

# Improvement Of Sub-Grade Soil Properties Using Admixture (Quarry Dust) And Woven Geo-Textile

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**Abstract:** The important factor for design and construction of pavement is the behavior of underlying sub-grade. Large deformations in the sub-grade will lead to a continuous deterioration of the paved surface. As the sub-grade soil is too weak to bear the load, engineering solutions such as geo reinforcement using geo-synthetics are additives which are earlier used in sub-grade improvement and such experimental study is carried by pervious authors. This paper deals with the sub-grade improvement using geo-textile as a reinforcement sheet and quarry dust as admixtures. In order to increase the strength of the sub-grade the quarry dust is varied with different percentages i.e., 0%, 5%, 10%, 15%, 20% and 25%. In this study, Proctor's compaction tests, and CBR soaked and unsoaked tests are conducted on locally available soil with reinforced material and with admixture. For this study it is identified that the engineering properties of the soil is improved in all conditions. The soil with quarry dust at optimum value is 20% has CBR soaked value is obtained 6.83% and unsoaked value is obtained 7.02% is increased when compared with conventionally soil. The soil, quarry dust at optimum value is at 20% and Geo-textile has CBR soaked value is 6.59% and unsoaked value is 8.95% is increased when compared with conventionally soil and soil with quarry dust.

**Index Terms:** CBR, Geo-textiles, MDD, Quarry dust, Red soil, Stabilization, soaked, unsoaked

## 1 INTRODUCTION

The objective of pavement design is to provide a structural and economical combination of materials to carry traffic in a given climate over the existing soil conditions for a specified time interval. In which subgrade is the lower most layer in the earth's surface which is the native material underneath a constructed road, Generally subgrade is compacted before laying a pavement as it is the lower layer and it should have the bearing capacity to sustain the entire pavement. A geo-textile is defined as a permeable geo-synthetic made of textile materials. The Geo-synthetics industry has expanded rapidly in recent years, and the number and types of geo-textiles manufactured with a specific focus in roadway design has increased dramatically. This increase has resulted in many new performance-enhancing and cost-saving design alternatives for roadways. The use of geo-textiles in pavement applications has addressed five main functions: separation, filtration, drainage, reinforcement, and mitigation of crack propagation. Depending on the type of geo-textile and its location within the pavement system, geo-textiles can perform one or more of these various functions simultaneously as part of an overarching application.

**Sahu et al.** have reported that concrete containing quarry dust as fine aggregate is promising greater strength, lower permeability and greater density which enable it to provide better resistance to freeze/thaw cycles and durability in adverse environment.

**Robert G.Carroll et al.** described about the use of geo-grids in landfill closures from the perspective of both cover soil stability and subsidence-induced liner support. Both applications have as their objective the avoidance, or at least the minimization, of tensile stresses in the geo-membrane.

Case histories regarding each application are provided. The important design consideration of long-term allowable strength of geo-grids is also addressed. Factors such as geo-grid creep, installation damage, chemical degradation, biological degradation and structural connections are discussed since all should be considered in arriving at proper allowable design strength.

**S. W. Perkins et al.** discussed about a constitutive model for geo-synthetics is presented that incorporates components describing direction-dependent elastic, plastic and time-dependent creep properties. The model is compared to a series of uni-axial tension tests performed on a biaxial geo-grid and a woven geo-textile. Tension tests to which model predictions are compared include fast and slow monotonic tension, constant load creep tests and two series of cyclic tension. The model is shown to offer reasonable predictions of in-air tensile load-strain properties commonly associated with geo-synthetic materials. In this paper determine the properties of soil and quarry dust. Evaluate the performances of quarry dust with Soil. Study the effects of stabilization on index and engineering properties of soil using two types of materials as admixtures and evaluate the performances of soil using woven geo-textiles.

## 2 MATERIAL STUDY

In this experiment we are evaluating the index properties of soil in which the materials used are an unmodified Red soil which is collected near Sanketika college, pmpalem. Quarry Dust which is collected from Gonnavanipalem quarry. It consists mainly of sand size particles (89%). Geo-textile of 200 GSM non-woven 1.6mm thick (+1-20%) and holding in position in the foundation trench in between the sand layers including over lapping of 100mm for every joint.

### 2.1 Tests on Materials

The following parameters are studied in experimental work

- Specific gravity of soil
- Grain size distribution of soil
- Compaction characteristics of soil
- California bearing ratio (CBR) of soil.

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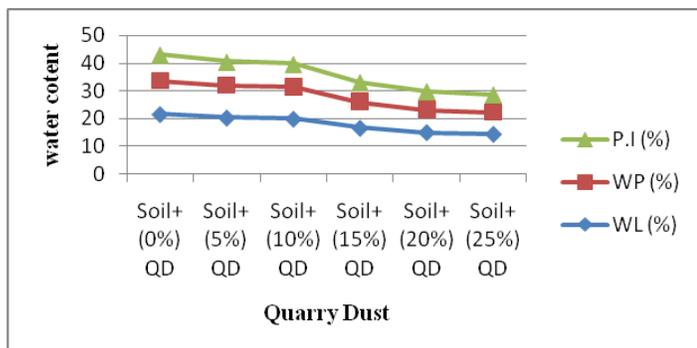
**Table 1: Properties of Unmodified Soil and Admixtures**

Properties	Soil	Quarry dust
Specific gravity	1.9	2.4
W <sub>L</sub> (%)	21.5	NP
W <sub>P</sub> (%)	12.01	NP
P.I (%)	9.49	NP
Gravel size particles (%)	2.82	1.78
Sand size particles (%)	22.62	89
Fines size particles (%)	71	5
ISCS	CI	SP
γ <sub>d</sub> (kN/m <sup>3</sup> )	18.94	26.5
W <sub>o</sub> (%)	18.3	10.6
S <sub>c</sub> (%)	1.74	-
U <sub>c</sub> (%)	2.8	-

**Atterberg's Limit**

**Table 2: Properties of unmodified soil and Admixtures**

Properties	Soil+ (0%) QD	Soil+ (5%) QD	Soil+ (10%) QD	Soil+ (15%) QD	Soil+ (20%) QD	Soil+ (25%) QD
W <sub>L</sub> (%)	21.5	20.2	19.8	16.5	14.89	14.29
W <sub>P</sub> (%)	12.01	11.82	11.62	9.56	8.25	8.01
P.I (%)	9.49	8.38	8.18	6.94	6.64	6.28

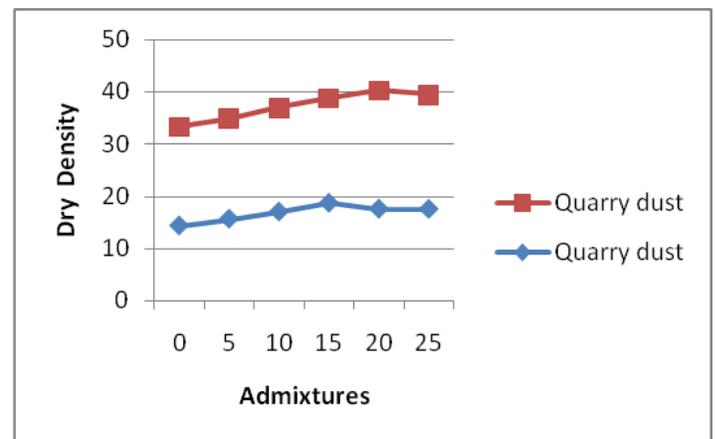


**Graph 1: Atterberg's Limits for Quarry Dust**

**Compaction Test**

**Table 3: Effect of percentage of Admixture on Compaction characteristics**

Admixture (%)	W <sub>o</sub> (%)	γ <sub>d</sub> (kN/m <sup>3</sup> )
	Quarry dust	Quarry dust
0	18.3	18.94
5	19.61	19.22
10	20.97	19.89
15	21.66	20.09
20	20.52	22.69
25	20.48	21.89

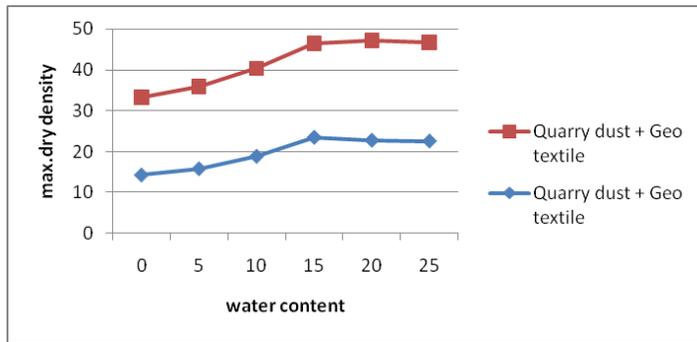


**Graph 2: Effect of percentage of Admixture on MDD**

**Compaction Test with Respect Quarry Dust and Geo-Textile**

**Table 4: Effect of Percentage of Admixture With Respect To Geo Textile on Compaction Characteristics**

Admixture (%)	W <sub>o</sub> (%)	γ <sub>d</sub> (kN/m <sup>3</sup> )
	Quarry dust + Geo textile	Quarry dust + Geo textile
0	18.3	18.94
5	19.84	20.05
10	20.89	21.47
15	23.56	22.92
20	22.84	24.37
25	22.65	24.09

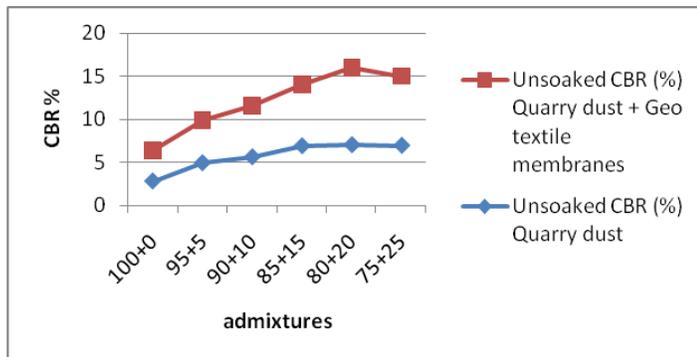


Graph 3: Effect of percentage of Admixture on OMC

CBR Test

Table 5: Effect of percentage of Admixtures on (Un-soaked) CBR

Soil+ (%)Admixture	Un-soaked CBR (%)	
	Quarry dust	Quarry dust + Geo-textile membranes
100+0	2.8	3.6
95+5	4.92	5.02
90+10	5.61	5.98
85+15	6.89	7.12
80+20	7.02	8.95
75+25	6.94	8.06



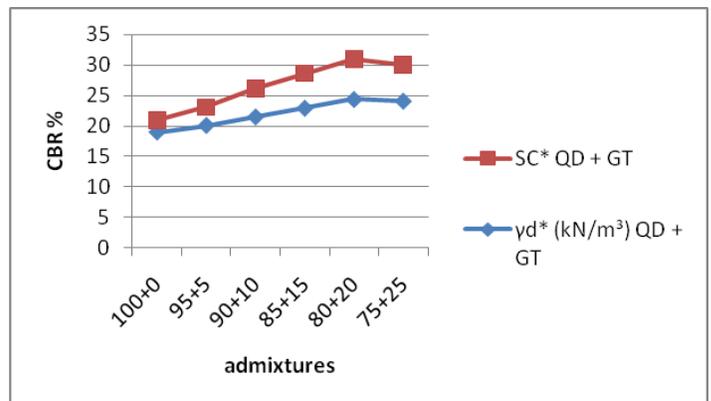
Graph 4: Variation of (Un-soaked) CBR value with different percentage of Admixtures

Effect of percentage of Admixtures on Dry density and CBR

Table 6: Effect of percentage of Admixtures on Dry density and CBR

Admixture (%)	$\gamma_d^*$ (kN/m <sup>3</sup> )	$S_c^*$
	QD + GT	QD + GT
100+0	18.94	1.91
95+5	20.05	2.97
90+10	21.47	4.59
85+15	22.92	5.68
80+20	24.37	6.59
75+25	24.09	5.89

Graph 5: Variation of (Soaked) CBR value with different percentage of Admixtures



4 Conclusion

Conclusions that are studied from the course of study include the following:

- i. The effect of all the admixtures on various properties is significant in general and of geo-textile in particular. Among two admixtures it is observed that workability of geo-textile membrane is better than quarry dust.
- ii. The Liquid limit of soil with quarry dust gradually decreases from 5% to 25% when compared with soil with zero percentage of quarry dust. The decrease in liquid limit is 1.3%, 1.7%, 5%, 6.61% and 7.21%.
- iii. The plastic limit of soil with quarry dust gradually decreases from 5% to 25% when compared with soil with zero percentage of quarry dust. The decrease in liquid limit is 0.89%, 0.39%, 2.45%, 3.76% and 4%.
- iv. The plasticity index of soil with quarry dust gradually decreases from 5% to 25% when compared with soil

- with zero percentage of quarry dust. The decrease in liquid limit is 1.04%, 1.25%, 2.55%, 2.85% and 3.21%.
- v. The water content of soil with quarry dust gradually decreases from 5% to 25% when compared with soil with increase in percentage of quarry dust. The optimum moisture content was attained at 15% with 21.66%. The decreases in water content with respect to OMC is 3.36%, 2.05%, 0.69%, till 15% and a gradual increase in water content with respect to OMC is 1.14% and 1.18%.
- vi. The dry density of soil with quarry dust gradually decreases from 5% to 25% when compared with soil with increase in percentage of quarry dust. The MDD is attained at 20%. The decrease in dry density with respect to MDD is 3.75%, 3.47%, 2.80%, 2.60% and 0.8%.
- vii. The void ratio of soil with quarry dust is gradually decreasing with a percentage of 5% to 25%. The decrease of void ratio of soil is 0.041%, 0.0876%, 0.1159%, 0.1762%, 0.0199%.
- viii. The un-soaked CBR value with a modified soil gradually decreases with addition of quarry dust from 5% to 25%, the decrease of CBR value from the graph is 4.22%, 2.1%, 1.41%, 0.13%.
- ix. The un-soaked CBR value with a modified soil gradually decreases with addition of quarry dust and geo-textile membranes from 5% to 25%, the decrease of CBR value from the graph is 5.35%, 3.93%, 2.97%, 1.83%.
- x. CBR studies were done and it was observed that both Soaked and Un-soaked has been improved with admixtures. However the improvement is more pronounced in soaked performance over Un-soaked. Soaked CBR value of Quarry dust stabilized soil is found to increase up to 20 % and there after the increase is nominal, hence the optimum in case of Quarry dust is found to be 20%.
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