Improvement of Pavement Soil Subgrade by Using Burnt Brick Dust and Scrap Tyre Rubber

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Abstract— An experiment is conducted to evaluate the engineering properties of clayey soil blending with different percentage of Burnt Brick Dust of 10%, 20%, 30%, 40% and 50% by weight where the Burnt Brick Dust is used to stabilize the clayey soil. After achieving the optimum percentage of Burnt Brick Dust the sample mix is further mixed with 8% by weight with Scrap Tyre Rubber of length 25 mm and width 10mm and then the tests are performed. Tests conducted on clayey soil mixed with Burnt Brick Dust and Scrap Tyre Rubber are Liquid Limit, Plastic Limit, Free Swell Index, Optimum Moisture Content, Maximum Dry Density and California Bearing Ratio. A comparison between clayey soil, clayey soil mixed with Burnt Brick Dust and clayey soil mixed with Burnt Brick Dust and Scrap Tyre Rubber is performed. It is found that the properties of clayey soil are improved drastically.

Key words: Engineering Properties, Clayey Soil, Subgrade, Burnt Brick Dust, Scrap Tyre Rubber

I. Introduction

In highway the most prominent is a wearing course of pavement. The pavement failure or success depends upon the underlying subgrade and the material upon which the pavement structure is built.

In this section, the engineering properties of soil used for pavement base course, subbase course and subgrade is improved by using waste material which are mixed into the soil to gain the desired improvement.

Clayey soil is highly expansive soil. In heavy loading, the clayey soil is weak and has low stability. Removing or replacing the existing soil might not be feasible option; therefore, the best approach is to stabilize the soil with suitable stabilizers (Nelson and Miller, 1992).

Locally available waste materials like cement kiln dust, fly ash, lime, slate dust, rice husk ash, burnt brick dust, shredded tyre rubber etc.,can be used to stabilized the expansive soil. Additional advantage of using waste material to stabilize the clayey soil is that it is cheap, easily available, eco friendly and saves the disposal cost of waste material.

II. Stabilization

Soil stabilization is a geotechnical technique of increasing and maintaining the stability of soil mass and chemical or mechanical alteration of soil to enhance their engineering properties. Stabilization process increases the soil strength, decrease plasticity, lowering or sometimes increases permeability, reduces the volume change due to temperature or moisture variations and increases the workability of soil. Thus, it lowers the pavement thickness when it is used in road construction. It plays a vital role to reduce the harmful waste. Stabilization of clayey soil with waste material controls the volume change and improves the strength of soil.

For stabilizing clayey soil, recently many types of waste are investigated to be used as additive or replacement material such as marble dust, industrial waste, demolition waste, plastic waste, burnt brick dust, slate dust, fly ash, and scrap tyre rubber. To stabilize the clayey soil there are many methods, but they are broadly divided in two groups: mechanical (physical) stabilization and chemical stabilization.

III. Material used

The soil is used for the testing is taken from Malanpur, Bhind District of Madhya Pradesh. The natural clayey soil sample mixed with different percentage of burnt brick dust of 10%, 20% , 30% , 40% and 50% and 8% of scrap tyre rubber of length 25 mm and width 10 mm of dry soil mass.

Properties	Soil
Liquid limit (%)	36
Plastic limit (%)	20
Plasticity index (%)	16
Free swelling index (%)	45
Specific gravity	2.66
Optimum moisture content (%)	18.6
Maximum dry density (KN/m^3)	17.6
CBR value (%)	2.88
Grain size distribution	
Gravel (%)	0
Sand (%)	(11.6 +.8) =12.4
Silt and Clay (%)	87.6

Table 3.1: Physical Properties of the clayey soil

IV. Laboratory investigation and result

In this research work experiments to determine the physical and mechanical properties of soil were conducted. According to Indian Standard Classification System (ISCS) the soil is classified. Liquid limit, plastic limit, plasticity index, specific gravity, free swelling index, standard proctor compaction, California bearing ratio test were conducted on both treated and untreated soil sample. Tests on treated soil sample are conducted after seven days of curing.

A. 1 Results of Soil Sample after Replacement with Burnt Brick Dust (BBD)

S. No	Mix proportions	Clay Soil	10% BBD	20%BBD	30% BBD	40% BBD	50% BBD
1	Initial vol.	10 ml	10 ml	10 ml	10 ml	10 ml	10 ml
2	Final vol.	14.5 ml	13.3 ml	12.4ml	11.1 ml	10.6 ml	10 ml

3	Free swell index	45%	33%	24%	11%	6%	0%

Table 4.1.1: Free swell index value for mix proportions of soil and burnt brick dust

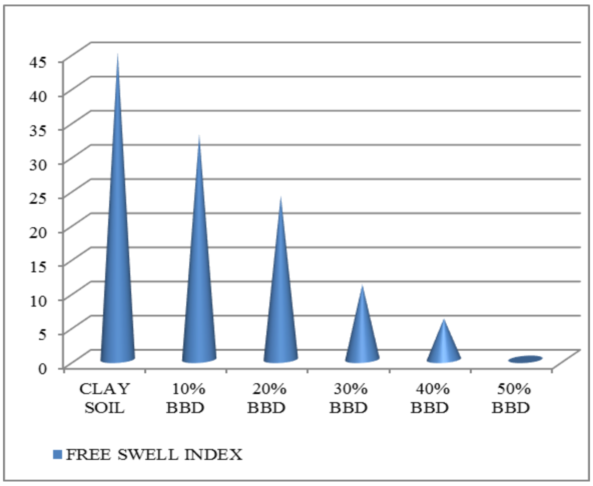

Fig. 4.1.: Chart showing the variation in Free Swell Index for mix proportions of soil and burnt brick dust (BBD)

Content	Clay soil	10% BBD	20% BBD	30% BBD	40% BBD	50% BBD
MDD(KN/m^3)	17.66	18.09	18.89	18.97	19.11	19.64
OMC (%)	18.6	16.59	15.38	14.99	13.33	11.9

Table IV.1.2: Compaction Test value for mix proportions of soil and burnt brick dust (BBD)

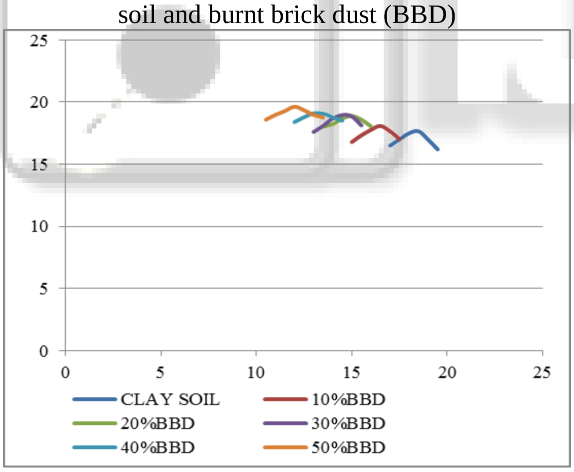

Fig. 4.1.2: Graph showing OMC and MDD of mix proportions of soil and burnt brick dust (BBD)

Percentages of BBD	CBR at 2.5 mm	CBR at 5 mm
Clayey soil	2.88	2.40
10% BBD	3.68	4.92
20% BBD	7.6	7.2
30% BBD	8.1	7.62
40% BBD	9.13	9.003
50% BBD	10.72	10.36

Table IV.1.3: CBR Value for mix proportions of soil and burnt brick dust (BBD)

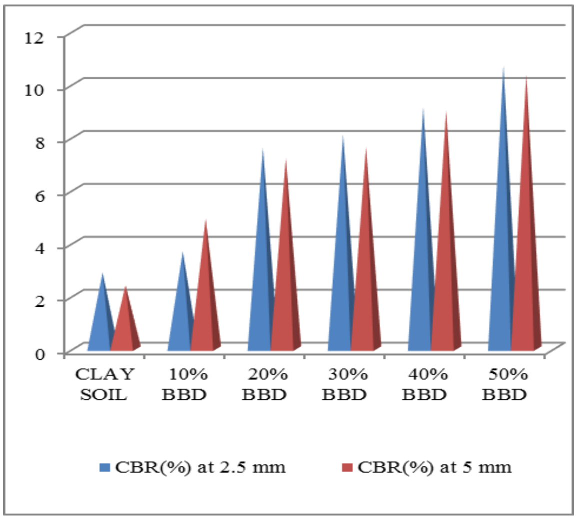

Fig. IV.1.3 Chart showing the variation of CBR Value for mix proportions of soil and burnt brick dust (BBD)

B. 2 Results of Soil Sample with Burnt Brick Dust (BBD) and Scrap Tyre Rubber (STR)

S.No.	Mix proportions	Clayey soil	50% BBD	50%BBD + 8% STR
1	Initial vol.	10 ml	10 ml	10 ml
2	Final vol.	14.5ml	10ml	10ml
3	Free swell index	45%	0%	0%

Table 4.2.1: Free swell index value for mix proportions of soil, burnt brick dust (BBD) and scrap tyre rubber (STR)

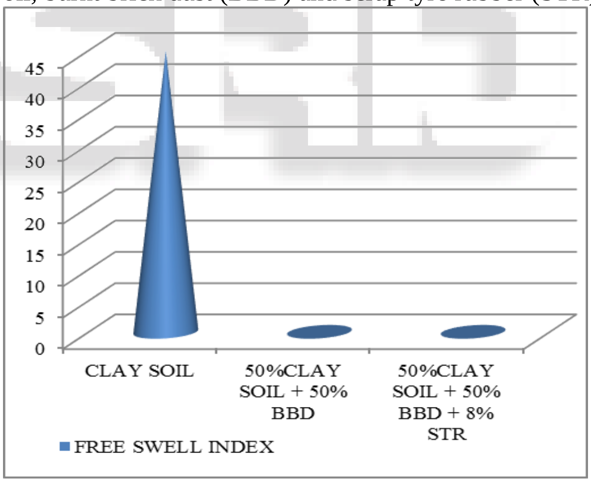

Fig 4.2.1: Chart showing the variation in Free Swell Index for mix proportions of soil and burnt brick dust (BBD) and Scrap Tyre Rubber (STR)

Content	Clayey soil	50% BBD	50% BBD +8% STR
MDD(KN/m^3)	17.66	19.64	18.75
OMC (%)	18.6	11.9	12.5

Table 4.2.2: Compaction Test value for mix proportions of soil, burnt brick dust (BBD) and scrap tyre rubber (STR)

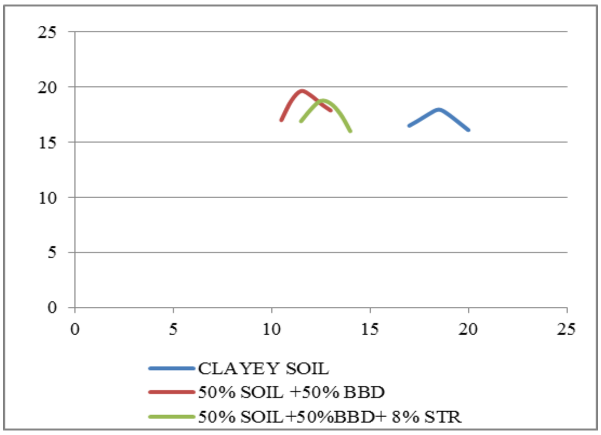

Fig. 4.2.2: Graph showing OMC and MDD of mix proportions of soil, burnt brick dust (BBD) and scrap tyre rubber (STR)

Percentages of BBD	CBR (%) at 2.5 mm	CBR(%) at 5 mm
Clayey soil	2.88	2.40
50%Soil + 50%BBD	10.72	10.36
50%Soil +50% BBD +8%STR	12.54	12.06

Table 4.2.3: CBR Value for mix proportions of soil and burnt brick dust (BBD) and scrap tyre rubber (STR)

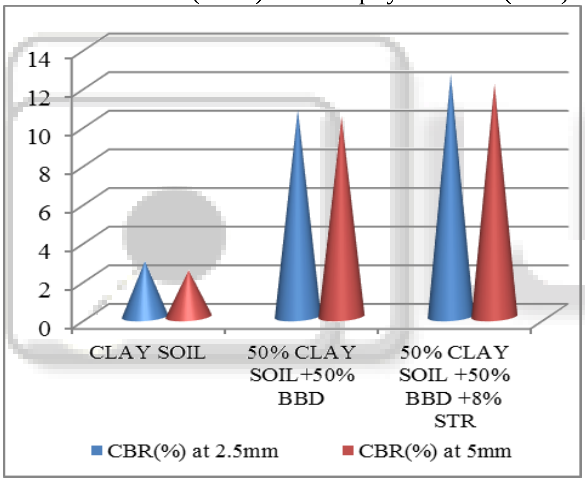

Fig. 4.2.3: Chart showing the variation in CBR Value for mix proportions of soil and burnt brick dust (BBD) and Scrap Tyre Rubber (STR)

V. CONCLUSION

In this experimental study soil is replaced with burnt brick dust in different percentages (10%, 20%, 30%, 40% and 50%) and tests are performed after seven days of curing. On increasing the percentage of burnt brick dust the swelling of soil decreases. When the replacement of soil reached 50% (means 50% BBD and 50% soil) the swelling of soil becomes zero. The optimum moisture content (OMC) and maximum dry density (MDD) at 50% replacement of soil with burnt brick dust is 11.9% and 19.64 KN/m^3 and CBR Value of soil increases from 2.88% to 10.72%.

For further experimental study soil replaced with 50% of burnt brick dust is treated with 8% of scrap tyre rubber. On adding 8% scrap tyre rubber optimum moisture content (OMC) and maximum dry density (MDD) of sample is 12.5% and 18.75 KN/m^3 and CBR Value of soil increases from 10.72% to 12.54%.

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