Laboratary Expermental Studies on Pavement cyclic performance in Reinforced Sub Bases Laid on Expensive Soil Subgrade

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ABSTRACT*: Evaluation* Studies on flexible pavement system were carried out by using the different reinforcement materials in the fly ash sub base courses laid on expansive soil sub grades. It was observed from the laboratory test results of direct shear and CBR, that the optimum percentage of waste plastics is equal to 0.4% for fly ash materials. Cyclic load tests were carried out in the field by placing a circular metal plate on model flexible pavements. It is observed that the maximum load carrying capacity associated with less value of rebound deflection is obtained for geo grid reinforced stretch followed by bitumen coated bamboo mesh and waste plastics reinforced stretch in the flexible pavement system laid on expansive sub grades.

1.0 INTRODUCTION: The amount of wastes has increased year by year and the disposal becomes a serious problem. The creation of nondecaying waste materials, combined with a growing consumer population, has resulted in a waste disposal crisis. One solution to this crisis lies in recycling waste into useful products. Research into new and innovative uses of waste materials is continually advancing. Many highway agencies, private organizations, and individuals have completed or are in the process of completing a wide variety of studies and research projects concerning the feasibility, environmental suitability, and performance of using recycled products in highway construction. Most developed and developing countries all over the world have huge resources of waste materials such as fly ash, stone dust, and waste plastic. The quantities of wastes that are accumulating in developed and developing countries are causing disposal problems that are both financially and environmentally expensive. One method to reduce some portion of the waste disposal problem is by utilizing these waste materials for engineering purposes.

In India there are about 82 thermal power plants, which are currently producing about 100 million tons of flyash per annum (Dhar, 2001). In order to utiliseflyash in bulk quantities, ways and means are being explored all over the world to use it for construction of embankments and roads (Hausmann, 1990; Veerendra Singh et al., 1996; Boominathan and Ratna Kumar, 1996; Murthy, 1998). According to the latest MORT specifications, several types of gravel are found to be unsuitable for road construction in view of higher finer fraction and excessive plasticity properties.

In recent years, researchers from many fields have attempted to solve the problems posed by industrial wastes. Finding a way for the utilization of these wastes would be an advantageous way of getting free of them. Flyash being the most common pozzolanic material encountered in construction is a by-product of coal burning power plants. The flyash is disposed of either by sluicing to ponds or hauling to solid waste disposal areas. Disposal operations are quite expensive and require the use of land that could be used for other purposes. Recent projects illustrated that successful waste utilization could result in considerable savings in construction costs. This necessitates effective utilisation of this accumulated flyash is being felt by the engineers and scientists.

Conventionally gravel has been used for construction of all categories of roads in our country. In highway engineering field gravel successfully used for sub base and base courses and construction of embankments. Although gravel is a good construction material, due to scarcity of good quality of gravel, they increase the construction cost at some parts of the country. By modifying the physical properties of this poor gravel by reinforcing with other low cost materials like waste tyre rubber necessitates effective utilization of both the materials. This present work deals with effective utilization of gravel and fly ash materials reinforcing with waste tyre rubber chips.

2.0REVIEW OF LITERATURE:Sujit Kumar Pal and Ambarish Ghosh (2009), has conducted shear strength parameters of all the nine fly ash samples, compacted at optimum moisture content and maximum dry density by standard Proctor compaction tests. The results showed with increase in confining pressure the deviator stress at failure (q¦) increases and the shear strength also increases, irrespective of variety of fly ash. The effect of confining pressure on deviator stress at failure is more prominent for the fly ash samples of low strength than for fly ash samples of high strength. Fly ash achieves most of its shear strength from internal friction and exhibits some amount of apparent cohesion. It implies that the fly ash is of mostly noncohesive in nature and internal friction is directly proportional to the shear strength values of fly ash. Maximum dry density of fly ash influences the shear strength parameter like, angle of internal friction. The strain to attain the peak deviator stress increases with increase in confining pressure.

3.0 LABORATORY EXPERIMENTATION:

3.1 MATERIALS AND THEIR PROPERTIES

Expansive soil collected from Godilanka near Amalapuram is used for this investigation as a subgrade material. The soil properties are W_L = 66%, W_P = 32%, W_S =12%, I.S. Classification = CH (Clay of high compressibility), OMC=23%, MDD = 15.69 kN/m^3, Differential Free Swell = 150 %, Soaked CBR = 2 %

S.No	Property	Value
1	Specific Gravity	2.65
2	**Grain Size Distribution**	
	Sand (%)	8
	Silt (%)	32
	Clay (%)	60
3	**Compaction Properties**	
	Maximum Dry Density(kN/m^3)	15.45
	O.M.C. (%)	25
4	Atterberg Limits	
	Liquid Limit (%)	72
	Plastic Limit (%)	31
	Plasticity Index (%)	41
	Shrinkage Limit (%)	14
	IS Classification	CH

5	Differential Free Swell (%)	122
6	Soaked CBR (Compacted to MDD at (OMC) (%)	2

2 Flyash: Flyash used as subbase material, is collected from Vijayawada thermal power station, Vijayawada. The physical and chemical properties of flyash are furnished in Tables 3.2 & 3.3.

Table 3.2 Properties of Flyash

S.No	Property	Value
1	Specific Gravity	1.93
2	**Grain Size Distribution**	
	Sand (%)	26
	Silt (%)	65
	Clay (%)	09
3	**Compaction Properties**	
	Maximum Dry Density (kN/m^3)	13.37
	O.M.C. (%)	24
4	Liquid Limit. (%)	27
	Plastic Limit. (%)	---
5	Soaked CBR. (Compacted to MDD at OMC) (%)	4

Table3.3 Chemical Composition of Flyash(Courtesy: VTPS, Vijayawada**)**

Name of the chemical	Symbol	Range by % of weight
Silica	SiO_2	61 to 64.29
Alumina	Al_2O_4	21.60 to 27.04
Ferric Oxide	Fe_2O_3	3.09 to 3.86
Titanium dioxide	TiO_2	1.25 to 1.69
Manganese Oxide	MnO	Up to 0.05
Calcium Oxide	CaO	1.02 to 3.39
Magnesium Oxide	MgO	0.5 to 1.58

Phosphorous	P	0.02 to 0.14
Sulphur Trioxide	SO_3	Up to 0.07
Potassium Oxide	K_2O	0.08 to 1.83
Sodium Oxide	Na_2O	0.26 to 0.48
Loss on ignition		0.20 to 0.85

3.2.3 Road Metal

Road metal of size 20 mm conforming to WBM-III, satisfying the MORT Specifications is used as base course material.

3.2.4 Waste Tyre Rubber Chips

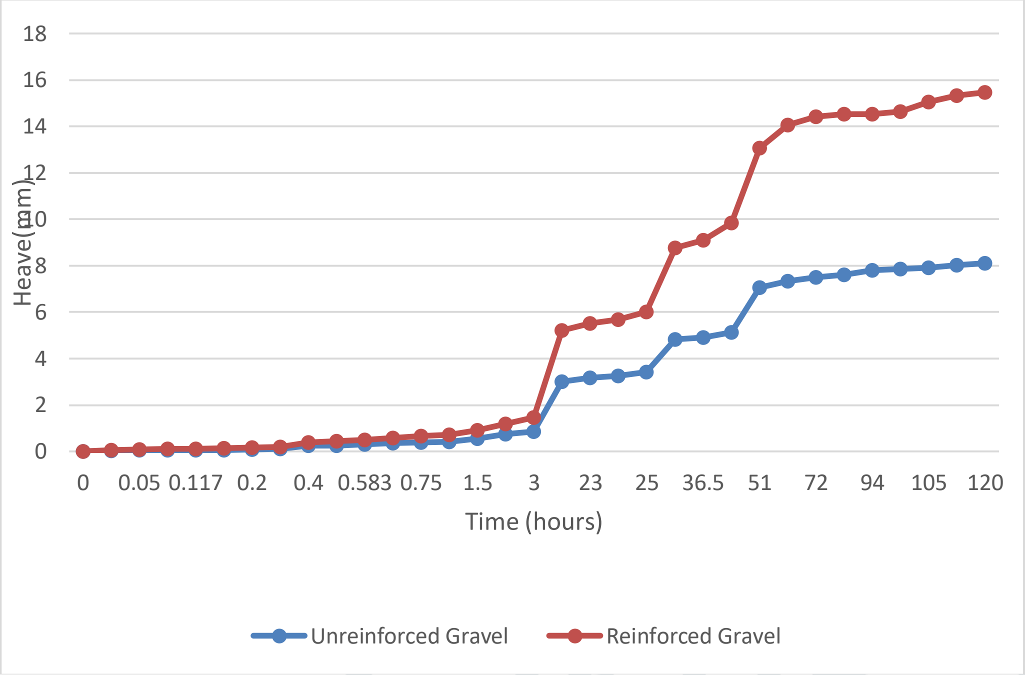
Waste Tyre Rubber chips passing through 4.75 mm sieve were used in this study, as an alternative reinforcement material as shown in the Fig. 3.1.

Fig 3.1 Waste Tyre Rubber Chips

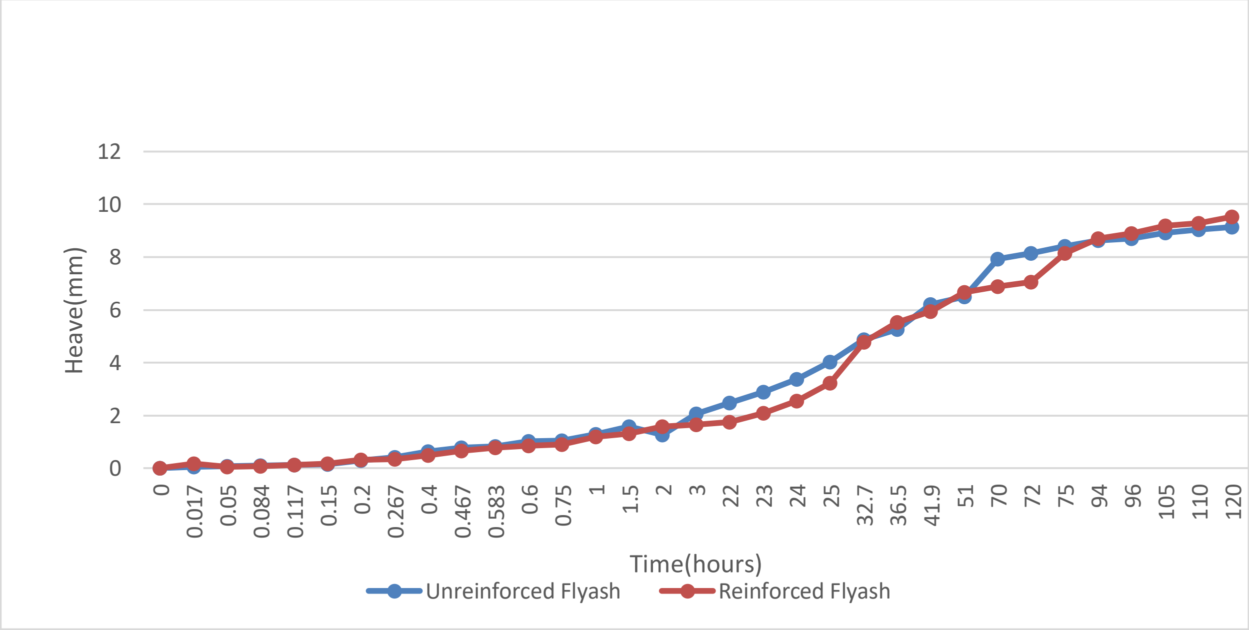
3.2.5 Gravel

Gravel collectedfrom Dwarapudi, near Rajahmundry was used as subbase course. The soil Properties are WL=38%, WP = 20 %, OMC=13 %, MDD=18.05 kN/m3, Soaked CBR=8.0%, Permeability =1.2 × 10 -1 cm/sec.

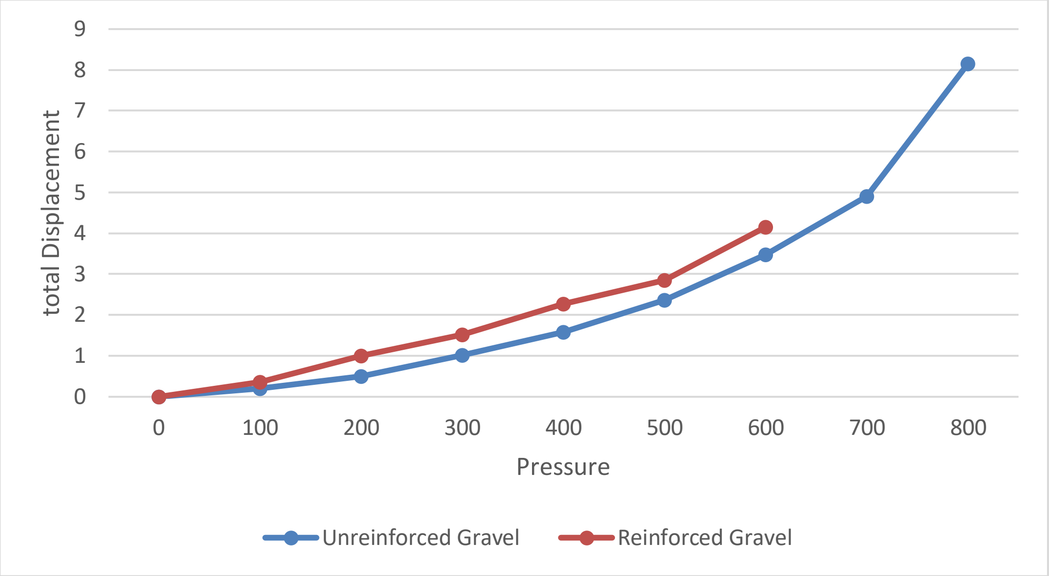
4. Results



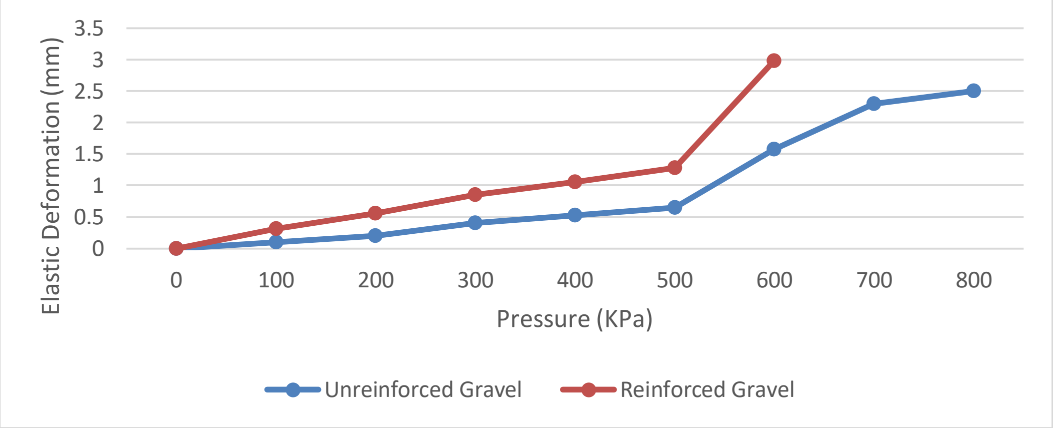
Laboratory Heave-Time Plot for Waste Plastic Strips and Waste Tyre Rubber Chips Reinforced model Flexible Pavements laid on Expensive Soil Subgrade with Gravel Subbase



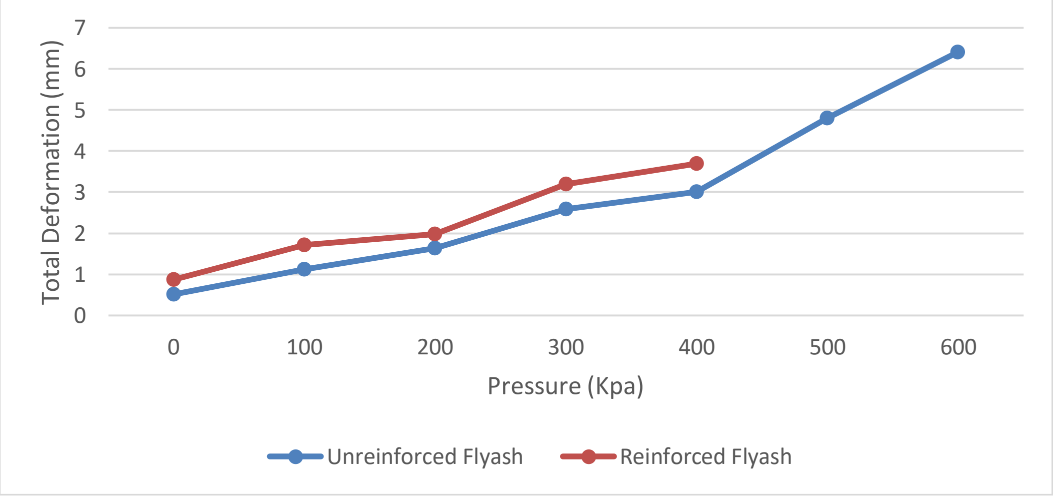
Laboratory Heave-Time Plot for Waste Plastic Strips and Waste Tyre Rubber Chips Reinforced materials in gravel Sub base



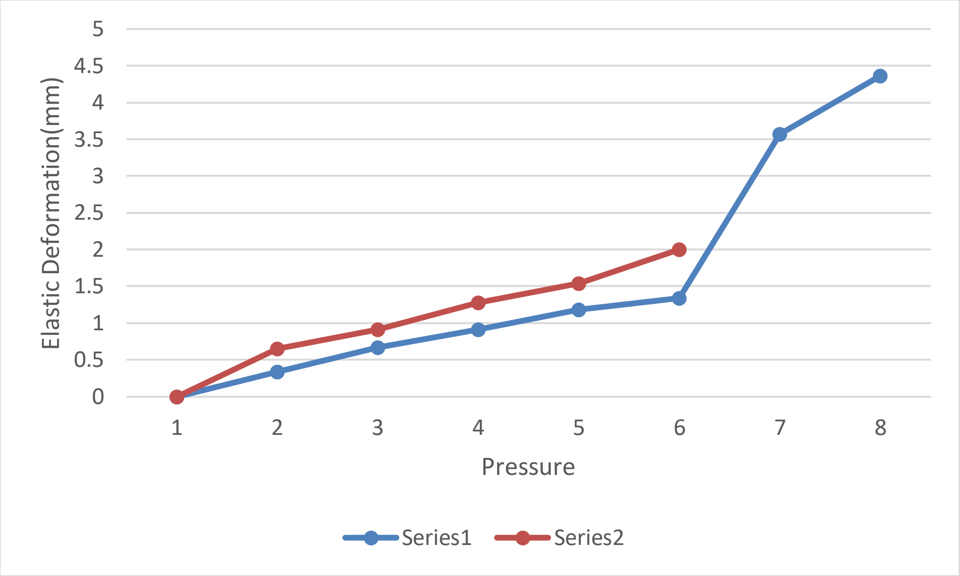
Pressure-total Deformation values for Waste plastic strips and waste tyre rubber chips reinforced material in gravel subbase of flexible pavement laid on expansive soil subgrade at unsaturation



Pressure-elastic Deformation values for Waste plastic strips and waste tyre rubber chips reinforced material in gravel subbase of flexible pavement laid on expansive soil subgrade at unsaturation



Pressure-total Deformation values for Waste plastic strips and waste tyre rubber chips reinforced material in flyash subbase of flexible pavement laid on expansive soil subgrade at unsaturation



Pressure-elastic Deformation values for Waste plastic strips and waste tyre rubber chips reinforced material in flyash subbase of flexible pavement laid on expansive soil subgrade at unsaturation

5. Conclusions

The load carrying capacity of the model flexible pavement system is significantly increased by introducing reinforcement material in gravel / flyash subbases laid on expansive soil subgrade. The load carrying capacity has increased for gravel reinforced subbase when compared to flyash reinforced subbase laid on expansive soil subgrade.

The improvement of the pavement performance is cognizable for the two reinforcement materials tried viz.geogrid and bitumen coated chicken mesh. Both geogrid and bitumen coated chicken mesh provide excellent interlocking of soil particles, there by resulting in better performance compared to other material.

6. References

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