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Research Paper

EFFECT OF INDUSTRIAL WASTE AND CHEMICAL ADDITIVES ON CBR VALUE OF CLAYEY SOIL

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The construction of rural road in clayey soil is a challenge to civil engineer due to its low California Bearing Ratio (CBR) value. This paper deals with the effect of industrial waste and chemical additives on the CBR value of soil. The various industrial waste like fly ash, pond ash and stone dust mixed in clayey soil with RBI Grade 81 as chemical additives in different proportions and its soaked CBR value determined in the laboratory. The CBR value of subgrade soil is less than 2%, it is required to replace this soil by good quality granular material. If the granular materials are not available near the site, the cost of construction of road increases due to transportation of these materials. To overcome this problem, it is possible to improve the CBR value of subgrade soil by using various industrial waste and RBI Grade 81. The CBR value of untreated soil is 2.56%. The CBR value of treated soil with 20% pond ash and 4% RBI Grade 81 is 12.74%. The percentage increase in CBR value is 397% than untreated soil. If the CBR value of subgrade soil improved the thickness of road section also reduces which help to reduce the cost of construction.

Keywords: Clayey soil, CBR value, Industrial wastes, RBI Grade 81, Subgrade soil

INTRODUCTION

Rural road connectivity is a key component of rural development. It helps increase agricultural productivity, non-agricultural employment as well as nonagricultural productivity which help to improve rural economy. The rural roads mostly passing through clayey soil, therefore it is difficult to construct these roads. To overcome this difficulty, it is required to improve CBR value of clayey soil. The various industrial wastes like fly ash, pond ash easily available near thermal power plants can be use for soil stabilization with RBI Grade 81. The RBI Grade 81 is a chemical soil stabilizer. For construction industry huge amount of aggregates are required which are obtained from crushing of rocks. During crushing process huge amount of stone dust is obtained as by- product. As the stone dust having compressive strength which help to improve the CBR value of clayey soil.

Indian Infrastructure Report 2007 (Mohapatra and Chandrasekhar, 2007), gives the use of locally available materials for

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construction of roads. The fly ash and pond ash used for construction of subbase course instead of conventionally used moorum. The CBR value of subgrade soil can be increased by 40% to 50% by using 15% to 25% marble dust depending on nature of soil. Anjan Kumar and Prasada Raju (2009) carried out study on use of fly ash with lime and cement for stabilization of expansive soil. The result shows that the maximum load carrying capacity is obtained for stabilized fly ash subbase compared to untreated fly ash subbase. Vinay and Mohit (2011) work on use of marble dust for stabilization of expansive soil. The experimental results shows that the swelling percentage deceases and rate of swell increases with increasing percentage of marble dust in expansive soils. The addition of marble dust in expansive clayey soil reduces the clay content and increases coarser particles, which helps to reduce LL and raises SL and decreases in the plasticity index of soil and thus swelling potential. Kolay *et al.* (2011) studied class F pond ash for stabilization of peat soil. The Maximum Dry Density (MDD) of peat soil increases and Optimum Moisture Content (OMC) decreases as the amount of pond ash increases in the peat soil. The Unconfined Compressive Strength (UCS) of peat soil increases significantly with increase in pond ash content and also curing periods. The use of pond ash in soil stabilization helps in reducing the pond volume and achieving environment friendly as well as a sustainable development of natural resources. Rafat (2009) studied use of various waste materials like fly ash, pond ash, foundry sand and by-products like cement kiln dust, wood ash in producing controlled low-strength materials. These controlled low-strength materials use for backfill, erosion control, void filling, etc. Prasad *et al*. (2011) carried out the study and the results of CBR test for moorum reinforced with different percentage of waste plastics, soaked CBR value were increased from 8.0% to 16.42% with 0.30% of waste plastics and there after decreases. Madurwar *et al*. (2013) worked on stabilization of black cotton soil by using RBI Grade 81 with sodium silicate. The results show that liquid limit of treated soil decreases and CBR value increases. The free swell index decreases as the addition of RBI Grade 81 and increases due to addition of sodium silicate.

MATERIALS

Soil Sample

In the present study the soil sample is collected from Road near Aurangabad, Maharashtra State, India. The soil in this area is mostly clayey soil. The basic properties of soil are

Table 1: Basic Properties of Soil

Properties of soil	Value
Specific Gravity	02.36
Liquid Limit (%)	67.00
Plastic Limit (%)	36.46
Plastic Index (%)	30.54
Dry Density (g/cm^3)	01.46
Optimum Moisture Content (%)	25.80
Soaked CBR value (%)	2.56
Classification of soil	
i) Silt and Clay (%)	82.15
ii) Sand (%)	12.89
iii) Gravel (%)	04.96

tested in the laboratory and results are as given in the Table 1.

Pond Ash

The pond ash sample is collected from the Thermal Power Plant located at Parli, in Beed district of Maharashtra state of India. After burning of coal in thermal power plant, about 20% to 30% of ash is collected at bottom in the form of slurry. This slurry is deposited in the pond. After evaporation of water from slurry, remaining ash in dry form is called as pond ash. The properties of pond ash depend upon type of coal, pulverization and combustion technique, collection and disposal systems. Pond ash consists of inorganic materials mainly silica and alumina with some amount of organic material in the form of unburnt carbon. It possesses pozzolanic characteristics.

STONE DUST

For the construction industry huge amount of crushed aggregates are required. The different types of rocks are crushed in the stone crusher to get required size of aggregates. During crushing of rocks huge amount of stone dust is formed which is deposited at the crusher site. Earlier stone dust was considered to be waste product. Nowadays it is considered as a by-product of stone crusher plant. The various properties of stone dust are depending on the type of rock used for crushing.

FOUNDRY SAND

The metal casting industry requires foundry sand for metal casting. The foundry sand is a waste from metal casting industry after its use is over. The millions of tons of foundry sand deposited every year in casting industry area. It requires huge space for deposition. To overcome this problem, it is possible to reuse the foundry sand in civil engineering works. The foundry sand can be used as highway subbase material.

EXPERIMENTATION

In the laboratory California Bearing Ratio test is carried out as per Bureau of Indian Standard (IS: 2720 Part-16) (Bureau of Indian Standard 1979). The soaked CBR value of untreated soil and different industrial waste was determined. The CBR value of mix of soil and RBI Grade 81 for different proportions was determined. The RBI Grade 81 added in 2%, 4%, and 6% by weight of soil. The CBR value of mix of soil and different industrial waste for different proportions was determined. The CBR value of mix of soil, RBI Grade 81 and different industrial waste for different proportions was determined.

RESULTS AND DISCUSSION

Effect of RBI Grade 81 on CBR Value of Soil

Figure 1: Effect of RBI Grade 81 on CBR Value of Soil

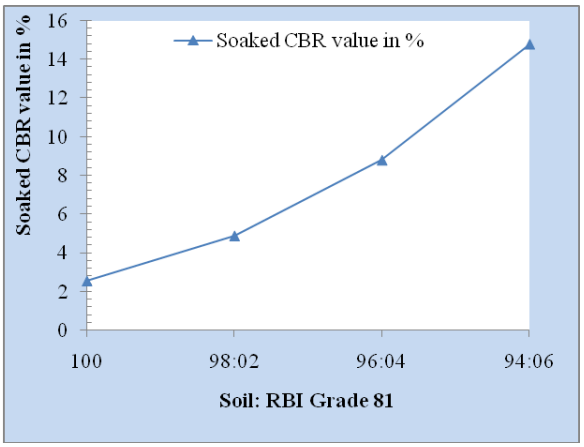
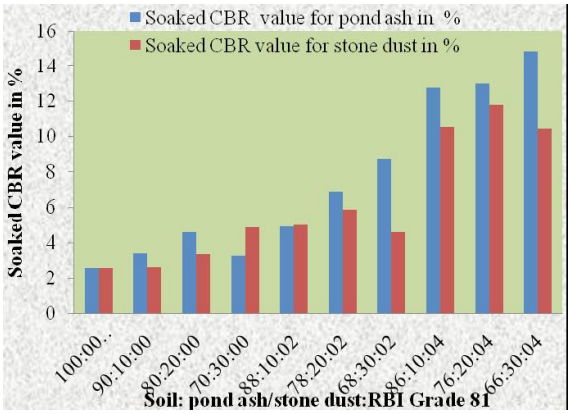


Figure 1 shows the effect of RBI Grade 81 on treated soil. The CBR value of treated soil with 2% RBI Grade increases by 91.01%. The content of RBI Grade 81 having binding property due which the soil particles bind together and the CBR value of mix increases. As the percentage of RBI Grade 81 increases, the CBR value of mix also increases.

Effect of RBI Grade 81 and Pond Ash on CBR Value of Soil

The CBR value of soil and pond ash for 10%, 20% and 30% by weight of soil was determined. After that the CBR value of soil, pond ash and RBI Grade 81 was determined. The Figure 2 shows the effect of pond ash and RBI Grade 81 on CBR value of soil. The CBR value of soil treated with pond ash only slightly increases as compare to untreated soil. But when the soil treated with pond ash and RBI Grade 81 together, the increase in CBR value significant. This shows that the content of pond

Figure 2: Effect of Pond Ash/Stone Dust and RBI Grade 81 on Cbr Value of Soil



ash and RBI Grade 81 helps to increase the CBR value of soil.

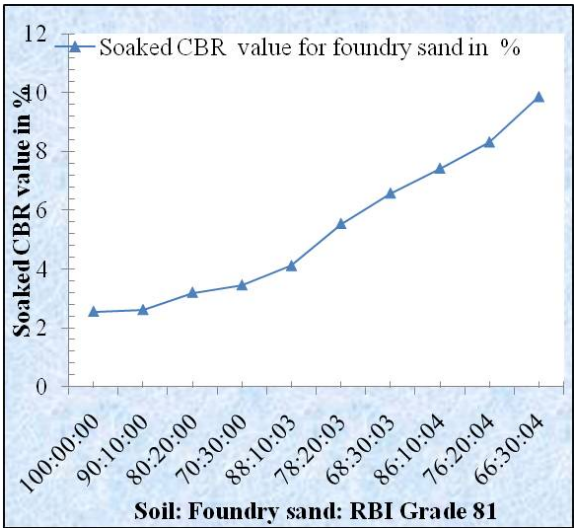
Effect of RBI Grade 81 and Stone Dust on CBR Value of Soil

Figure 2 shows the effect of stone dust and RBI Grade 81 on soil. The soaked CBR value of treated soil with stone dust increases up to 20% of stone dust content and after that it reduces. The stone dust having compressive strength and RBI Grade 81 having binding property, therefore the CBR value of mix increases. The increase in percentage of RBI Grade 81 in the mix helps to increase the CBR value.

Effect of RBI Grade 81 and Foundry Sand on CBR Value of Soil

Figure 3 shows the effect of foundry sand and RBI Grade 81 on soaked CBR value of soil. The foundry sand helps to increase the compressive strength and RBI Grade 81 binds

Figure 3: Effect Of Rbi Grade 81 and Foundry Sand on CBR Value of Soil



the soil particles so that the CBR value of soil increases.

CONCLUSION

The following conclusions are drawn from the above experimental work.

1. The soaked CBR value of soil is increase slightly by addition of industrial wastes, when these wastes added with RBI Grade 81 the increase in CBR value is considerable.
2. The use of various industrial wastes for road construction saves natural materials.
3. The RBI Grade 81 help to utilize locally available soil for road construction and therefore the cost of construction can be reduces.
4. The use of thermal wastes for construction of roads solves the problem of their disposal up to certain extent.

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