESSIVE STRENGTH AFTER ADDING ADMIXTURES OF 8%LIME AND 20% QUARRY DUST : As per IS code (IS 2720(Part 10): 1991)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| S. NO | VERTICAL DIAL GAUGE | STRAIN (E) % | COMPACTED  AREA | PROVING RING | LOAD | UNCONFINE COMPRESSIVE STRENGTH | UNDRAINED SHEAR STRENGTH |
| 1 | 50 | 0.5 | 9.669 | 3.6 | 4.104 | 0.424 | 0.212 |
| 2 | 100 | 1 | 9.718 | 5 | 5.7 | 0.286 | 0.2.93 |
| 3 | 150 | 1.5 | 9.76 | 8 | 9.12 | 0.934 | 0.467 |
| 4 | 200 | 2 | 9.81 | 8.2 | 9.348 | 0.962 | 0.476 |
| 5 | 250 | 2.5 | 9.36 | 8.2 | 10.46 | 1.048 | 0.24 |
| 6 | 300 | 3 | 9.91 | 9.1 | 11.62 | 1.049 | 0.26 |
| 7 | 350 | 3.5 | 9.96 | 10.2 | 12.54 | 1.26 | 0.13 |
| 8 | 400 | 4 | 10.02 | 11 | 12.54 | 1.33 | 0.33 |
| 9 | 450 | 4.5 | 10.07 | 11 | 12.54 | 1.345 | 0.255 |
| 10 | 500 | 5 | 10.12 | 11 | 12.54 | 1.42 | 0.72 |
| 11 | 550 | 5.5 | 10.18 | 11 | 12.54 | 1.233 | 0.616 |
| 12 | 600 | 6 | 10.23 | 11 | 12.54 | 1.22 | 0.613 |

**6. Conclusion and Discussion:** Black cotton soils when blended with quarry dust and lime are very promisinG to improve the geotechnical properties. This will provide solution for the use of locally available black cotton soil.

* Specific gravity of BC soil decreased with the addition of quarry dust and lime, this reduction of specific gravity value may be due to the reduction of plasticity character of BC soil.
* Maximum dry density (MDD) is observed at soil for addition of quarry dust and lime. Further addition of it, MDD value decreased.
* The strength of black cotton soil increasing with the addition up to soil and further decreased.
* From the test it is concluded that the strength characteristics of BC soil are optimum at (8% lime + 20% quarry dust) .

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