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Experimental Study On Improvement Of Black Cotton Soil By Using Waste Materials

Abdullah Khan[1], Ansari Tauseef[2] Ansari Yakub[3], Khalid Iqbal[4]
[1,2,3,4]*(Department of Civil Engineering. ,MMANTC, Mansoora, India)*

Abstract: *This paper is based on the experimental study on improvement of black cotton soil which has beenproven to be a vast and scope oriented research field. The basic objective of this study was taken into after due consideration of shortage of land due to rapid urbanization, unsuitable land mass for construction activities and severe need of suitable land for construction process etc.Developmentisbackboneto multidimensional growth ofaparticularregionbutprovidedthatexistingground condition is favorable for development activities. This study covers the major soil deposits of India having black cotton accumulations which is indeed unsuitable for any construction activity but only used for cultivation.We cannot replace the entire soil mass but we can modify them in economical way by technical approach andthisreportrepresentsthevarioustestsconductedonreinforcedsoilwithvarying ceramic and plastic content. Reasonbehindusingceramicandplasticisthatthesame materialsare locallyandeasilyavailableandpose danger tonaturalcalamities.Wehavealsotriedtolessentheadverseimpactofthematerialscontributingtosafeguard the environment though it's a littlecontribution.The proposed technique can be a promising alternative as compared to other costly methods and advantageous in improvement of engineering performance of sub grade soil.*

Keywords: *Atter berg Limit, Sieve Analysis, SPT, UCS.*

I. Introduction

Black cotton soils are problematic for civil engineering because of their unconventional behavior .These soils shows large volume change with respect to variation of seasonal moisture content. In hot dry season soil shrinks so cracks are seen which are 10 to 20 cm wide and up to 1m deep. This permits oxygenation of soil to sufficient depth and soil has extraordinary fertility. In many parts of India black cotton soil are found.Geographically it varies over 5.46 lakhs sq. of total geographical area of country. These soils are found in Maharashtra,Gujarat,Madhya Pradesh,Karnataka,TamilNaduandAndhraPradesh.Itcontainsmontmorillonitemineralduetothisithastendencytoswellsandshrinksexcessivelywithchangeinmoisturecontent.Italsocontains 10%alumina,9to10%Ironoxide,6to8%Limeandmagnesiumcarbonate,Potashislessthan0.5%andNitrogen and Humus are very low. Ceramic dust is waste product produced in Tile industry while cutting tiles to desired sizeandshapes.Itisestimatedthatabout3000metrictonesofCeramicdust/slurryproducedperdayasbyproduct during manufacturing of Ceramic tiles. The marble and tile cutting industry dumping these wastes to nearby pits or open land leads to serious environmental pollution. This study envisage that the effect of Ceramic dust on Compaction characteristics (OMC and MDD), compressive strength of black cotton soil mixed with percentage of ceramic 5% , 10% ,15% ,20% ceramic dust by weight of dry soil. Soil improvement is of major concern in construction activity due to rapid growth of urbanization and industrialization. Term soil improvement is used for techniques which improves index properties and engineering properties of weak soil. In India expansive soil covers about $0.8x10^6 km^2$ which is approximately one-fifth of its surfacearea.

This study envisages that effect of ceramic dust on consistency limit, standard proctor test and UCS of black cotton soil mixed with 5% 10%, 15% ,20% ceramic dust and 0.5% , 1% 1.5% ,2% of plastic strips.

II. Experimental Programme

2.1 Material used

Material used in experiments are Black Cotton soil , Ceramic Dust and plastic strips.

2.1.1 Black Cotton soil

They exhibit shrink condition and swell condition when exposed to change in weather and hence have been found to be most troublesome from engineering consideration. The rate of montmorillonite is more in black cotton soil which causes expansiveness and crack occurs in soil without any warning which is dangerous for construction. Major soil deposit is BC soil. Black soils are formed by lava basaltic rocks. Hence they are very dark in colour.BC soil develop crack in dry period and moist in saturate condition, hence they are self-

tilling in nature, that's why they are fertile and can hold water for long time. This capacity is used for Cotton cultivation; hence they also called Regular Black Cotton Soil. Chemically black soils consist of lime, iron, magnesium, alumina and potash but they lack in nitrogen, phosphorus and organic matter.
Soil sample for the test was collected from the college campus and the properties examined are as follows

Table 1 Geotechnical properties of Black cotton soil use.

Sr. No	PROPERTIES	VALUES
1	Atterberg's Limit	
	Liquid limit	71%
	Plastic limit	31%
	Plasticity Index	41%
2	MDD	1.41
3	OMC	26.5%
4	UCS	2.05

2.1.2 CeramicDust

Soil of same size. This is because of the reason that the raw Locally collected waste ceramic tiles (brokenpieces)fromtheconstructionsitewereusedintheexperimentafter converting it into powder and passing through the 425 micron sieve. The parent material of ceramic tiles are natural clay minerals typically form over long periods of time as a result of the gradual chemical weathering of rocks, usually silicate-bearing, by low concentrations of carbonic acid and other diluted solvents thus it form homogenous masswithblack cottonmixedwithitbutcontraryitdoesnotswellandshrinklikeblackcotton material undergoes several physical and chemical changes while tile making process and its finishing surface has crushed glass materials forglazing.

2.1.3 Plastic Strip

Plastic strip was made by cutting the waste plastic bottles collected from college. Theses bottles are made up of polymers consist of high density polyethylene.

2.2 Methodology:-

Broken/waste ceramic tiles were broken into small pieces by using a rammer. Plastic used is high density polyethylene is cut in square form of size 1cm x 1cm by means of scissor. The different tests conducted to study the effect of ceramic dust and plastic strips in the expansive soil are;

A)Atterberg's Limit

1- Liquid Limittests.
2- Plastic limittests.
3- Plasticityindex
3- Standard Proctor compactiontests.
4- Unconfined Compressive Strengthtests.

2.2.1 Ceramic and PlasticTest:

In stabilization of soil with ceramic powder at different proportion like 10% , 15% and 20%and plastic strip at 0.5%, 1% and 1.5% , the following result of various test see

2.2.2 Index properties

Liquid limit and plastic limit of the clayey soil was obtained by treating it with different percentage of tiles wastepowder. The test were conducted on the soil sample by 10% 15% and 20% ceramic with soil sample according toIS2720(part5)1985.

Table 2Index Properties of soil with ceramic

% of ceramic	Liquid limit	Plastic limit	Plasticity Index	Group (IS1498 1970)
10%	65.32	53.5	33.08	CH
15%	37.75	41.04	12.95	IM
20%	27.57	12.46	5.52	CL

The table 2 shows the value of liquid limit and plastic limit with varying percentage of tiles waste and From the The table 2 shows the value of liquid limit and plastic limit with varying percentage of tiles waste and From the table,itcanbeevaluatedwiththeadditionoftileswasteabove10%theliquidandplasticlimitdecreasesbeyond this limit the value decrease. As per IS 1498-1970 the soil group changes from CH group to CLgroup

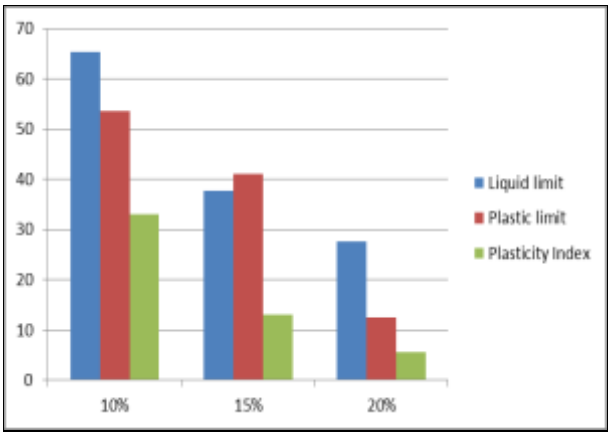

Fig. No- 01Index Properties of soil with ceramic.

2.2.3. Standard Proctor Test and UCS

Table3 Standard Proctor test andunconfined compression test with ceramic

% of ceramic	MDD	OMC	UCS
10%	1.45	23.7	2.377
15%	1.52	17.3	2.43
20%	1.37	27.7	2.368

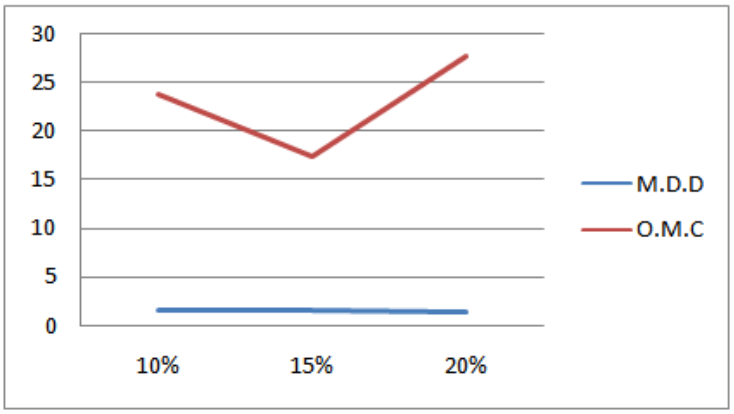

Fig. No- 02Standard Proctor test and unconfined compression test with ceramic

Table 4unconfined compression test with ceramic

% of ceramic	Without mix	UCS
10%	2.05	2.377
15%	2.05	2.43
20%	2.05	2.36

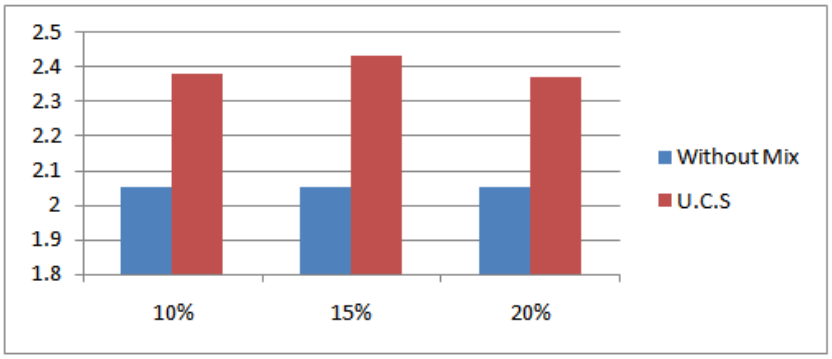

Fig. No- 03Unconfined Compression test with Ceramic.

Table 5 Standard Proctor test and unconfined compression test with Plastic waste strip.

PROPERTY	WITHOUT MIX	0.5% PLASTIC	1% PLASTIC	1.5% PLASTIC
MDD	1.41	1.349	1.454	1.34
OMC	26.5	22.58	27.27	15.78
UCS	2.05	2.2	2.113	2.09

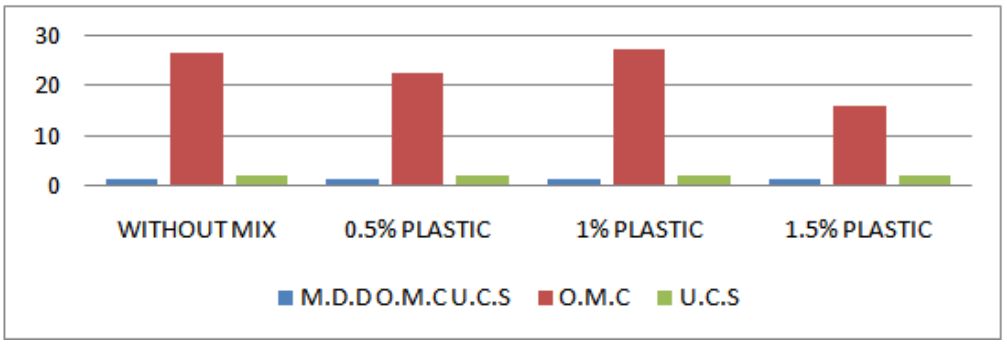

Fig. No- 043Standard Proctor test and unconfined compression test with Plastic waste strip.

Table 6 Standard Proctor Test and unconfined compression test with both plastic andceramic.

PROPERTY	WITHOUT MIX	0.5% PLSTC + 10 % CERAMIC	1% PLSTC + 15% CERAMIC	1.5% PLSTC + 20% CERAMIC
MDD	1.41	1.48	1.55	1.51
OMC	26.5	18.47	15.43	20.98
UCS	2.05	2.377	2.43	2.368

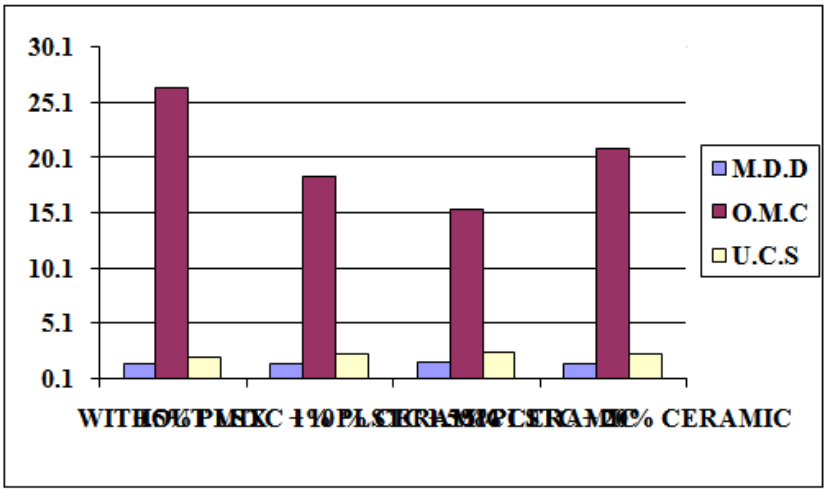

Fig. No- 05Standard Proctor Test and unconfined compression test with both plastic and ceramic.

III. Conclusion

Based on Work an experimental study following conclusion are made

1. This project focused on effect of waste plastic and ceramic from surroundings and industries as a soil admixture on properties of soil. The study suggests that if plastic and ceramic prepared properly, mixed and applied can enhance the engineering properties of soil
2. As the percentage of Plastic was increased in mix, MDD value have shown Decline up to adding 0.5% plastic then increased at1% plastic then again decreased at 1.5%.
3. On other hand OMC values were kept increasing upon increasing percent of plastic. This means that increase amount of plastic takes more water content for mixture to reach its maximum dry density.
4. UCS values also shows combined nature increases up to 0.5% then decrease then increase at 1.5%.
5. OnaddingCeramicalsoshowssamepropertylikeplasticMDDincreasesat10%then15%thendecreases by adding 20%ceramic.
6. Also OMC value also shows first decrease at 10% then increases at 15% then increases at 20% ceramic.On addition of both ceramic & plastic maximum dry density is achieved at 1% plastic & 15% plastic.
7. UCSvaluesshowssimultaneousincreaseanddecreasedat10%itdecreasesthen15%increasesthenfurther

decreases at20%.

8. Hence it can be said that use of Plastic and Ceramic in subgrade can enhance its stability up to certain quantity. After that optimum content after addition of Plastic and Ceramic in subgrade has detrimental effect on Stability.
9. Accordingtoresearchersreductioninliquidlimitonadditionofceramictostabilizedsoilisduetoreplace-metofsodiumionswithcalciumions,reductionindiffuseddoublelayer,andincreaseinelectrolyteconcentration of porefluid.
10. Based on overall results and discussion it can be concluded that the engineering properties of soil are enhancedbyusingceramicandwasteplasticmaterialasan51admixtureinvariousproportion.Useofplasticand ceramictocertainpercentageasafillerinsoilmasscanincreasethestrengthandcapabilityofsoiltostabilize.
11. The results of this study suggest that strip cut from plastic and ceramic powder may prove useful as soil reinforcement application. However further study is needed to optimize size, thickness and shape of strip along with a binding media in optimum proportion.
12. This work serve as a means to meet the challenges of expansive soil in Malegaon City and nearby regions byreducingtheamountofplasticwasteandproducingusefulproductfromnon-usefulwastematerialsleadingto the foundation of sustainablesociety.

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