

A Review Study on Stabilization of soil by waste tyre rubber

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ABSTRACT- A major problem associated with socio-economic development of a country is waste disposal. Safer disposal of rubber tyre waste has become a challenging job. This paper presents the stabilization of soils using crumb rubber at varying percentages (5%, 10%, 15% and 20%). Stabilization is being used for a variety of engineering works, the most common application being in the construction of road and airfield pavements, where the main objective is to increase the strength or stability of soil and to reduce the construction cost by making best use of locally available materials. Stabilization is process of fundamentally changing the chemical properties of soft soils by adding binders or stabilizers, either in wet or dry conditions to increase the strength and stiffness of the originally weak soils.

The soil properties such as permeability of soil, compaction and unconfined compression strength were used to gauge the behavior and performance of the stabilized soils. The samples were subjected to California bearing ratio, unconfined compression tests and falling head permeability test. The tests have clearly shown a significant improvement in the shear strength, bearing capacity of soil and also vast increases in the permeability of the studied soil. It was also observed that there were decreases in OMC and MDD with increase in percentage of crumb rubber on soil. The results obtained are compared with unreinforced samples and inferences are draw towards usability and effectiveness of fiber reinforcement as a replacement for deep or raft foundation, on pavement subgrade soil and also for drainage material in landfill cover system as a cost effective approach

Keywords – Stabilization, Crumb rubber, strength of soil, OMC, MDD.

1. INTRODUCTION –Soil stabilization is a way of improving the weight bearing capabilities and performance of in situ sub soils, sands, and other waste materials in order to strengthen road surfaces. The main objectives of soil stabilization are to improve the California Bearing Ratio of in situ soils, to improve onsite materials with the aim to create a solid and strong sub base and base courses and also to replace (fully or partially) scarce and valuable virgin construction materials which are non renewable.

Solid waste management is one of the major environmental concerns worldwide. In India, the scrap tires are being generated and accumulated in large volumes causing an increasing threat to the environment. With globalization of Indian economy and emphasis on development of infrastructure, the number of vehicles on road is increasing day by day. This increase in growth apart from causing noise and air pollution has begun to cause pollution in terms of stock piles of discarded tyres. Many countries already banned the disposal of the waste tires in sanitary landfills. The use of waste tyres as fuel is now prohibited by the Indian Government due to its environmental impact. In this regard, to develop newer applications a study has been conducted to use crumb rubber with soil for possible use in highway construction. Historically, a significant portion of the waste tires have been processed into finely ground tire rubber (GTR), or crumb rubber, for use as an additive in hot mix asphalt (HMA) pavements to improve pavement performance.

It is desirable from an engineering standpoint to build upon a foundation to ideal and consistent density. Thus, the goal of soil stabilization is to provide a solid, stable foundation. Density is the measure of weight by volume of a material and

is one of the relied upon measure of the suitability of a material for a construction purposes. The more density a material possesses, the fewer voids are present. Voids are the enemy of the road construction, voids provide a place for moisture to go, and make the material less stable by allowing it to shift under changing pressure, temperature and moisture condition. Improving an in situ soil engineering properties is referred to as either soil modification or soil stabilization. The term modification implies a minor change in the properties of soil, while stabilization means that the engineering properties of the soil have been changed enough to allow field construction to take place.

2. LITERATURE REVIEW

Soil stabilization means alteration of soil properties to meet the specified engineering requirements. Disposal of tyres wastes are essential since it cause various hazardous to the environment. With the same intention literature review is undertaken on utilization of solid waste materials for stabilization of soil and their performance.

Baykal et al., (1992) mixed clay and fly ash samples with used tire obtained from retarding industry and hydraulic conductivity test were conducted and he observed that strength decrease once tyre percentage exceeds 30%

Foose, (1996) falling head permeability test were conducted on rubber mixed soil sample and it was observed that when water permeated through samples, slight increases in hydraulic conductivity.

Papp et al., (1997) conducted research on shredded scrap tires blended with subbase soils under flexible pavements. Resilient modulus (M_r) testing was used to determine the plastic and elastic strains. Tests were conducted on cohesionless soils blended with varying amounts of shredded tire chips. Blend ratios ranged from 0.1 to 0.5 tire chips to soil by dry weight. The performance of the shredded tire blends was compared to that of the naturally occurring

virgin soil used in subbase applications in New Jersey. He concluded that physically mixing tire chips with the soil did not present any problems except when excessive steel wires were protruding from the chips. The addition of the tire chips to the soil reduced both density and strength of the soil. The 50-mm (1.96-inch) tire chips were most economical and had the least negative strength impact.

Lee et al., (1999) determined the shear strength and stress strain relationship of tyre chip and a mixture of sand and tyre chips. They found out the stiffness and strength properties for tyre sheds and rubber sand mixture.

Rao and Dutta, (2001) conducted studies on sand mixed with rubber chips. Compressibility tests and triaxial tests were conducted. The stress strain relations and strength parameters were studied. It was found that the value of internal friction and effective cohesion of sand increased with increase in percentage of rubber up to 15%.

Ghazavi (2004) investigated the suitability of recycled granular rubber as a lightweight backfill material. He observed that the unit weight of the soil was reduced from approximately 14 kN to approximately 8 KN original for the 70%rubber blend. Ghazavi concluded that

1. Addition of rubber to sand did not improve the shearing resistance of blends.
2. An apparent cohesion of approximately 10KPa was obtained from blends containing rubber grain.
3. Initial frictional angle decrease with increase in percent of rubber.
4. Unit weight of blend decrease with addition of rubber.

Ventappa and Dutta (2006) performed a study with objective of determining compressibility and strength characteristics of sand and tire mixtures for suitability of sand tire chip mixture for embankment. they concluded that upto20% compressibility of sand-tire mixture was 1% i.e. in

tolerance limit for 10m height of embankment and produced cohesion between 7-17.5 KPa and also internal frictional angle increased from 38 to 40 degree.

Cabalar (2011) blended GTR with sands from two geologic formations, Leighton Buzzard Sand (LBS) and Ceyhan Sand (CS). These sands were selected for their differences in structure and engineering properties. LBS is coarse with sub angular particles, and CS is fine with angular particles. The rubber particle size was not listed but the particles were described as "flaky." Rubber was blended with each type of sand at 5, 10, 20, and 50% by weight. Each blend was subjected to direct shear tests and observed that the shear stress and internal friction angle of the two mixtures decreased at about 10% rubber concentration and then leveled off. He concluded that the blends were useful as lightweight embankment fill on weak foundation soils and retaining wall backfill material since the sand rubber mixtures were significantly lighter than 100% sand mixtures.

3. CONCLUSION

1. The overall objective of this study is to determine the approximate percent of waste tire rubber which is to be added in the studied soil sample to get the maximum shear strength and stability of soil because percentage of waste tire greater than this will cause further decrease in the strength of soil.
2. The use of crumb rubber tire as a stabilization is a low cost method because due to tire rubber mix, CBR value increases and hence thickness of pavement decreases and tyre used as a waste material is at very low cost.
3. This method of stabilization reduces the disposal of waste tire disposal problem which exist currently.
4. Mixes should be acceptable for smaller height embankment as well as a substitute or addition to a conventional fill material.

5. Permeability increases with addition of larger particle size of crumb rubber in lieu of smaller size of soil.

4. DISCUSSION

In this review paper we studied that the soil is stabilized by waste rubber tire. At varying percentage of rubber tire (5%, 10%, 15% and 20%), we obtained that at certain rubber content maximum value of CBR is obtained which is greater than the CBR value without any rubber content. Due to increase in CBR value, thickness of pavement is decrease which is a cost effective approach. Applications of this study are as a fine aggregate in asphalt pavement, as a drainage material in landfill cover system, embankment construction and backfill as a light material etc.

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