7th International Conference on Recent Development in Engineering Science, Humanities and Management
National Institute of Technical Teachers Training & Research, Chandigarh, India (ESHM-17)
3rd June 2017, www.conferenceworld.in ISBN: 978-93-86171-26-9

STRENGTH AND PROPERTIES OF CLAYEY SOIL TREATED WITH LIME AND STONE POWDER: REVIEW

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ABSTRACT

Inthis research, stone powder obtained from stone crushing plant were used for stabilization of clayey soil with addition of lime. Fine powder of stone and clayey soil with lime are mix with different rate of proportion. Thus the improvement of using stone powder and lime in stabilizing clayey soil is investigate in laboratory. The stabilization of clayey soil with stone powder is a better way for construction of road way and railway lines. Stone powder has a unique composition which justifies the need for research to study the feasibility of using stone powder for clay soil improvement. The powder contains bassanite ($Ca\ So_4\ ½\ H_{2\,O}$), Calcite ($CaCO_3$). The soil sample in natural state when mixed with different percentage of stone powder and lime were used for laboratory tests that includes atterbergs limit test ,specific gravity test, grain size analysis , standard proctor compaction test , unconfined compression test , California bearing ratio test. The result shows significant reduction in plasticity and change the optimum moisture content and maximum dry density of clayey soil with increasing percentage of stone powder and lime content. Also the result shows that the addition of stone powder and lime has significant effect on clayey soil.

Keywords; Soil Stabilization, Stonepowder, Lime, Clayey Soil, Strength, CBR Test

I.INTODUCTION

Preconstruction treatment of soft and weak deposit is necessary to ensure the safety and stability of building, pavement and infrastructure. The conventional method of soil stabilization is to remove the weak soil and replace with stronger material.The stabilization process aim to increasing the soil strength and reducing its permeability and compressibility. The stabilization process may include mechanical, chemical, electrical or thermal processes. The processes used depend on the type of soil at site, the time available to execute the project and the stabilization cost compared to the overall cost of the project.

Expansive soil possesses great threat for the construction of buildings due to its less characteristic shear strength and high swelling and shrinkage characteristics. Problematic soils, especially expansive soil deposits are considered to be a potential natural hazard, which can cause extensive damage to structures if not adequately treated. Stone powder may improve the engineering properties of clayey soil. The paper presents of summary of a research project investigating one of the alternatives to improve soil.Especially the paper presents result of laboratory investigation of the stabilization properties of clayey soil mixed with stone powder and lime.

ISBN: 978-93-86171-26-9

In recent years, environment issue have driveninterest to utilize industrial waste product as a alternative construction materials. The well-established industrial waste product such as fly ash, slag, rice husk ash, waste stone powder have been obtained and mixed with lime and cement to improve the geotechnical properties of soil. The study aims to investigate the laboratory study of mixed material of clay, lime and stone powder by stabilizing the soil. In general, the main issues associated with quarrying and stone production are:

1) Heavy metals in stone powder are not soluble in water.
2) Stone powder waste disposal reduces the area of fertile land.
3) Consumption of large amount of fresh water
4) Increase in ph. value and impact of flora, fauna soil.
5) High impact on air quality, ground water and surface water
6) Fine suspended solids cause respiration problems

II LITRETURE REVIEW

Very little information has been published on stabilization of clayey soil using stone powder and lime Bilgin et al (2012), investigated the usability of waste marble dust as an additive material in industrial brick. They concluded that addition of marble dust as an additive had positive effect on physical chemical and mechanical strength of the produced industrial brick.

Soil stabilization is the process of improving the engineering properties of the soil and thus making it more stable. It is required when soil available for construction is not suitable for the intended purpose. In the broad sense, stabilization includes compaction, pre-consolidation, drainage and many other such processes. Stabilization is the process of blending and mixing materials with a soil to improve certain properties of the soil. The process may include the blending of soils to achieve a desired gradation by the mixing of commercially available additives that may alter the gradation, texture or plasticity, or act as a binder for cementation of the soil. Soil stabilization is used to reduce the permeability and compressibility of the soil mass in earth structures, to reduce the swell in case of expansive soils and to increase its shear strength. Soil stabilization is required to increase the bearing capacity of foundation soils.

Stone slurry waste is a one of the newest additives and many studies about using stone dust in soil improvement have been done. The use of stone slurry in some talented fields such as soil improvement, seepage and grouting will offer great advantages in geotechnics.

Stone slurry is the by-product material generated by cutting and shaping of building stones in cutting plants the water used for cooling up the cutting saw flows out carrying very fine suspended particles as high viscous liquid known as stone slurry. For stabilization we use stone slurry with cement because cement increases its cementaneous properties of soil.

Some of the investigative studies in which stone slurry has been used are described below:

III .REVIEW OF LITERAURE

Roobhakhshan and Kalantari (2013) conducted consistency limit, standard compaction test, unconfined compressive test and CBR test and concluded that there is remarkable influence on strength and CBR value at

ISBN: 978-93-86171-26-9

1% lime + 6% waste stone powder for CBR and 7% lime + 6% waste stone powder for U.C.S which are optimum percentage.

Sabat (2012) conducted series of tests and concluded that addition of quarry dust decreases Liquid limit, Plastic limit, Plasticity index, Optimum moisture content, Cohesion and increases shrinkage limit, Maximum dry density, Angle of internal friction of expansive soil.

Satyanarayana et al. (2013) conducted plasticity, compaction and strength tests on gravel soil with various percentage of stone dust and found that by addition of stone dust plasticity characteristics were reduced and CBR of the mixes improved. Addition of 25-35% of stone dust makes the gravel soil meet the specification of morth as sub-base material.

Ali and Koranne (2011) presented the results of an experimental programmer undertaken to investigate the effect of stone dust and fly ash mixing in different percentages on expansive soil. They observed that at optimum percentages, i.e., 20 to 30% of admixture, the swelling of expansive clay is almost controlled and there is a marked improvement in other properties of the soil as well. It is concluded by them that the combination of equal proportion of stone dust and fly ash is more effective than the addition of stone dust/fly ash alone to the expansive soil in controlling the swelling nature.

Bshara et al. (2014) reported the effect of stone dust on geotechnical properties of poor soil and concluded that the CBR and MDD of poor soils can be improved by mixing stone dust. They also indicated that the liquid limit, plastic limit, plasticity index and optimum moisture content decrease by adding stone dust which in turn increases usefulness of soil as highway sub-grade material.

Mousa f. atom & magdi el-emam, (2011) ,using cutting stone slurry waste as a stabilizing material withcohesive soil. Result indicate that mixing the cohesive soil with cutting stone slurry waste increased dry density and decreased optimum water content also increased direct shear and unconfined strength significantly due to addition of stone slurry to cohesive soil.

Al zboon & mahasneh, (2009),the use stone sludge as water source in concrete production has insignificanteffect on compression strength, while it has a sharp effect on slump values.

Misra et al, (2008), the author using stone slurry powder in soil stabilization, production of bricks, tiles,mortars, and self-compacting concrete.

Almedia et al, (2007),production of high performance concrete, the stone slurry powder used as a substituteof fine aggregate in concrete production.

IV. MATERIAL USED

In this study, clayey subgrade soil is used with stone slurry waste to improve the CBR value of the clayey soil. Index properties of clayey subgrade soil are determined as per relevant Indian Standard and classification of soil is done on the basis of engineering properties of the soil.

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V. CLAYEY SOIL

Clayey soil consists of microscopic and sub microscopic particles derived from the chemical decompositions of rocks. It contains a large quantity of clay minerals. It can be made plastic by adjusting the water content. It exhibits considerable strength when dry. Clay is a fine grained and cohesive soil. The particle size is less than 0.002 mm. Organic clay contains finely derived organic matter and is usually dark grey or black in colour. It has a conspicuous odour. Organic clay is highly compressible.

In clayey soils the absorbed water and particle attraction act such that it deforms plastically at varying water contents. This cohesive property is due to presence of clay mineral in soils. Therefore the term cohesive soil is used synonymously for clayey soils.

SAMPLE COLLECTION

Locally available clayey soil was collected from the fields of village Bhiwani Khera District Kurukshetra. The depth of 0.35 to 0.47 m below the ground surface by using technique of disturbed sampling and thoroughly hand sorted to eliminate the vegetative matters and pebbles

VI. STONE POWDER

It is the by product material generated by cutting and shaping of building stones in the stone cutting plants. The water used for cooling up the cutting saw flows out carrying very fine suspended particles as high viscous liquid known as stone slurry.

The chemical composition of stone slurry powder may vary depending on the origin of parent rocks. Basically, the stone slurry powder is composed of calcite, as denoted by high content of CaO and loss of ignition.

SAMPLE COLLECTION

Stone powder will be collected from the stone cutting crusher Baniwala Khijrabad, Yamunanagar , Haryana.

VII. LIME

Lime is a calcium-containing inorganic material in which carbonates, oxides, and hydroxides predominate. In the strict sense of the term, lime is calciumoxide or calciumhydroxide. It is also the name of the natural mineral (native lime) CaO which occurs as a product of coalseamfires and in altered limestone xenoliths in volcanic ejecta.

These materials are still used in large quantities as building and engineering materials (including limestone products, cement, concrete, and mortar), as chemical feedstock's, and for sugar refining, among other uses. Lime industries and the use of many of the resulting products date from prehistorictimes in both the OldWorld and the NewWorld. Lime is used extensively for wastewatertreatment with ferroussulfate.

The rocks and minerals from which these materials are derived, typically limestone or chalk, are composed primarily of calcium carbonate. They may be cut, crushed, or pulverized and chemically altered. Burning (calcination) converts them into the highly caustic material quicklime (calcium oxide, CaO)

ISBN: 978-93-86171-26-9

and, through subsequent addition of water, into the less caustic (but still strongly alkaline) slakedlime or hydratedlime (calcium hydroxide, $Ca(OH)_2$), the process of which is called slakingoflime. Lime kilns are the kilns used for lime burning and slaking

VIII. MIXING PROPORTIONS

Clayey Soil, stone powder, lime is to be mixed thoroughly to have a uniform and homogenous mixture. Sample will be prepared using different combination of stone powder, lime and parent soil and different tests will be conducted on the prepared samples and result will be compared with the original clay sample.

Sample 1:

Clayey soil =100%

Sample 2:

Clayey soil = 85%

Stone powder = 12%

Lime= 3%

Sample 3:

Clayey soil = 80%

Stone powder = 15%

Lime =5%

Sample 4:

Clayey soil = 75%

Stone powder = 18%

Lime=7%

IX. TESTING PROGRAMME

For obtaining the significant result we will conduct tests on specimens. These tests result gives compressiveStrength, indirect tensile strength and natural absorption. These tests are:

A. Direct shear test: This test conducted on different percentage of additives. This percentage decided. By using this test we can find shear strength parameters (C, φ) of soil with different percentage of additives.

B. Compaction test: The objective of this test is to determine the maximum dry density and optimum moisture content at different percentage of additives and to use these results in the preparation of CBR specimens. The standard proctor test results give the variation of dry density values with moisture contents for soil samples with different percentage of additives.

C. CBR Test: the CBR test vales are commonly used in mechanistic design and as an indicator of strength and bearing capacity of sub grade soil, sub base and base course material for use in road and airfield pavement.

D. Apart from these tests liquid limits test, plastic limit test, shrinkage limit test, grain size analysis and

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specific gravity test will be conducted on the parent clay and stabilizer as well as on the prepared samples.

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