EXPERIMENTAL STUDY ON STRENGTH IMPROVEMENT OF SUBGRADE USING PRESS MUD AND GRANITE DUST

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Abstract:In many conditions sub grade soils are unsatisfactory at their natural state. So the soils which are unsatisfactory can be altered to make satisfactory by adding some additives or materials which helps to get the soil into the good condition as required for the road construction or for any other work. Soil stabilization implies improvement of soil so that it can be used for sub bases, bases and etc. if we are able to improve the soil condition with some of the industrial waste materials which are most abundant and having goodstrengtheningpropertieswecanalsosavetheenvironment.Inthisthesis,theworkisallaboutcomparative study of sub grade stabilization with press mud and granite dust, which may give the different stabilization properties of a soil and can determine the strength friendly material comparatively. Comparative study of sub grade stabilization includes large number of soil samples to be tested. But it is one of the best ways to carry out work with two or more materials at one time and to evaluate the good soil properties. It was found that the thickness of pavement material and CBR values are decreased and increased respectively. Best results are found with addition of Granite Dust at22%.

Keywords:UCS (Unconfined Compressive Strength) ,CBR (California Bearing Ratio).Granite dust and press mud.

Introduction: In transportation engineering department, engineers are allowed to work on pavements, railways, airways and waterways. Study of waterways may also come under the marine engineering department, which deals with the harbors, docks and other water bodies. When we talk about pavement, it comprises of different layers which are sub grade layer, base layer, sub base layer and wearing course. Above all these layers themainlayerissubgradewhich ispreparedwiththenaturalmaterialavailable underneaththeearth.Itactslike back bone of roads and railways. Sub Grade is well known as formation level. Formation levels are commonly compacted before constructing a road. Sometimes these sub grade layers are stabilized according to the requirements using additive materials. Sub grade is the foundation of the pavement. All the other layers are laid on the subgrade.

Ken et al (2012) Investigated about the availability of land which is having good natural bearing capacity used for the building is getting decreased day by day. The scarcity of lands leads to the construction of building in lands having poor soil conditions leads to the failure in structural foundations. So it has become very important to increase the quality of soils by adopting appropriate methods. This quarry dust can be used as the replacing material to soil. Many Researches were done from the past years on the improvement of soil condition with the help of waste products evolving in nature. The improvement of engineering properties of soil is happens with the introduction of the quarry dust. Crushed stone industry recommends the quarry dust for the stabilization of soil. Before the use of quarry dust in the soil stabilization process it should be check whether the material can give the good performance over the shrinkage, freeze, moisture andetc.

Method and Material: Press mud a waste of Sugar Industry and Granite dust from Construction Industry are proposed to be used as additives for the strength improvement of subgrade soil.

Press mud (Solid Waste from Sugar Industry): After the filtration of sugar cane juice the residue formed is press mud. Sugar cane juice and press mud are purely separated in the clarification process, The filtration is done using insoluble salts and fine bagasse. The press filter (used in carbonation factories), mechanical filters and rotary filters are the three types of filters used for the filtration process. After the filtration the press mud is yielded in the form of a cake, which is also called as filter press cake (wet) it can be variable from 1 to 7kg for every 100kg of cane. The total production of press mud is 1700 million tones, only in the year of 2009. It is purely an industrial waste material.

Granite dust (Rock Dust):

An igneous rock of light color with the large grains which are enough to visible with the human eye. It is formed under the earth's surface with the slow crystallization of magma. It consists of large amounts or quartz and feldspar and minor amount of mica and other mineral dust also known as the rock powder, rock minerals, rock flour, mineral fines. It is the main formation of the fine crushed rock.

Result &Discussion: In this chapter all the results of different tests on are shown. Physical, Geotechnical and strength properties of virgin soil with addition of Granite Dust and Press Mud individually and with combination are shown in detail. Results that are obtained from soil and with different additives are also discussed.

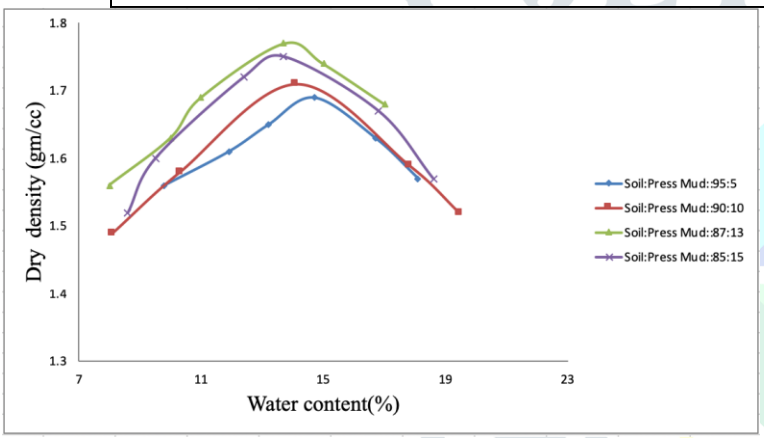
The obtained results till now are as follows:

By performing the sieve analysis, it is known that the soil sample taken is poorly graded sand.

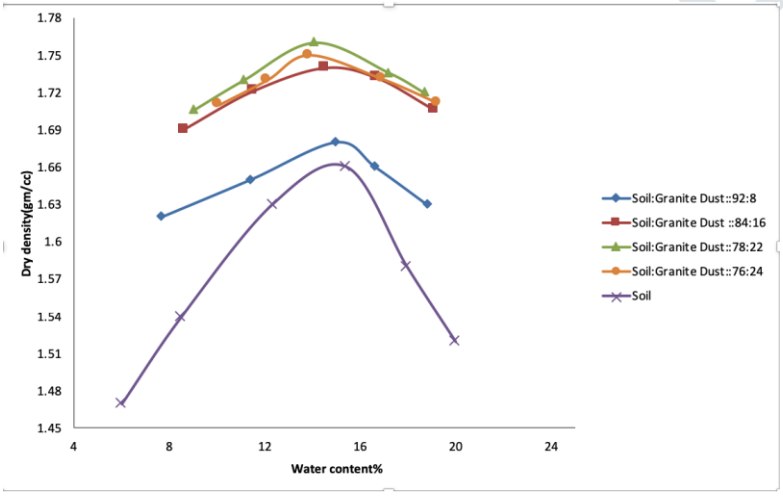
By performing the liquid limit analysis, it is known that the soil sample contains 24% of the moisture content. By performing the plastic limit analysis, it is known that the plastic for the sandy soils are not able to prove because the sample breaks when it is rolled. so the soil has non-plastic properties.

Properties of soil

Property	Value
Specific gravity(SP)	2.61
Liquid limit(LL)(%)	37.3
Plastic limit(PL)(%)	19.6
Plasticity Index(PI)(%)	17.7 (LL-PI)
Soil classification.	CI
Optimum moisture content(%)	15.4
Maximum dry density (kN/m^3)	16.3
UCS at 1 day (kPa)	98
UCS at 7 days (kPa)	387
UCS at 28 days (kPa)	490
Soaked CBR (%)	2.31
Permeability 10^{-8} (cm/sec)	4.16

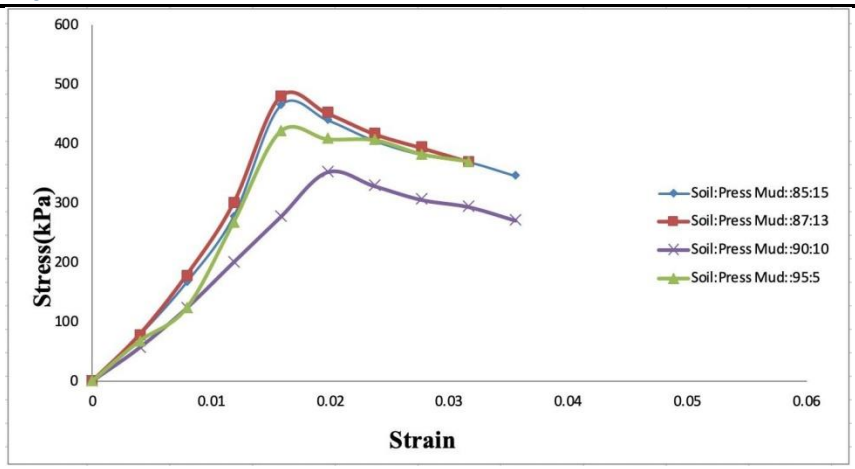


The above graph is shown represents the value of OMC and MDD with addition of Press Mud. It can be stated that at 13% of press mud give the best result in terms of dry density and it can be considered as optimum value because after adding more than 13% press mud it starts to decrease the value of MDD



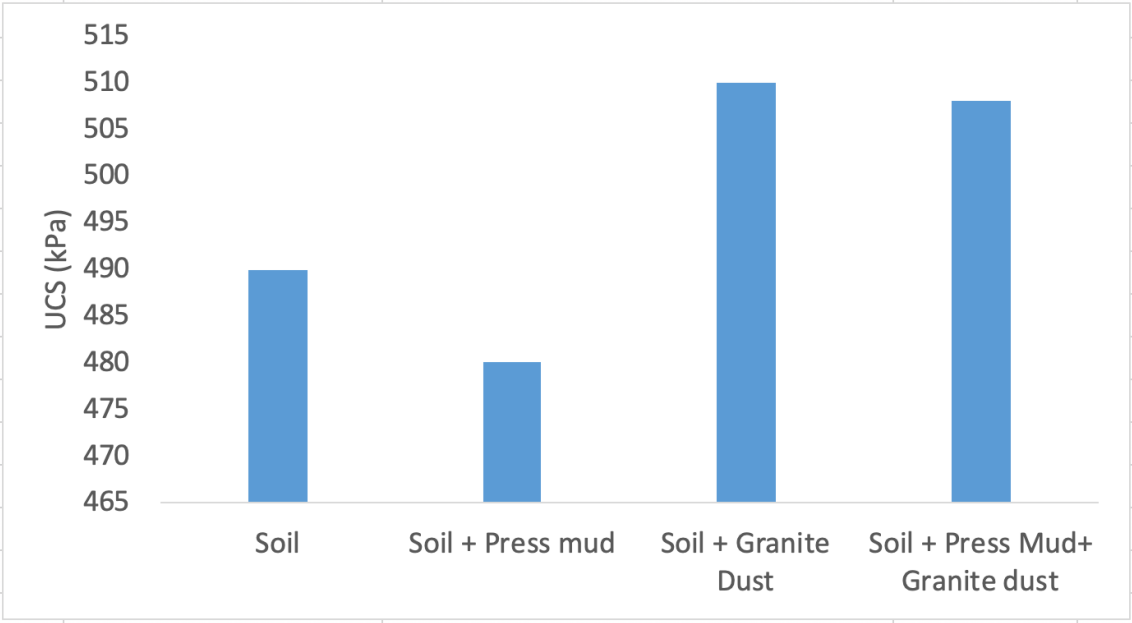
Compaction curve of soil with combination of Granite Dust

Above graph represents the values of OMC and MDD with respect to the increment in the amount of Granite dust. With these results in could be said that optimum value of granite dust is 22% as after further increment of granite dust the dry density of soil starts to reduce.



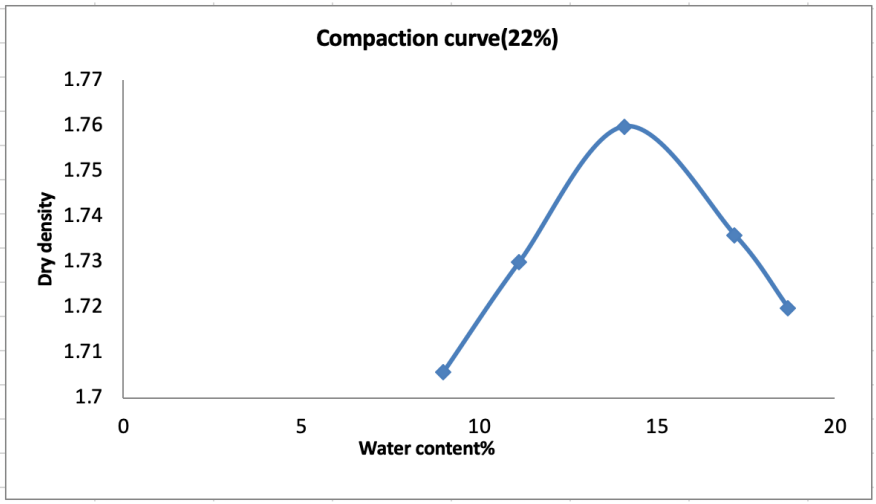
UCS of soil with addition of Press Mud.(28 days)

The above graph shows the results of UCS value of soil with addition of press mud at 5, 10, 13 and 15 percentages. UCS values were found to be decreased to 352kPa, 420kPa, 480KPa and 465 kPa respectively. By the results it can be concluded that the best results were found when 13% press mud was added. The same pattern was found for 1 day and 7 days as well. So, the optimum value can be considered is13%.



Variation of UCS value with addition of optimum values of Waste materials(28 DaysCuring)

Above graph is referring to results of 28 days UCS tests with addition of optimum individual waste material and addition of both the materials in optimum quantity. It is clearly seen that the values of UCS are reduced form 490kPa to 480kPa. There is a significant increment in UCS value of soil with addition of both Granite dust and Press mud at optimum content.



Above Graph shows the OMC and MDD of soil with addition of Press mud (22%). OMC Was decreased to 14.1% and MDD was increased to 1.76g/cc.

Conclusion:

The CBR of virgin soil was determined in the laboratory which comes out to be 2.31%. and as per IRC 37: 2012 guidelines, the soil subgrade need to be improved if CBR is below 3%. Therefore waste materials like press mud and granite dust were proposed to use to improve the strength of subgrade soil. Various experiments mentioned in chapter 3 were carried out and following conclusions were drawn.

Conclusion on Granite Dust

Compaction Characteristics

By performing compaction test it was found that the dry density of soil was increased form 1.66g.cc to 1.77g/cc at 22% of Granite Dust. At same amount of Granite Dust Optimum Moisture Content was found to be minimum, which was reduced from 15.4% to 14.1%. So, it can be said on the basis of compaction characteristics that 22% Granite Dust can be used as optimum amount for improvement of compaction characteristics.

California Bearing Ratio

At 22% addition of Granite Dust it was found that CBR value was increased to 13.22% from 2.31%. This is a significant amount of increment in CBR value. UCS values are found to be decreased initially as the Granite Dust was added but increment upto 22% of Granite Dust increased the value of UCS. So, on the basis of CBR and UCS results it can be concluded that 22% of Granite Dust will be used as optimum amount of Granite Dust.

Thickness of flexible pavement

As it was discussed that the maximum value of CBR was found at 22% of Granite dust. Thickness of the flexible pavement shows the same results. Initially it was not possible to design flexible pavement as the CBR value was less that 3%. Thickness was found to be 200mm. This is the minimum thickness that was found after adding various percentages of Granite Dust.

Conclusion on Press Mud Compaction Characteristics

Press Mud was added in soil in the percentages of 5, 10, 13 and 15. By performing compaction test it was found the addition of Press Mud decreases the Optimum Moisture Content and increases the Maximum Dry Density. This pattern was followed till 13%. The maximum dry density was found at 13%. It was increased from 1.66g/cc to 1.77g/cc. From the results it can be concluded that 13% of Press mud is the optimum content of Press Mud.

California Bearing Ratio

CBR value was found to be 7.27% with addition of 13% of Press Mud which earlier was 2.31%. The maximum value of CBR was found at 13% of Press Mud. So, it can be considered as the optimum amount of Press Mud for CBR test. During UCS test initially the values of UCS were found to be decreased but at addition of 13% of Press Mud, the values were maximum.

Thickness of flexible pavement

While calculating the thickness of the flexible pavement, it was found that the minimum thickness of flexible pavement is 200mm at addition of 13% Press mud because the CBR values were found to be maximum at 13% of Press Mud. When soil was mixed with optimum dose of granite dust, CBR increases from 2.71 to 13.22% and if this mix is treated with mud press , CBR increases marginally to 14.21%. but the overall as well as thickness of each layer of flexible pavement came to be same if designed by IRC 37: 2012. Therefore it was concluded it is not economical to use both material simultaneously. Granite dust is a better additive to be mixed in the soil to upgrade the strength properties of soil subgrade soil.

Future Scope:

In this investigation total work is based on the strength characteristics of the soil. It can also be done based on the atterberg limits by the addition of strength improvement materials like lime, cement, rise husk ash and etc. strength improvement can be conducted different types of tests like modified proctor test to find maximum dry density, optimum moisture content and plate load test to find strength of the soil sub grade. Plate load test is generally used in sites(In situ condition).Thickness of the pavement can be reduced by the improvement in strength of the sub grade soil through the traffic calculation at the selected area. Thickness can find from the recommendations given by Indian road congress.

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