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Effect of Gypsum and Polyester Fibers on Compaction and CBR Value of Fine Grained Soil

[1]Gaurav, [2]Gurdeepak Singh Kler & [3]Charanjeet Singh

[1] *Research Scholar, Guru Nanak Dev Engineering College, Ludhiana (India)*
[2] *Associate Professor, Guru Nanak Dev Engineering College, Ludhiana (India)*
[3] *Assistant Professor, Guru Nanak Dev Engineering College, Ludhiana (India)*

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ABSTRACT

In this paper we center around the improvement of designing properties of soil by utilizing polyester fiber and gypsum treating with the fine-grained soil. In this polyester fiber and gypsum mixing with the fine-grained soil to upgrade the designing properties. The point of the present examination is to decide the polyester fiber geo material as soil stabilizer. This investigation talks about the capability of fine-grained soil adjustment with polyester fiber and gypsum as admixture. The shifting rate 0.5%, 1%, 1.5% of polyester fiber and 2% ,4%,6% of gypsum was blended with fine grained soil. All the California bearing ratio Tests were directed at various blend creations of polyester fiber and gypsum with fine grained soil. The value of CBR increases with the increasing proportion of polyester fiber and gypsum, in this mixing the value increases up to 1% of polyester fiber after that the value start decreasing. The pavement is designed with the help of IRC 37:2012 which shows reduction in the thickness of pavement leads to cost effective approach.

1. Introduction

Soil is the slight layer of material cover the top surface of earth and is framed from the enduring of rocks. It is made up basically of living being's inorganic particles, natural materials, water, air and inorganic particles. Earth materials a regularly utilized as a development material since they are the least expensive conceivable structure material. Nonetheless, its building properties, for example, compressibility and quality are frequently normally poor, and their measures taken to quality, thickness, and strengthened soil.It gives information about the effects on soil behavior like swelling and shrinkage characteristics or permeability of soil when water mixed with it. At that point we get into the compressibility of soil, which is very significant engineering structure constructed on soil masses. It is helpful to design the foundation, slopes and retaining walls.Some similar results of various fibres on geotechnical propertied of soil were Kumar et al. (2007) studied the strength and compaction behavior of expansive soil using lime, fly ash and polyester fibre by conducting UCS, compaction test and split tensile strength test in laboratory. Naeini et al. (2008) studied the waste polymer's effect on shear strength of clays by performing direct shear test in the laboratory by varying fibre percentages as 1%, 2%, 3% and 4% respectively. Rao and Jayalekshmi (2010) studied the properties of sub grade soil to be used in flexible pavement using different percentages of polyester fibre and found out that with the inclusion of fibre reinforcement in the soil sub grade, the CBR value increased. Patel et al. (2011) used polyester fibre on high volume fly ash concrete and studied the change in its engineering properties and results showed increase in value of flexural strength for 14, 28 and 56 days. Kinjal et al. (2012) studied the properties of expansive soil using different percentages of polyester fibre. Maheshwari et al. (2013) studied the improvement in strength properties of clay by using polyester fibre by varying its percentages as 0.25%, 0.5%, 0.75%, 1% and 1.5% respectively. Changizi and Haddad (2014) studied the improvementin strength properties of clay soil with low liquid limit (CL) and high liquid limit (CH) by using recycled polyester fibre.

Tests conducted for fine grained soil mixed with gypsum and polyester fiber are Plastic Limit, liquid Limit, Maximum Dry Density, and OptimumMoisture Content and California Bearing Ratio. A comparison between properties of fine-grained soil, fine grained soil mixed with gypsum, fine grained soil mixed with gypsum and polyester fiber is performed. It is found that the properties of fine-grained soil mixed with gypsum and polyester fiber are suitably improved.

2. Methodology

2.1 Soil

As per Unified Soil Classification System, the soil used in this study was classified as clay of medium plastic (CI).The maximum dry density of soil was found to be 17.42kN/m^3. The soil used in this collected from Boparai village district Ludhiana.

Table 1 properties of virgin soil

S. No.	Characteristics of soil	value
1.	Liquid Limit (%) Plastic Limit (%) Plasticity index (%)	44 21 23
2.	Soil classification	CI
3.	OMC (%) MDD(kN/m^3)	16.1 17.42
4.	Soaked CBR (%)	2.76
5.	Specific gravity	2.55

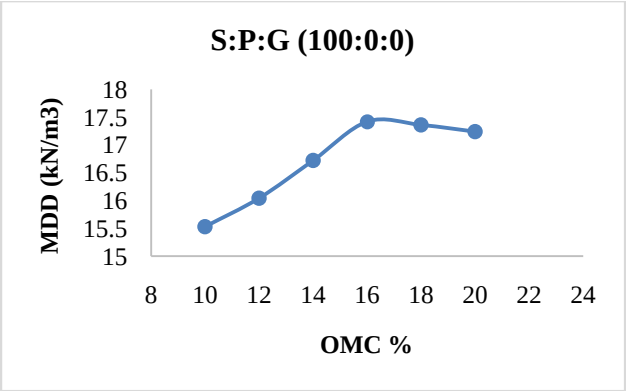

Figure:1 compaction curve of virgin soil

2.2 Polyester Fiber

Polyester fiber the geo-fiber used in study was bought from the Ludhiana market. Polyester strands are the fundamental engineered fiber utilized in the modern assembling part and can be found in a few territories of use. Polyester fibers are utilized in attire for jackets, coats, recreation and sportswear, defensive apparel, etc. In home decorations, their utilizations go from drapery and window ornament textures to furniture covers, cushions and pad stuffing, and table and bed cloth to divider and floor covers.

Table 2 properties of polyester fiber

Physical Property	Standards
Cut length(mm)	64
Linear mass density (Denier)	15
Diameter (microns)	46
Specific gravity	1.36
Colour	White

2.3 Gypsum

Gypsum (CaSO4 · 2H20), a hydrate of calcium, is sedimentary in nature. Gypsum is by and by utilized broadly in the development field. It is utilized as a mortar material, in wallboard, ceramics, throwing, figures, manures, and if uncalcined as a retarder in concrete. The assortment of gypsum known as alabaster has for quite some time been utilized for molding and for making vases, statues, and other decorative items.

Table 3 properties of gypsum

Sr. No	Properties	Gypsum
1	Physical State	white crystalline powder
2	Odor	Odorless
3	Melting Point	100(°C)
4	Density	2.3 (g/cc)
5	Specific Gravity	2.32
6	Water Solubility	0.24g/100mL@25°C

3. Testingprocedure

Total sixteen laboratory tests were conducted by changing different proportions as shown in Table 4.

Table-4 Mix proportions used

Sr. No.	Proportions (S:G:P)
1.	100:0:0
2.	98:2:0
3.	96:4:0
4.	94:6:0
5.	99.5:0:0.5
6.	99:0:1
7.	98.5:0:1.5
8.	97.5:2:0.5
9.	95.5:4:0.5
10.	93.5:6:0.5
11.	97:2:1
12.	95:4:1
13.	93:6:1
14.	96.5:2:1.5
15.	94.5:4:1.5
16.	92.5:6:1.5

4. Results and discussion

4.1 Compaction Characteristics:

The maximum dry density of clayey soil used in this study was 17.42kN/m3 with the optimum moisture content of 16.1%.

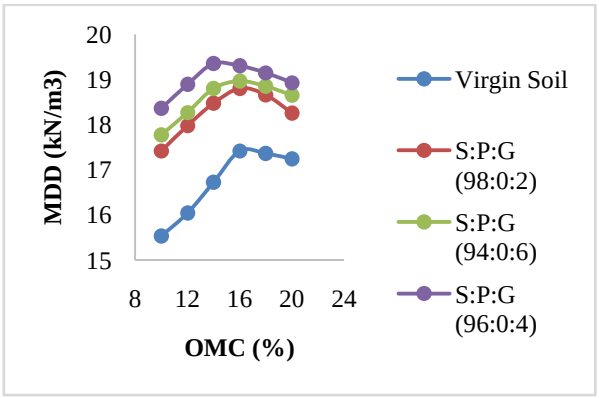

Figure:2 compaction curve of virgin soil and gypsum

When the degree of Gypsum is utilized as 2 %, 4%, 6 % thusly, as needs be an important OMC reduces and increment of MDD was represented. The expansion in MDD ranges from 17.42 to 19.3 and moderately the reduction in OMC is delineated in the scope of 16.1 to 14.6%. Reason for This increase in MDD was due to the hydration process between gypsum and water, and formed a gel which helped in binding the soil particles and therefore the strength increased.

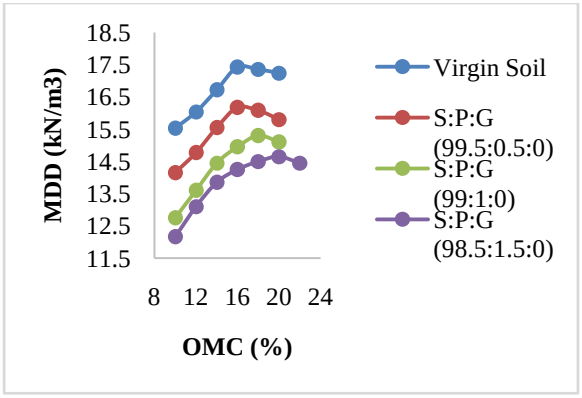

Figure: 3compaction curve of virgin soil and polyester fiber

When the degree of polyester fiber in is utilized as 0.5 %,1 %,1.5 % thusly, as needs be an imperative increment was shown in OMC and MDD reduces. The expansion in OMC ranges from 16.1 to 19.2% and the MDD was in scope of 17.42% to 14.65%. Reason for MDD decreases due to lower specific gravity of polyester as compared to soil. These fibers also don't let the soil particles to come near each other and hence the density decreases. The reason for increase in OMC is the water absorbing capacity of fibers which is greater as compared to soil particles.

An increase in OMC from 16.1% to 18.5% when the percentages of gypsum and polyester fiber used were 2, 4, 6% and 0.5, 1 and 1.5% respectively and also an increase in MDD from 17.42 kN/m3 to 19.65kN/m3 was observed when the percentages of gypsum and polyester fiber used were 2, 4, 6% and 0.5,1and 1.5% respectively. A decrease in MDD after 1% addition of fiber was observed in every mix proportion.

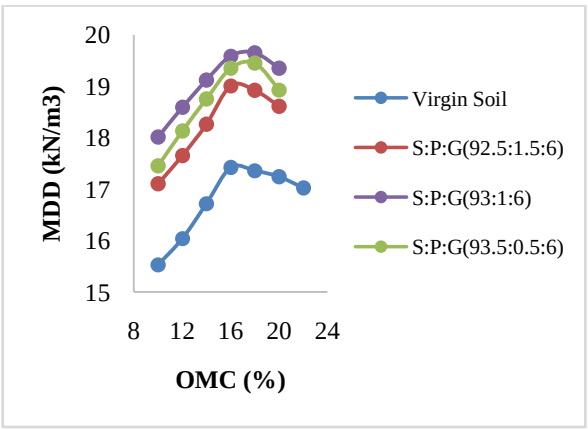

Figure: 4compaction curve of virgin soil, polyester fiber And gypsum

4.2 C.B.R Test

Inclusion of polyester in soil also resulted in the observation of rise in CBR value. The optimization occurs at the inclusion of 1 % polyester fiber. This increase in CBR value may be due to the enhancement in isotropic and homogenous properties of soil with the addition of fiber. This increase was found up to 1% fiber content, beyond which the CBR value decreased as it became difficult to mix the fiber. Initial Value of CBR in virgin soil was detected as 2.7% but with the inclusion of 1 % Polyester fiber and 6% gypsum to it. It rises from 2.7% to 11.0%.

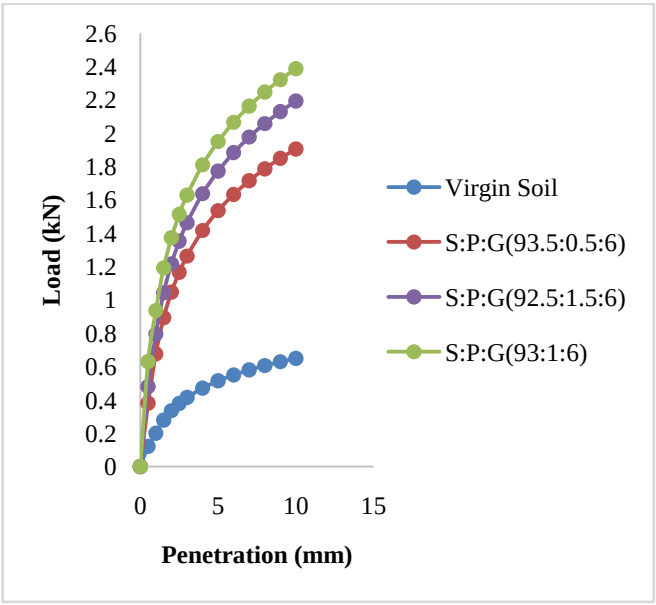

Figure: 5 CBR curve of virgin soil, polyester fiber and gypsum

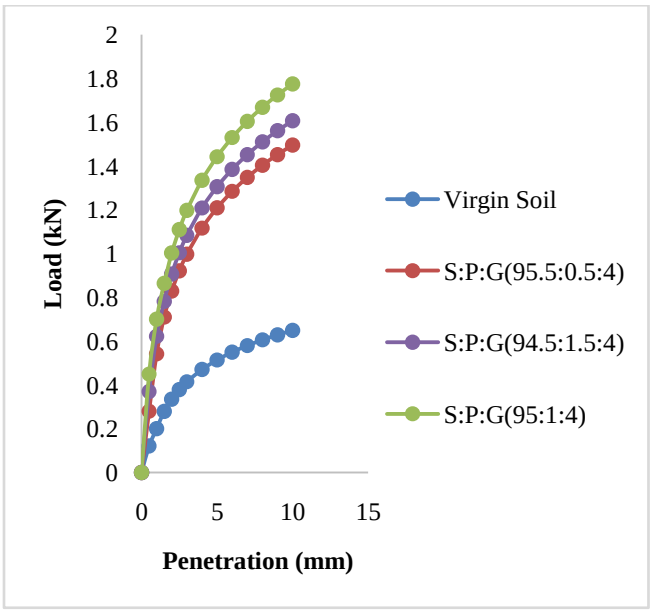

Figure: 6 CBR curve of virgin soil, polyester fiber and gypsum

5. Conclusion:

The Strength characteristic of Soil-Polyester-gypsum mix has been studied. The following conclusion can be made on the basis of test results obtained from gypsum mixed clayed soil:

- An increase in OMC from 16.1% to 18.5% when the percentages of gypsum and polyester fiber used were 2, 4, 6% and 0.5, 1 and 1.5% respectively and also an increase in MDD from 17.42 kN/m3 to 19.65kN/m3 .
- In the CBR test, when 1% of polyester fiber and 6% gypsum mixing with soil than the CBR value of soil increase from 2.7 % to 11.0 %.
- After addition of gypsum and polyester fiber in soil mixture, it increases the strength of soil which represent it good quality of road material.

- It is also significant decrease the thickness of pavement when using mixing of soil-polyester fiber-gypsum.

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