"COMBINED EFFECT OF QUARRY DUST & CERAMIC DUST ON STABILISATION OF CLAY": Review

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ABSTRACT

An environment friendly & cost effective way to deal with the combined effect of solid waste is quarry dust & ceramic dust mixing with cohesive soil. These solid wastes generally generate from the crushing industries & disposal of such wastes possess lots of geoenvironmental problems such as landfill disposal, health & environmental hazards. The best way to eliminate these problems is to make use of such wastes as an experimental study that can be conducted on cohesive soil by mixing these wastes. We can conduct various lab tests such as specific gravity, liquid limit, plastic limit, shrinkage limit & unconfined compressive strength test with these waste & study is carried out to check the improvement in properties of soil. The result of various percentages (10%, 20%, and 30%) by dry weight of soil is compared to check their effect on different properties of soil. This has an additional benefit of providing an environment friendly way to deal with these solid wastes products.

Keywords: *Quarry dust, Ceramic dust, unconfined compressive strength test*

I. INTRODUCTION

Soil stabilization is generally defined as making major improvements to the engineering properties of soils by amending the natural soil characteristics with an additive. These additives may include other soils or materials such as ceramic dust cement, lime, fly ash, asphalt cement, polymers, and fibres, quarry dust many more industrial wastes which may be used. Traditionally, additives such as bitumen, cement, and lime have achieved widespread use. Bitumen is typically used as a soil surface treatment to limit dust and loss of fines. Cement is used to provide strength to soil. Lime is often used in clay soils to control plasticity.

There are three purposes for soil stabilization. The first one is strength improvement, to enhance its load-bearing capacity. The second purpose is for dust control by binding soil particles together, to eliminate or alleviate dust, generated by the operation of equipment and aircraft during dry weather or in arid climates. The third purpose is soil waterproofing, which is done to preserve the natural or constructed strength of a soil by preventing the entry of surface water. The research is conducted to study the clayey soil and the admixtures like quarry dust and ceramic dust, to determine Index properties of the untreated soil and soil treated with five different quarry dust and lime contents of 10%, 20%, 30% and 40%,to determine the maximum dry density and optimum moisture content of the soil, to study the behaviour of strength gain in clayey soil using process of quarry dust & ceramic dust.

II. REVIEW OF LITERATURE

2.1. (Ceramic dust)

Akshay Kumar Sabat (2012)[1] explored the impact of ceramic dust waste on index properties, compaction qualities, unconfined compressive strength, California bearing ratio, shear strength parameters and swelling pressure of an expansive soil. The expansive soil collected locally was mixed with clay dust from 0 to 30% at an augmentation of 5%. From the examination of test results it was found that liquid limit, plastic limit, plasticity index, OMC, cohesion and swelling pressure decreased while MDD, UCS, CBR and angle of internal friction increased with an increment in ceramic dust content's. Gaeta Rani,Ch.Shiva Narayana,D.S.V. Prasad and G.V.R. Prasad Raju[2] (2014) carried out studies on an expansive soil mixed with tile waste from 0 to 30% at an increment of 10%. From the analysis of test results, it was found that liquid limit, plastic limit, optimum moisture content, and swelling pressure decreased, maximum dry density and California bearing ratio increased with an increase in tile waste. It was also observed from CBR and swell pressure tests that the stabilized expansive soil has shown maximum improvement compared to untreated expansive soil and it is found that tile waste up to 20% can be utilized for strengthening the expansive soil sub grade of flexible pavement with a substantial save in cost of construction.

2.2. (Quarry dust and lime)

The quarry dust is obtained as an aggregate waste, during crushing of rubble to obtain aggregates. Sabat and Das (2009) had stabilized expansive soil using quarry dust and lime for strengthening the sub grade of a rural road for low volume traffic. The properties tested were compaction (standard proctor), UCS, soaked CBR and Ps. The stabilizer strengthened road was found to be cost effective for low volume traffic.Sabat (2012) had investigated the effect of lime on Atterberg's limit, compaction(modified proctor), shear strength parameters and durability of an expansive soil stabilized with optimum percentage of quarry dust (40%).The lime added were 2 to 7 % at an increment of 1%. The effect of 7 and 28 days of curing were also studied on shear strength parameters. From the study it was concluded that with increase in percentage of addition of lime the wP, wS, C, Ø , OMC increased, the wL, IP,, MDD of the soil-quarry dust mixes decreased. Though MDD decreased but it was greater than the MDD of the virgin soil at 5% addition of lime.

2.3. (Quarry dust)

R.Vinoth kumar & Dr.P.D.Arumairaj[3] (2013**)** the liquid limit (LL) of untreated soil was 58%. It has decreased to 36.8% at 30% Quarry Dust. On further addition of Quarry Dust, Liquid Limit has finally reduced to 29.7%. Liquid Limit has decreased to 39% at 40% Fly Ash. On further addition of Fly ash, Liquid limit has finally reduced to 32.5%.The MDD of untreated soil was 1.53g/cc. The addition of quarry dust increases the MDD from 1.53g/cc to 1.82g/cc at 50% quarry dust. MDD has increased to 2.15 g/cc at 40% FA. On further addition of fly ash, MDD has finally decreased to 2.11g/cc.

2.4. (Quarry dust & fly ash)

Akshaya Kumar Sabat(2013) Effects of fly ash –quarry dust on UCS of soil. He has been found that with increase in percentage of fly ash-quarry dust, the UCS of soil goes on increasing up to 45% of fly ash-quarry dust, there after it decrease&the effects of fly ash –quarry dust on CBR of soil. He found that with increase in percentage of fly ash-quarry dust the CBR of soil goes on increasing. This is attributed to the increase in MDD of soil with increase in fly ash-quarry dust percentage. The prediction model is developed for the change in CBR value with addition of different percentage fly ash-quarry dust.

2.5. (Ceramic dust)

T.G. Rani,Ch. Shivanarayana, D.S.V. Prasad and G.V.R. Prasada Raju (2014) carried out studies on an expansive soil mixed with tile waste from 0 to 30% at an increment of 10%. From the analysis of test results it was found that index properties, OMC, and swelling pressure decreased, MDD and CBR increased with an increase in tile waste.Babita Singh, Amrendra Kumar and Ravi Kumar Sharma[4] (2014) made an attempt toward enhancing the lacking geotechnical properties of locally available clayey soil by including admixtures i.e. sand, fly ash and tile waste in suitable extent. A significant increase in the CBR worth was obtained for these ideal mixes in correlation to that of unadulterated soil. The results reveal that soil:sand::70:30, soil:sand:flyash::63:27:10 and soil:sand:flyash:tile waste::63:27:10:9 are the best ideal mixes for compaction qualities and for each ideal mix, CBR value demonstrates an increasing pattern.

2.6.(Ceramic dust)

Chen, James A. & Idusuyi, Felix O[5]2015) The MDD goes on increasing and OMC goes on decreasing with increase in percentage of addition of ceramic dust. The soaked CBR goes on increasing with increase in percentage of addition of ceramic dust. There is 150% increase in soaked CBR value as compared to untreated soil, when 30% ceramic dust was added. The Free swell and swelling pressure of the soil also decreased with increase in waste ceramic dust. With increase in percentage of WCD, the MDD of soil goes on increasing.

The MDD increases from 15.6 kN/m^3 to18.1 kN/m^3 when WCD were increased from 0 to30%. The reason of such behaviour is due to replacement of WCD particles having high specific gravity (2.82) with soil particles having low specific gravity (1.9).

III. EXPERIMENTAL INVESTIGATIONS

3.1. Quarry dust

Quarry dust is a rock particle. When huge rocks brake in to small fragments it is used in construction. It is like sand but mostly grey in colour. It is a mineral particle. The composition of quarry dust depends on the mineral composition of the parent rock. Quarry dust has been used for different activities in the construction industry such as road construction and manufacture of building materials such as light weight aggregates, bricks, and tile. It is a by-product of the crushing process which is a concentrated material to use as aggregates for concreting purpose, especially as fine aggregates. In quarrying activities, the rock has been crushed into various sizes; during the process the dust generated is called quarry dust and it is formed as waste.

3.2. Ceramic dust

The principle waste coming into the ceramic industry is the ceramic powder, specifically in the powder forms. Ceramic wastes are generated as a waste during the process of dressing and polishing. It is estimated that 15 to 30% waste are produced of total raw material used, and although a portion of this waste may be utilized on-site, such as for excavation pit refill, the disposals of these waste materials acquire large land areas and remain scattered all around, spoiling the aesthetic of the entire region. It is very difficult to find a use of ceramic waste produced. Ceramic waste can be used in concrete to improve its strength and other durability factors.

3.3. Soil Sample

The soil planned to use in this study was obtained from Dayalpur village of District: Kurukshetra, Haryana. The top soil was excavated up to a depth of 1.0m. The samples taken were disturbed soil sample. In the dry state shrinkage-soil has distinct shrinkage cracks having width about 20mm.

TABLE 1

S.No.	**Property of soil**	**Value**
1.	Mean Specific Gravity	2.5
2.	Liquid limit	51.85%
3.	Plastic limit	27.86%
4.	Shrinkage limit	23.94%
5.	IS Classification	CH

IV. EXPERIMENTAL TESTS

4.1. Standard Proctor Tests

Standard Proctor tests were conducted to determine optimum moisture content and maximum dry density of parent soil and soil stabilized with 3, 6, 9, 12 and 15% of various industrial waste materials passing 425 micron IS sieve. These tests were conducted in order to prepare specimens at maximum dry density by adding desired optimum moisture content as per specifications of IS: 2720 (Part 7) (1974).

4.2. Liquid limit test

Liquid limit test was conducted by using casagrandae apparatus as per specifications of IS: 2720 (Part 4) 1970. & it was found is equal to 51.85%,

4.3. Shrinkage limit test

Shrinkage limit test was conducted as per specifications of IS: 2720 (Part 4) 1972 & it was found is equal to 23.94%.

4.4. Plastic limit test

Plastic limit test was conducted as per specifications of IS: 2720 (Part 4) 1970. & it was found 27.86%

4.5. Specific gravity test

This test is done to determine the specific gravity of fine-grained soil by density bottle method i.e. pcyrometer as per IS: 2720 (Part III/Sec 1) – 1980. Specific gravity is the ratio of the weight in air of a given volume of a material at a standard temperature to the weight in air of an equal volume of distilled water at the same stated temperature & it was found is equal to 2.5.

4.5. Unconfined compression test

UCS test on clay treated with different percentage of quarry dust & ceramic dust as per specifications of IS: 2720

V. SAMPLE PREPARTION

5.1. Composition of specimens

Specimens of parent soil and soil treated with 3, 6, 9, 12 and 15% by weight of various industrial waste materials passing 425 micron IS sieve will be prepared at maximum dry density and optimum moisture content as per IS: 2720 (Part 7) (1974).

5.2. Mixing

Oven dry soil will be dry mixed with various percentages of additives. Sufficient quantity of distilled water will then be added to bring the moisture content to the desired level. The mixture will then be manually mixed thoroughly with a spatula. All the specimens will be kept in polythene bags for maturing for three days.

5.3. Compaction

Specimens will be compacted by static compaction in 10 cm diameter consolidation ring to the required height of 2.5 cm. The inner surface of the ring will be smeared with mobile oil to help minimize friction between inner surface of the ring and the soil sample. The wet homogenous mixture will be placed inside the specimen ring using a spoon in three layers, leveled and gently tap-compacted by 5cm diameter ram. Sample will be placed in specimen ring with extension collar attached to it and both the exposed sides of the sample will be covered with saturated filter papers. After that porous stone and pressure pad will be inserted into the extension collar and the whole assembly will be statically compacted in loading frame to the desired density. The sample will be kept under static load for not less than 10 minutes in order to account for any subsequent increase in height of sample due to swelling.

VI. CONCLUSION

From the above literature review of paper the conclusion is comes out that waste ceramic dust & and Quarry dust can be used to improve the engineering properties of the soil. This is found from the performing the various testes such as liquid limit, plastic limit, CBR test, compaction test &UCS test with addition of different percentages of these wastes. These wastes is also increases the strength of soil & CBR value of soil up to 100-150% & also help to attain the maximum dry density of soil & decreasing the optimum moisture content. By this study it is also help to solve the disposal problem of these wastes which is also create hazards problem in environment.

REFERENCES

Journal Papers:

[1] Sabat, A.K. (2012) “Stabilization of Expansive Soil using Waste Ceramic Dust,” Electronic Journal of Geotechnical Engineering, 17(Z), 3915-3926.

[2] Geeta Rani, T., Shivanarayana, Ch., Prasad, D.S.V. and PrasadaRaju, G.V.R. (2014), “Strength Behavior of Expansive Soil Treated with Tile Waste”, International Journal of Engineering Research and Development, Vol. 10, Issue 12, pp. 52-562.

[3] Singh, B., Kumar, A. and Sharma, R. K. (2014), “Effect of Waste Materials on Strength Characteristics of Local Clay”, International Journal of Civil Engineering Research, Vol-5, No-1

[4] H,Venkateswarlu, A.C.S.V Prasad, Dr. DSV Prasad & Dr. GVR PrasadaRaju(2015)". Study on behavior of soil treated with quarry dust." IJEIT. Vol.4

[5] Chen, James A. &Idusuyi, Felix O.(2015),"Effect of waste ceramic dust on index properties of shrink swell soils."ISSN 2504-8848 Vol. 1 No.8 2015