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Strength Improvement of Lateritic Soil Using Flyash and Tyre Chips

Nidhin G. Raj[1], Binil Gopinath[2]

[1]Mtech: Geotechnical engineering, St Thomas Institute of Science and Technology, KTU

[2]Associate professor, Dept of civil engineering, St Thomas Institute of science and Technology, KTU

Abstract: ***Soil is an indispensable element in the field of geotechnical engineering works. Lateritic soil, in ordinary form requires some sort of modifications to meet the specific requirements. In India there are bulk amount of fly ash and tyre wastes were produced. The introduction of these materials accompany with soil to makes appreciable improvement in both physical and chemical properties. Substantianal criteria is that we analyzed the waste materials to reuse it economically for construction purpose. Constituents like silica and aluminia in flyash provide pozzolonic property and thereby increasing bonding between soil particles. Inclusion of tyre chips improves the coefficient of internal friction and provides a strong bond with soil results in improving the strength. Sand is overlayed on tyre chips shows an improved value of friction along with strength. In order to improve the stability of soil we are proposing a concept by mixing the soil with fly ash and sand coated tyre chips to remould the engineering properties of the soil***

Keywords: Lateritic soil ,flyash, tyre chips, sand coated tyre chips, ucs, cbr**…**

1. Introduction

Worldwide constructions are inaugurated by civil engineers in the vicinity of soil testing. The behaviour of the structures represents peculiarity of the soil on which they are constructed. Due to increased rate of infrastructure development it is mandatory to construct on soft soil. Lateritic soil is one of the well known fill material in construction works. Some lateritic soils in their natural state need some standardizations to meet the specification requirements.

Soil stabilization is a mechanism of enhancing the load bearing capabilities. The best part of soil stabilization is to upsurge the strength of the soils and thereby magnifying the California Bearing Ratio (CBR) of in-situ soils by 4 to 6 times. Flyash (FH) being an industrial waste consumed from burning the pulverized coal discharged in thermal power plants. Flyash to soil as addictives will increases the strength characteristics by virtue of its pozzolonic property. Dispatching of waste tires had emerged as an environmental problem. Supplementary disposal of used tires in landfills and stockpiles upsurge the risk of accidental fires with uncontrolled emissions of potentially harmful compounds. Tyre chips have the potential to improve some engineering properties of lateritic soil like California bearing ratio, dry density, coefficient of internal friction etc

Table 1: Properties of lateritic soil

Properties	*Values*
Dry unit weight (gm/cm^3)	1.66
Moulding water content (%)	10
Uniformity coefficient	6.9
Coefficient of curvature	2.13
Specific gravity	2.21
California bearing ratio	3.89
Unconfined compressive strength	18.71
IS classification	
Percentage of gravel (%)	4.01
Percentage of sand (%)	94.99

Figure 1: Collected sample of lateritic soil.

2. Materials And Methods

2.1. Lateritic soil

Lateritic soils are soil types rich in iron and aluminum, distributed in many areas of the world. Locally available lateritic soil collected from vizhinjam was used in this study. Properties of lateritic soil sample are mentioned in Table 1.

2.2 Flyash

Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants, and together with bottom ash removed from the bottom of the furnace is in this case jointly known as coal ash. For this study flyash of class F which was purchased from Thermal power plant near Thovalai. Flyash is added to lateritic soil to find out the optimum flyash content. Table 2 shows the properties of flyash. The SEM analysis image of flyash is shown in fig 2.

Table 2: Properties of flyash

Properties	*Values*
Specific gravity	2.5
Plastic limit	1.9
Maximum dry density (gm/cc)	1.12
Optimum moisture content (%)	18
Coefficient of curvature	0.32
Class	F
Free swell	.75
Permiability (m/sec)	$6*10^{-5}$
Angle of internal friction (θ)	29.7
Cohesion intercept (kg/cm^2)	3.396

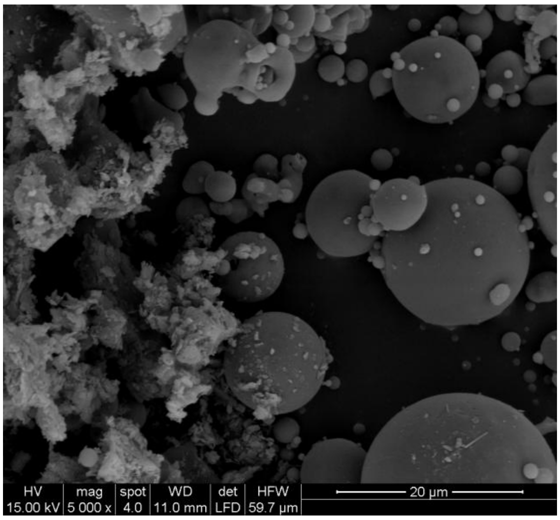

Figure 2: SEM image of flyash

2.3 Tyre chips

These tires are among the largest and most problematic sources of waste, due to the large volume produced, their durability, and the fact they contain a number of components that are ecologically problematic. However, material recovered from waste tires, known as "crumb," is generally only a cheap "filler" material and is rarely used in high volumes. Environmental problems associated with tire waste. Tyre chips for this study is collected from industrial estate kochuveli, Trivandrum. Tyre chips are added to soil–optimum flyash mixture to find optimum tyre chips content.

Figure 3: Tyre chips

2.4 Sand coated tyre chips

Sand is coated over the tyre chips and is added to soil flyash mixture at optimum tyre chip content. Coating process of sand over tyre chips is done by melting tyre chips at 180 degree celesius and sand is allow to sprinkle over the melted tyre chips. The addition of tyre chips increases the cohesion intercept and angle of internal friction than tyre chips alone and this will result in increased strength charachterstics to lateritic soil. Fig 4 shows the representative sample of sand coated over the tyre chips

Figure 4: Sand coated tyre chips

3. Result and Discussion

3.1 Compaction characteristics

Lateritic soil is mixed with varying percentage of flyash. From compaction curve, observed that 6% of flyash by weight is recorded as optimum. To that soil and optimum flyash mixture tyre chips are added with different percentages. Addition of 2 % tyre chips to above mixture is found to be optimal. Table 3 shows the varing mix proportion of soil-flyash-tyrechips and optimum dry density.

Table 3: Optimum dry density for various mix.

Sl No	*Description*	*Mix designation*	*Optimum dry density (gm/cc)*
1	Soil	S	1.66
2	Soil + 3% flyash	Mix 1	2.055
3	Soil + 6% flyash	Mix 2	2.177
4	Soil + 9% flyash	Mix 3	1.985
5	Soil + 12% flyash	Mix 4	1.950
6	Soil + 6% flyash +1% tyre chips	Mix 5	2.030
7	Soil + 6% flyash +2% tyre chips	Mix 6	2.075
8	Soil + 6% flyash +3% tyre chips	Mix 7	2.066

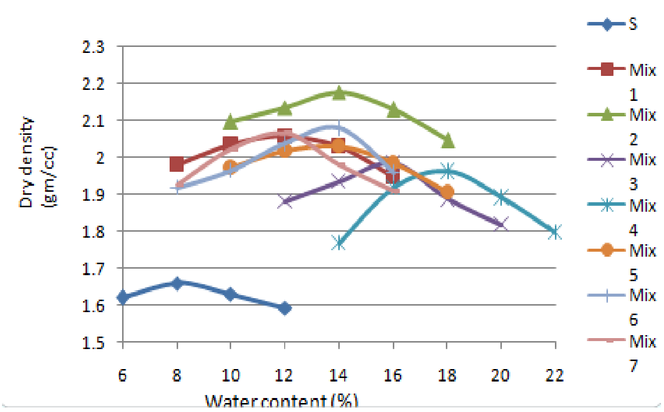

Figure 5: Compaction curve for different mix proportion

3.2 CBR characteristics

Cbr characteristics of lateritic soil is mixed with varying percentage of flyash. From cbr curve, value increases to 1.42 times to that of soil and by adding tyre chips value becomes 2.1 times to original.Table 4 shows the cbr value for different mix.

Table 4: CBR value for different mix

Sl no	*Mix designation*	*CBR value*
1	S	3.89
2	Mix 1	4.27
3	Mix 2	5.51
4	Mix 3	4.21
5	Mix 4	2.98
6	Mix 5	5.84
7	Mix 6	8.11
8	Mix 7	7.13

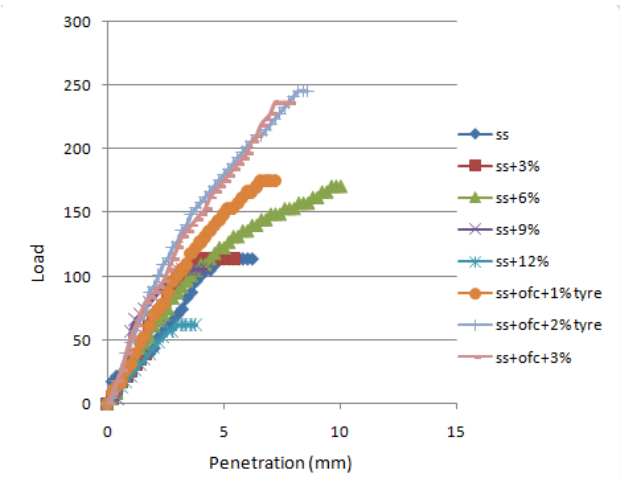

Figure 6: CBR values for different mix proportions

3.3 UCC characteristics

Ucc characteristics of lateritic soil is mixed with varying percentage of flyash. From ucc curve, value increases to 2.08 times to that of soil and. Addition of tyre chips and so increases ucc value to 1.14 times than 6% flyash.

Table -5: Ucc value for distinctive mix proportions

Sl no	*Mix designation*	*UCC values (Kn/m²)*
1	S	18.71
2	Mix 1	22.90
3	Mix 2	38.97
4	Mix 3	33.00
5	Mix 4	30.90
6	Mix 5	39.40
7	Mix 6	44.75
8	Mix 7	38.80

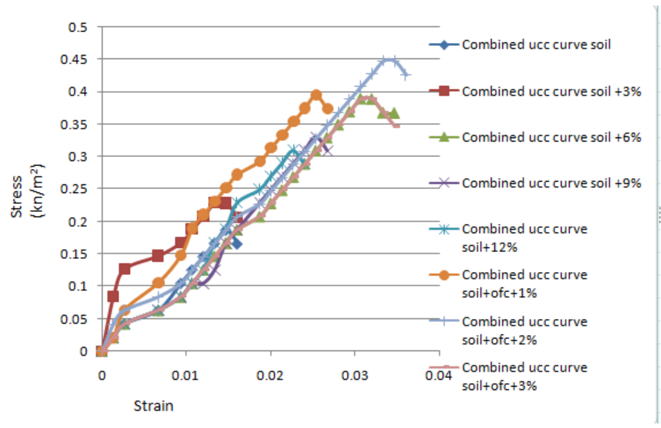

Chart 3: Ucc curve for different mix

3.4 Change in strength characteristics with the addition to the sand coated tyre chips.

From the experiments,it can be noticed that strength character like cbr and ucc values are increased when sand coated tyre chips are added.

Table 6: variation in cbr and ucc values by the inclusion of sand in tyre chips

Sl no	*Mix proportion*	*Cbr value*	*Ucc value (Kn/m²)*
1	Soil + 6% flyash + 2% tyre chips	8.11	44.75
2	Soil + 6% flyash + 2% sand coated tyre chips	8.76	53.7

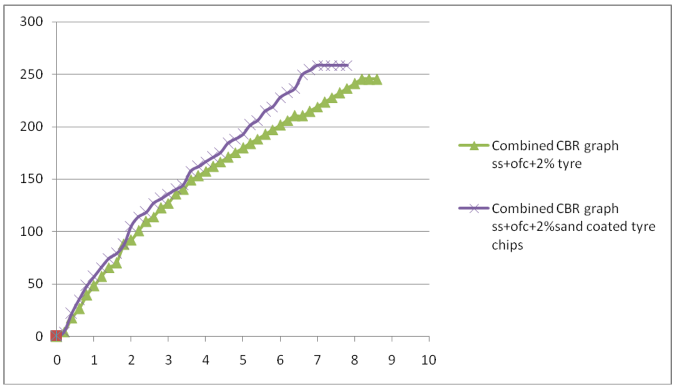

Chart 4: Comparison of cbr value for tyre chips and sand coated tyre chips

4. Conclusions

1) The dry density increases with increase in flyash content up to 6% and thereafter decreases. Flyash would contribute in shear strength increase due to its 'pozzolanic property'.

2) Dry density increases upto 1.31 times for addition of 6% flyash and
3) Maximum CBR value obtained is 5.51 for 6% flyash which is 1.42 times greater than soil
4) CBR value for optimum tyre content added to soil flyash mixture is 2.1 times greater than soil
5) For sand coated rubber CBR value increases 1.08 times greater than tyre chips.Its because of increased φ value
6) UCC value increases with increase of flyash content upto 6% and then decreases.Ucc value increased upto 2.08 times that of soil.
7) Addition of tyre chips and so increases ucc value to 1.14 times than 6% flyash.
8) For sand coated tyre chips ucc value increased upto 20.67% than tyre chips only

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Author Profile

Nidhin.G.Raj. received Btech degree in civil engineering from PRS college of engineering and technology in 2010 and received Mtech in Geotechnical engineering from St Thomas institute of science and technology in 2017.