REVIEW ON SOIL STABILIZATION USING CERAMIC WASTE

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Abstract - *A soil needs to be stabilized when it lacks in properties which are required for the intended construction. Therefore it is imperative to improve the engineering properties of such soil by selecting suitable materials and methods. The choice of particular material and method depends on properties of soil and type of construction also on cost and environmental considerations. There is a need to look toward different industrial waste materials which are being produced in huge quantities. Soil stabilization using waste ceramic dust is one of such method, which can be used to improve the geotechnical properties of soil. Clayey soils have poor shearing strength and low bearing capacity. It is not easy to work with such soil, as it does not have enough strength to support the imposed load on them. For satisfactory performance of the structure put on such soil, the properties of such soil need to be improved. The ceramic waste can be mixed with waste materials to obtain better results.*

Key Words: *Soil Stabilization, Ceramic waste, Black Cotton Soil, CBR, UCS, and DFS*

1. INTRODUCTION

Clayey soils are problematic soils having poor strength and beating capacity. Engineers face many problems while constructing facilities on such soils. Clayey soils do not possess sufficient strength to support the loads of the structure coming on them during construction or service life of the structure. Clayey soils are spread over more than one third part of the country. Many parts of India are covered with such soils having poor strength and bearing capacity. Presence of such treacherous soil poses many challenges to the civil engineers. The poor strength characteristics of clayey soil are due to the type of clay mineral. Clay mineral montmrilonite is responsible for swelling properties of clayey soils. Such poor engineering performance of clayey soil has forced researchers to improve the properties of these soils, thus soil stabilization is an effective method of improving the properties of soil and performance of the facilities put on them. The main objective of the soil stabilization is to improve the strength and stiffness of the soil. There are many methods are available to improve the properties and performance of the soil. The various methods of soil stabilization includes replacing the existing poor soil with another soil having good properties, blending it with some another soil or material to improve its properties, use of solid waste from different industries, addition of fibrous material to increase the strength of soil or use of some chemical additives to improve the characteristics of soil.

Stabilization using ceramic waste is one such waste material which can be used for improving the properties of poor clayey soils. Ceramic waste materials are easily available at various manufacturing units and at construction sites. In developing countries like India, waste management is a matter of serious concern because waste materials are generated at rapid rate. Ceramic waste can be conveniently used for soil stabilization and problem of their disposal can be overcome in environmentally safer way. Thus use of ceramic waste not only improves the soil properties but problem of their disposal can also be solved. In the present study ceramic waste materials have been used to improve the properties of clayey soils and effect of ceramic dust on various soil properties have been evaluated.

2. EXPERIMENTAL STUDIES

Some of the research work conducted on clayey soil using ceramic wastes has been described below:-

Sabat (2012) had stabilized expansive soil mixed with waste ceramic dust. The locally available clayey soil was mixed with ceramic dust from 0 to 30% with an increment of 5%. Effect of ceramic dust on consistency limits, compaction characteristics, unconfined compressive strength, California bearing ratio, shear strength parameters and swelling pressure of clayey soil was evaluated. From the results of tests it was found that liquid limit decreases from 62% to 35%, plastic limit decreases from 30 to 20%, PI decreases from 32 to 15%. The compaction characteristics were also improved. The MDD increases from 15.6 KN/m^3 to 18.1 KN/m^3, OMC decreased from 20.4% to 17.6%. The UCS increases from 55 KN/m^2

to 98kN/m^2. The soaked CBR value increased from 1.6% to 4%. There was 150% increase in soaked CBR value. The cohesion decreased from 18 KN/m^2 to 13.5 KN/m^2. When ceramic dust increases from 0 to 30% the angle of internal friction increased from 13^0 to 17.7^0. The swelling pressure decreases from 130 KN/m^2 to 24 KN/m^2 when ceramic dust increases from 0 to 30%. The economic analysis for stabilized was conducted and it was found that ceramic dust up to 30% can be utilized for strengthening the sub grade of flexible pavement with a substantial save in cost of construction.

Babita Singh and Ravi Kumar (2014) had blended the locally available clayey soil with sand, fly ash, tile waste and jute fibers. The mix clay : sand : fly ash : tile waste : jute fiber 63:27:10:9:0.5 was selected as the most appropriate and optimum clay, sand, fly ash, tile waste mix proportion. The maximum dry density of clay-sand-fly ash mix decreases as the content of fly ash is increases while optimum moisture content increases as fly ash content increases. When tile waste was added to the selected appropriate clay-sand-fly ash mix, the maximum dry density increased up to a certain percentage of tile waste and then decreased. On the inclusion of jute fiber in the optimum clay-sand-fly ash-tile waste mix, the maximum dry density increased slightly and then decreased with increasing jute fiber content. Optimum moisture content was not much affected by inclusion of jute fibers. Soaked and unsoaked CBR values improved considerably for the optimum mixes in comparison to that of locally available clayey soil. The value of failure stress obtained for the final composite mix of clay-sand-fly ash-tile waste-jute fiber was not appreciably more than that of the pure clay, but considerable strain absorption capacity can be observed for this final composite mix. The final optimum mix obtained was an improved construction material and when used in the construction of flexible pavement imparts considerable cost saving.

Prasad et al. (2014) had evaluated the effect of tile waste on clayey soil. The clayey soil available locally was blended with tile waste from 0 to 30% at an increment of 10%. The liquid limit and plastic limit were decreased irrespective of the percentage of addition of tile waste. The MDD attained at 20% tile waste and OMC was decreasing with increase in percentage of tile waste. The soaked CBR was increased with increase in percentage of addition of tile waste. The CBR value has increased by 105% as compared to untreated soil, when 20% tile waste was mixed. There was 48 % decrease in swelling pressure of soil as compared to untreated soil, when 20% tile waste was added. From the above analysis it was found that tile waste up to 20% can be utilized for strengthening the clayey soil sub grade of flexible pavement with considerable save in cost of construction.

Ameta and Wayal (2013) had stabilized the dune sand using ceramic tile waste as admixture. From the test results it was found that on increment of particle size of admixture, the C.B.R. value of the mix composition increases. Also as the quantity or percentage of admixture increases, the C.B.R. value of the mix composition increases. Variations in C.B.R. values at different percentages of mix composition at different size also showed that increase in CBR values was more at unsoaked condition than that compared with soaked condition. From the results obtained it was concluded that angle of internal friction varies with increase in size of ceramic tiles wastage in mix composition. On the other hand for the same size of ceramic tiles waste, the angle of internal friction increases with increase in percentage or quantity of ceramic tiles waste.

Babita et al. (2014) studied the strength characteristics of expansive soil mixed with foundry sand, fly ash and tile waste. The compaction properties and CBR value were studied using different proportion of foundry sand, fly ash and tile wastes. The maximum dry density of clay-foundry sand (60:40) mix decreased with addition of fly ash which is a light weight material as compared to clay and foundry sand. The highest value of maximum dry density was achieved for clay-foundry sand-fly ash-tile waste mix of 54:36:10:2.25 followed by other proportions. The California bearing ratio value of clayey soil improved significantly i.e. from 2.43% to 7.35% with addition of foundry sand , fly ash and tile waste in appropriate proportion.

Raghudeep and Prasad (2015) had mixed the available clayey soil with vitrified polish waste (VPW) up to 10% for flexible pavement construction. At 10% mix proportion of VPW, Liquid limit and Plasticity index of the soil decreased by 17.29% and 42.77%. The MDD increased by 13.61% and DFS decreased by 27.93% when 10% VPW added to the soil. Soil classification changes from the CI to CL. CBR value increases from 2.1% to 7.07%. Soaked and Unsoaked CBR values increased 3 to 4 times when 10% of VPW added to the soil compared to original clayey soil.

D Koteswara Rao (2013) studied the effect of vitrified polished waste (VWP) on marine clay. He added VWP up to 35% with an increment of 5%. The optimum content of VWP was found to be 15%. At optimum VWP content liquid limit of the marine decreased by 35.6%, the plasticity index of the marine clay decreased by 38.65%, the MDD of the marine clay improved by 16.99%, the C.B.R. value of the marine clay had been increased by 187.3%, the DFS value of the marine clay decreased by 66.6% ,Specific Gravity G value of the marine clay increased 15.02% ,the Cohesion of the marine clay improved by 27.34%, the Angle of Internal Friction of the marine clay increased 50.68% ,the soaked CBR of the soil on stabilizing was found to be 4.505, but according to IRC 2001 the CBR value should be in between 5-6.

3. CONCLUSIONS

Use of solid waste material in soil stabilization improves the geotechnical properties of soil. Different types of waste materials are suitable for different types of soil and they provide different degree of improvement. Solid materials can be used for soil stabilization in place of conventional stabilizer like lime. Ceramic waste with other waste materials can be used for soil stabilization. On the basis of the work conducted by different researchers following conclusions can be drawn:-

- With the addition of ceramic waste liquid limit, plastic limit and plasticity index of the clayey soil decreases.
- Optimum moisture content of the clayey soil decreases as the percentage of ceramic waste increases and maximum dry density obtained at certain optimum content of ceramic waste and decreases beyond this optimum content of ceramic waste.
- California bearing ratio of the clayey soil increases with the increase in the percentage of ceramic waste.
- The unconfined compressive strength of the clayey soil increases as percentage of ceramic waste dust increases.
- The differential free swell of clayey soil decreases as the percentage of ceramic waste increases.

4. REFERENCES

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