Plastic Waste as a Cementing Material in Civil Engineering

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Abstract— The removal of waste plastic jugs causes ecological contamination. Plastic can be reused or reused for example reprocessing these plastic squanders and make some valuable items. Misuse of plastics can be utilized as admixture for balanced out soil. Squander plastic materials can be reused in light of the fact that it tends to be reused ordinarily along these lines diminishing the wastage. Utilization of the plastic waste for the improvement of the properties of soil is a compelling and efficient method of adjustment. Employments of materials made of plastic are builds step by step, yet the removal of plastic expanding the waste plastic substance in city squander. As innovation is improving in the general public step by step, another strategy of soil adjustment is found in which squander amounts like plastic, bamboo, polythene sacks, bottles and so forth, are adequately used for upgrading the dirt properties. As these waste materials are increasing in society day by day which leads to different natural problems hence the use of waste plastic materials as an admixture should be imply which improves the strength of the soil, reduces the cost of admixtures and leads to economical use of plastic without causing any environmental and ecological hazards. Stabilized soil is more durable having comparatively high strength, good quality of soil, less permeability of soil and useful for constructions of roads by reducing the thickness of pavement and also control the shrinkage and swelling properties of soil, which helps in achieving better soil gradation. It can significantly improve the working platform for various construction operations. Stabilization enhances the properties of soil; most importantly it increases the load bearing capacity of soil thus, and has a remarkable effect on the strength of soil. Addition of suitable admixtures has the key role in soil stabilization.

Keywords: Cementing Material, Plastic Waste, Civil Engineering

I. INTRODUCTION

Plastics are considered as perhaps the main creation which has helped vital in different fields of life. The employments of plastic have been massively expanding from recent years. However, presently, it is turning into the significant toxin of Environment as a result of the propensity for utilizing it and tossing it. The utilization of plastic must be confined in any case human and climate needs to look in future for the unfavorable effects of plastic. For using the loss to the dirt and settling it for different future purposes, to lead this different explores are going on. In this manner, utilizing plastic as stabilizer will help twoly, one in aiding the issue of arranging the plastic waste with no antagonistic impact and besides, balancing out the relatively more vulnerable soil for the development reason and different exercises. Present investigation is directed on the dirt taken from Gomti stream front which is arranged in Gomti Nagar and plastic jugs strips are added for its adjustment. For correlation of solidarity between normal soil and soil having plastic strips, UCS (unconfined pressure strength) test is done in this examination.

II. LITERATURE REVIEW

A. Introduction

In this review paper A lot of researchers have done researches for the stabilization of soil. In the present scenario, there is a scarcity of good soil which makes the construction process difficult. Expansive soil is highly problematic because of its property of volume change under different moisture conditions. Out of several methods available to stabilize the soil, all methods are not economical, so cheap materials should be used most of the time in soil stabilization. To enhance the properties of soil for various construction purposes, it is important to add a suitable admixture in the soil. These admixtures should enhance the properties of soil and also be economical. Some researches that have been done on soil stabilization by adding some admixture are listed below.

Brooks M. Robert et al. [2009] conducted their study about soil stabilization by using rice husk and fly ash. Various tests such as compaction test, UCS, CBR, and free swell index were conducted by him. These test results concluded that an increase of CBR value, UCS, and swell deduction was observed with the increasing amount of rice husk ash added to the soil. With the increase in the amount of fly ash, there was a significant increase in the confined compressive strength of the soil. The quantity of optimum fly ash and rice husk ash were found out to be 25% and 12% respectively by the author. For the improvement of the subgrade of expansive soil, these stabilized soils were recommended by the author.

Choudhary, Jha, and Gill[2010] researched the potential of high-density polyethylene (HDPE) for improving the engineering properties of sub-grade soil by utilizing it as soil reinforcement. A series of CBR tests were carried out by the authors on soils reinforced with varying strip lengths and proportions of HDPE strips from waste plastics. The results proved that reclaimed HDPE can act as a suitable soil reinforcement material for subgrade improvement especially on highways.

Lavanya et al. [2011] carried her study about the applicability of copper slag in geotechnical projects. In this study, she determined the Index properties, free swell index, compaction properties, CBR, and UCC of the copper slagged soil. She concluded that these properties showed considerable improvement when the replacement of copper slag increased from 30% to 50% in the case of black cotton soils. She also concluded that with the partial replacement of copper slag with black cotton soil, the mixture can be effectively utilized for subgrade improvement and other transportation geotechnics projects.

Otoko Rowland et al. [2011] researched the effect of sawdust ash on the properties of Nigerian deltaic laterites. The soil properties of the stabilized soil mixture were determined through the liquid limit, plastic limit, shrinkage limit, free swell index, plasticity index, MDD with OMC, UCC, and CBR tests. The results showed that there was a significant improvement in the properties of the soil mix with the addition of 4% of sawdust ash. The author also concluded that as a soil waste material, the utilization of sawdust could reasonably reduce the cost of construction.

Patel V Arpita et al. [2011] researched the geotechnical properties of black cotton soil contaminated by castor oil and mixed with sawdust. Laboratory tests like specific gravity, Atterberg limits, MDD with OMC, CBR (soaked and unsoaked), and UCC were conducted by the authors. He showed that that the index and engineering properties of the soils were increased with partial replacement of the saw-dust (7.5%) in the black cotton soil contaminated by castor oil. Further, the authors also concluded that though the soil was contaminated, its properties were improved when sawdust was added up to 10% to the soil.

Malhotra Monica et al. [2013] conducted their study about the stabilization of expansive soils by using low-cost materials. In this, paper fly-ash and lime were added as stabilizing agents with varying percentages. They had conducted various laboratory tests like the Atterberg limit (Liquid limit), free swell index, and standard proctor test. Their results concluded that the mixing of soil with both lime and fly-ash could show a considerable increase in properties. Besides, the shrinkage and swelling characteristics of the stabilized soil were also reduced to a significant extent.

Gundaliya et al. [2013] researched the mixing characteristics of cement waste dust and lime with black cotton soil. He identified the improved behavior of the stabilized soil from various laboratory tests such as liquid limit, plastic limits, and UCC. The results showed that the compressive strength was significantly improved with the addition of cement dust with soil. He also concluded that the partial replacement of black cotton soil with cement dust shows improved engineering properties when compared to cement dust mixed with lime and lime.

Poweth Mercy et al [2013] conducted their study on quarry dust waste and plastic waste by utilizing them in the sub-grade of pavements. Their study was mainly concentrated on the methodology for finding the optimum percentages of waste plastics, quarry dust in soil mixtures through a series of CBR and SPT tests. They concluded that as a suitable pavement subgrade material only quarry dust should be mixed with the soil plastic mix for increasing its maximum dry density. On the other hand, plastic mixed with quarry dust in a stabilized soil keeps the CBR value within the desired limit.

Nsaif Hatem et al [2013] studied by mixing plastic waste pieces with clayey soil and sandy soil in mixing ratios of (0,2,4,6,8)% by weight. A significant improvement in the strength of soils was observed because of increase in internal friction. The percentage increase in angle of internal friction for sandy soil was found to be slightly more than that of clayey soil, but there was no significant increase in cohesion was observed for both soils. In addition, a decrease in MDD and OMC of the soil was observed due to specific gravity of plastic pieces.

Malhotra Akshat and Ghasemain Hadi [2014] investigated the effect of high density polyethylene (HDPE) plastic waste on the unconfined compressive strength of black cotton soil. It was concluded that unconfined compressive strength increases on addition of plastic waste. Unconfined compression strength is maximum when plastic waste was mixed was 4.5%.

Nagle et al. [2014] performed CBR test for improving engineering performance of sub grade soils. Polyethylene, bottles, food packaging and shopping bags were mixed as reinforcement in black cotton soil, yellow soil and sandy soil. It was observed that MDD and CBR value rises with increase in plastic waste. It was also observed that load bearing capacity and settlement characteristics of reinforced soil is improved.

Chebet et al. [2014] conducted study to determine increase in shear strength and bearing capacity of locally available sand by mixing of strips of HDPE from plastic shopping bags. It was observed that strength of reinforced soil is increased due to tensile stress mobilized in the reinforcements. The plastic properties (concentration, length and width of strips) and soil properties (gradation, particle size and shape) were found to be influence the reinforcement material.

Jaypal et al. [2014] researched about the comparison of different admixtures using weak soil stabilization. In this paper, admixtures such as quarry dust, fly ash and lime were compared. The tests such as liquid limit, plastic limit, modified proctor compaction, sieve analysis, differential free swell and CBR were conducted. He concluded that the addition of quarry dust, lime and fly ash had not prevented the swelling nature. He also stated that there was increase in the CBR value with the partial replacement of 20% quarry dust, which in turn reduced the pavement thickness of road construction.

Baraskar Tushal et al. [2014] conducted CBR test on Black cotton soil. Copper slag in various percentages were mixed with black cotton soil to study grain sieve analysis, compaction characteristics and CBR. Maximum CBR value was observed with 28% replacement of copper slag. It was observed that such soils can be effectively used as sub- base layer of road pavement.

Paliwal et al. [2016] performed experiment on stabilization of sub-grade soil by using foundry sand waste. Liquid limit, plastic limit, plasticity index, standard proctor test, CBR and direct shear test were conducted. It was observed that CBR value and angle of internal friction of soil was improved with addition of 20% foundry dust. The OMC value was found to be a lower value for 10% replacement of foundry waste. Butt et al. [2016] investigated the strength behavior of clayey soil by stabilizing with saw dust ash. The Liquid limit, plastic limit, plasticity index, specific gravity, UCS and CBR tests were performed. It is observed that property of soil showed a desired value up to 4% replacement of saw dust ash. The results showed that saw dust ash acted as a cheap stabilizing material for road pavement.

Michael et al. [2016] studied the stabilization of expansive soil using industrial solid wastes. The expansive soil was mixed with different proportions of materials such as

Red mud, copper slag, brick dust, polyvinyl waste, ceramic dust, sawdust and fly ash. Atterberg limits, CBR and compaction test were performed. It is observed that all industrial wastes have the ability to improve the expansive soil with low cost when compared with conventional soil.

kumar et al. [2017] studied black cotton soil blended with different percentages of copper slag and fly-ash. Liquid limit, plastic limit, plasticity index, free swell, compaction test and CBR (unsoaked) were determined. It is observed that dry density, CBR values were improved while swelling was reduced due to addition of copper slag by 30% and fly ash by 10% in the soil.

Babu et al. [2017] investigated the behavior of black cotton soil with addition of copper slag and steel slag. Compaction test, unconfined compression test and CBR test were performed. It is observed that CBR, optimum moisture content, maximum dry density and shear strength were increased when the soil is added with 20% of copper slag and steel slag.

All the studies that have been done on stabilization of soil suggest that there will be an increase in the shear and bearing strength of soil by the application of suitable admixture like cement, lime ,fly ash, plastic waste ,bitumen etc. Along with strength, other soil properties like shrink-swell index, liquidity index, permeability etc. also get better of the soil. But except some admixtures, most of them are quite expensive, so use of this admixture is not feasible most of the time. New researches on soil stabilization by waste material like plastic, fly ash etc. are economical. So, research of soil stabilization should be more focused on adding suitable admixtures which can not only enhance soil properties but also economical and feasible.

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