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REVIEW ARTICLE

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SOIL STABILIISATION USING WASTE PLASTIC BOTTLES- A CRITICAL REVIEW

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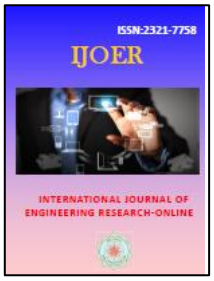

ABSTRACT

There is a fast increase in generation of waste plastics all round the world attributable to economic process, dynamic Consumption and Production Patterns. The world's annual consumption of plastic materials has inflated from around five million tons in the Nineteen Fifties to nearly a hundred million tones. Thus, presently twenty times a lot of plastic is produced as compared to fifty years ago.

Soil stabilization alters the physical properties of soil in order to improve its strength, durability, or other qualities to meet the engineering necessities. It will be achieved by adding appropriate admixtures like cement, lime and waste material like fly ash, mineral etc or by alternative appropriate stabilization technique. the value of adding these additives has tremendously increased in the past few years; therefore there is a need for the event of other forms of soil additive like plastic, bamboo etc and these new techniques of soil stabilization mistreatment plastic waste which may be effectively used to solve the challenges of society, thereby reducing the number of waste plastic material. Use of polyethylene luggage, bottles, and other plastic product is exponentially increasing year by year due to that we tend to face varied environmental issues.

Therefore the correct manner disposing off of the plastic waste without inflicting any ecological hazard has become a real challenge these days. A review paper presents the data massed on utilization of plastic waste in bettering the engineering characteristics of soil through experimental investigations. From literature accumulated, it is discovered that sundry engineering properties of soil are amended with incorporation of plastic waste in soil in sundry percentages.

KEYWORDS—Soil Stabilization, Engineering properties, Waste Plastics bottles;

I. INTRODUCTION

Soil is highly complex, heterogeneous and impulsive material which has been subjected to vagaries of nature, without any control.

Soil stabilization is that the alteration of soils to boost their physical properties. Stabilization will increase the engineering properties of a soil and/or management the shrink-swell properties of a soil, therefore up the load bearing capability of a sub-grade to support pavements and foundations. The properties of soil amendment not solely from one place to alternative however additionally at the place with depth and with a amendment within the environmental, loading and sort, emptying and therefore the conditions beneath that it exists.

In comparison to alternative construction materials like concrete or steel, it's not economically possible.

To move the soils from one place to alternative, as a result of a large amount of soil is concerned and it's not opened to examine at greater depth for foundations of various structures.

The most common improvements achieved through stabilization include better soil gradation, reduction of plasticity index or swelling potential, and increases in durability and strength. The widespread increase of single-use plastics in day to day consumer applications continues to contribute to an ever growing volume of plastic material in municipal solid waste generated across the world.

The main objective of reinforcing the soil was to upgrade its properties. The reinforcing material introduced within the soils alters the strength and deformation characteristics of the soil. Plastic is taken into account in concert of the simplest invention in several aspects of life.

The quantity of plastic waste is increasing year by year. Due to this the would like of plastic waste management has enlarged therefore that it will be used as soil stabilizer and in different ground improvement techniques because it behaves like reinforcing material. Therefore to create the development path property the use of plastic waste in geotechnical engineering has to be inspired. By doing therefore, Properties of soil are improved and employ of plastic may be created expeditiously.

Randomly distributed fibers in soil (RDFS) are among the latest technique in which fibers of desired type and quantity are added in the soil , mixed and laid. The composite material is called 'ply soil'. Thus the method of preparation of RDFS is similar to conventional Stabilization techniques.

Plastic is a material consisting of any of a wide range of synthetic or semi-synthetic organic compounds that are malleable and can be molded into solid objects

Plastics can be divided into two major categories:

1. Thermoset or thermosetting plastics. Once cooled and hardened, these plastics retain their shapes and cannot return to their original form. They are hard and durable. Thermosets can be used for auto parts, aircraft parts and tires. Examples include polyurethanes, polyesters, epoxy resins and phenolic resins.

2. Thermoplastics. Less rigid than thermosets, thermoplastics can soften upon heating and return to their original form. They are easily molded and extruded into films, fibers and packaging. Examples include polyethylene (PE), polypropylene (PP) and polyvinyl chloride (PVC).

Some of the plastics are listed below :

1. Polyethylene terephthalate (PET or PETE)
2. Polystyrene (Styrofoam)
3. Polystyrene (Styrofoam)
4. Polytetrafluoroethylene (Teflon)
5. Polyvinylidine Chloride (Saran)
6. Polyethylene, LDPE and HDPE
7. Polypropylene (PP).

Waste plastic and its sources

Waste Plastic	Origin
Low Density Polyethylene (LDPE)	Carry bags, sacks, milk pouches, bin lining, cosmetic and Detergent bottles.
High Density Polyethylene (HDPE)	Carry bags, bottle caps, house hold articles etc.
Polyethylene Terephthalate (PET)	Drinking water bottles etc.,
Polypropylene (PP)	Bottle caps and closures, wrappers of detergent, biscuit, vapors packets, microwave trays for readymade meal etc.,
Polystyrene (PS)	Yoghurt pots, clear egg packs, bottle caps. Foamed Polystyrene: food trays, egg boxes, disposable cups, protective packaging etc.
Polyvinyl Chloride (PVC)	Mineral water bottles, credit cards, toys, pipes and gutters; electrical fittings, furniture, folders and pens, medical disposables; etc.

II. LITERATURE REVIEWS

Amin Chegenizadeh, et al (2011),"Compaction Characteristics of Reinforced Clayey Sand" studied the compaction characteristics of soil reinforced with plastic fibres, Compaction tests were conducted on composite clayey sand which had 15% of kaolin. The results obtained showed that firstly by induction of fibre the maximum dry density slightly decreased. On other hand fibre inclusion caused increasing in Optimum Moisture Content (OMC). Secondly, similar to unreinforced soil, it was observed that maximum dry density increased due to increasing in compaction effort. The graph shows (Table 1) the

variation for different percentages of plastic fibres by weight.

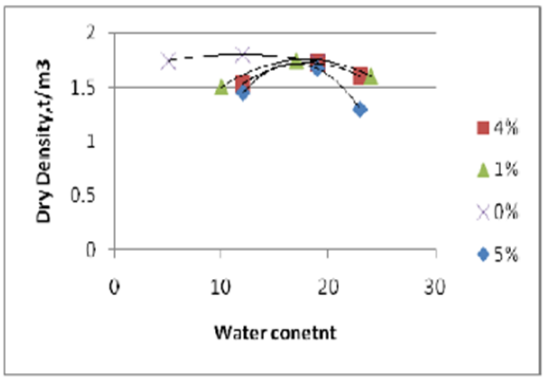

Figure 1: Results of compaction

Maha hateim nasif et al(October 2013)," Behavior of Soils Strengthened by Plastic Waste Materials" concluded by mixing plastic waste pieces with two types of soil. He conducted an experimental study on mixing plastic waste pieces with two types of soil (clayey soil and sandy soil) at different mixing ratios (0, 2, 4, 6, and 8%) by weight respectively. Direct shear test and compaction tests were performed. First physical properties of both sandy and clayey soil were calculated. (Refer table1). It was found that, there is significant improvement in the angle of internal friction. The percentage of increase in the angle of internal friction for sandy soil is slightly more than that in clayey soil, but there is no significant increase in cohesion for the two types of soils. (Refer table 2)Also, it was concluded that the plastic pieces decreases the maximum dry density of the soil due to their low specific gravity and decreases the optimum moisture content.

Table 2: Physical Properties of the clayey soil.

Physical properties	Index value
Specific gravity (Gs)	2.7
Liquid Limit (L.L. %)	41
Plastic Limit (P.L. %)	22
Plasticity Index (P.I. %)	19
Sand(%)	16
Silt(%)	34
Clay(%)	50
Maximum dry unit weight (kN/m^3)	17.8
Optimum moisture content (%)	16.68
Soil Classification (USCS)	CL

Table 3: Result of Direct Shear Test on the soil mixes

Type of soil	Plastic waste content (%)	Cohesion (kPa)	friction angle Φ(degrees)
Sandy soil	0	0	37
	2	2	42
	4	2	45
	6	3	52
	8	4	55
Clayey soil	0	53	21
	2	53	24
	4	54	25
	6	54	30
	8	54	32

Mercy Joseph Poweth et.al,(April 2014)" Effect of Plastic Granules on the Properties of Soil" conducted some experiments using different equipment's such as Proctors Compaction Test, Direct Shear Test ,Permeability Test and California Bearing Ratio Test. The experiments were conducted using soil reinforced with plastics and without plastics in varying percentage and the results were compared among themselves. It was found that there wasn't considerable change in the soil properties, but though this method is not much effective in stabilization; it can be used as an effective method in disposing waste plastic materials.

Miss Apurva J Chavan (April 2013), "Use of plastic waste in flexible pavements." Disposal of waste materials, together with waste plastic bags, has become a grave trouble and waste plastics arc burnt for apparent disposal that causes environmental contamination. Use of waste plastic luggage in hydrocarbon mixes has tested that these enhance the properties of mixtures additionally to determination disposal issues. Plastic waste that is clean is turn over a size such that it passes through 2-3mm sieve. The mix is heated and also the plastic is effectively coated over dry aggregate. This plastic waste coated combination is combined with hot hydrocarbon and also the resulted mix is employed for building. the utilization of the innovative-technology won't solely strengthen the building however conjointly increase the road life further as can facilitate to enhance the setting, Plastic roads would be a boon for India's hot and intensely wet climate, wherever temperatures often times cross 50°C and torrential rains produce mayhem, deed most of the roads with massive potholes.

Pramod S. Patil (Jun-2014), "Innovative techniques of waste plastic used in concrete mixture." Disposal of plastic waste in associate degree surroundings is taken into account to be an enormous downside thanks to its terribly low biodegradability and presence in giant quantities, In recent time use of such; Industrial wastes from polypropene (PP) and polythene terephthalate (PET) were studied as different replacements of a locality of the standard aggregates of concrete. Plastic usage was taking position on a big scale in associate degree India, the maximum amount as hr of each industrial and concrete plastic waste is recycled that obtained from numerous authors, plenty in India have discharged plastic wastes on an oversized scale have immense value, as a results of this, usage of waste plastics plays a serious perform in providing employment.

Shish pal, et al ,(November2015),"Soil Stabilization Using Polypropylene as Waste Fiber Material" published his results on the soil stabilization using propylene. Fibres of polypropylene were used for the improvement of the various properties of the Clayey (CL) type of soil obtained from Ambala City, Haryana (India). The physical properties such as :Maximum Dry Density at Optimum Moisture Content, Direct Shear Strength Parameters and Unconfined Compressive Strength have been determined with the use of waste fibres polypropylene in variation of length of 10mm, 20mm & 30mm at different percentage 0 %, 0.15%, 0.25% & 0.35% of waste fibre material by weight of the dry soil sample. It was found that the optimum quantity of fibres of waste polypropylene as reinforcement that can be used to improve the engineering properties of clayey soil (CL) is found to be 20mm in length at 0.25% of polypropylene by weight of dry soil sample for UCS and 0.35% of polypropylene by weight of dry soil sample for DST.

S.W.Thakare ,(2013)"Performance of Plastic Bottle Reinforced Soil" conducted experimental investigation on materials used for model foundation system, procedure is followed for the model tests and detailing test program. Materials used for model plate load tests were as follows:

a. Sand the sand used in this study was dry sand of SP type as per IS classification.

b. Reinforcement: The type of reinforcement used in the experiments is plastic straws of diameter 6 mm and 20 mm height representing plastic water bottles and arranged in staggered pattern. The diameter and height of model water bottles is selected corresponding to a scale ratio with respect to original dimensions of mineral water bottles of 1 liter capacity available. The numbers of model plastic bottles in a layer are varied depending upon L/B ratio of the reinforcement. The similar procedure is followed and the results are discussed. Each plate load test results were plotted and the ultimate bearing capacity was obtained by tangent method. In some cases, the load-settlement curve was observed to be straight without any change of slope.

III. CONCLUSIONS

Following conclusions are drawn based on the studied conducted by various researchers.

1. It can be clearly seen that reinforcing plastic in soil can improve soil properties.
2. Annually, a lot of Plastic as waste is generated and it occupies great space. It is very important to find a solution to this problem and based on literature, one of the solutions is use of different size waste plastic in soil reinforcement.
3. Addition of plastic reduces the maximum dry density of the soil; this is because plastics have low specific gravity.
4. It is seen that there is significant increase in the ductility of the soil.
5. In some cases it is found that by using the optimum amount of plastic as reinforcement shear strength is considerably increased.
6. The variation of the friction angle of clayey soil with percentage of plastic content is a nonlinear variation and similar trend is found in sandy soil.
7. All the results from various researchers indicate that soil properties are increased by reinforcing waste plastic. Additionally, it is the most effective way to dispose of plastic wastes generated. This accounts for sustainable development.

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