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Behaving Function of Built up Weak Grainy Soils by Artificial Fibers

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ABSTRACT

To investigate and measurement of different variables effects such as type of fibers, weight percent (ratio of yarn dry weight and soil dry weight) and length of fibers on loading improvement of reinforcement weak sandy soil (with random distribution), was used artificial yarn such as polypropylene in CBR experiment. Conclusion of indicator in these experiments is increase of shear strength of sand mix with random distribution in 13.8 percent of humidity. But in further humidity, behavior of reinforcement becomes different. Lengthening of fibers till 12 millimeters, increases the loading strength by changing the percent of fibers; while more lengthening, leads up to reduce strength.

Keywords: *Silty-sandy soil, Soil stabilization, polypropylene fibers, CBR.*

INTRODUCTION

Phenomenon of using fibers to raise the different behaving properties is an old idea. As ((Tongo and Phillips)) mentioned in ((New fibers)) book, human used fibers as strengthen element in soil 4000 years ago. Also fibers usage in China Wall in 2000 years ago shows that knowledge of textile engineers next to civil engineers since past were their helper to raise beneficial lifetime of different structures. In recent years, using of reinforcement soil by using different elements of reinforcing, especially Geo-synthetic materials are increasing and has a lot of usage in Geotechnics field. Fibers that produce in the forms of natural and artificial and by mixing with soil cause to increase the shear and tensile strength and modify their engineering properties.

One of these artificial fibers are carpet Trichet and geotextiles that correct using of them and correct excrete of them have special importance in environment point of view.

Strengthen of weak and inappropriate soil to use that in housetops, foundations, road pavement, dams and etc. to create soil configuration with desired engineering properties is named stabilization and reinforcing soil. Reinforcing soil with fibers include using fibers directly by random in a matrix like soil and in the other

hand include using fibers with specified formation, such as Geosynthetics family. Actually reinforcement soil is mixed material arising from combining and optimizing all materials properties that constituted it. Physical methods such as adding discrete elements by random distribution like using of artificial fibers, are approximately successfully methods in improving the function of soil. Also investigations show that properties of tension and strain of reinforcement soil's strength by random distribution of fibers are function of fibers rate, ratio of longitude and latitude and friction level of fibers along the soil and fibers and strength properties [2].

Done experiment studies on mixed with different fibers soils show noticeable results. In most cases, adding fibers to soil, is leading up to increase the strength of soil in different conditions [3]. Previous studies show that adding fibers increase the CBR of sand and reinforcement clay with polypropylene fibers significantly without any sign of breaking after experiment [4 – 6].

USED MATERIALS

Soil

Used soil in this research is a silty sand. This sample was provided from Segzy desert area located in northeast Isfahan.

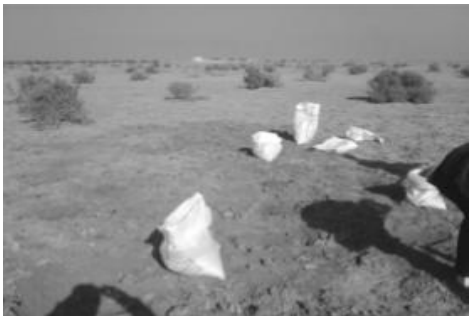

Figure1. *Excavation site (Segzi, Esfahan)*

Its grading curve (ASTM D422-87) is illustrated in figure (2). Average diameter of aggregates is 0.2 (D50) millimeters. In stabilization in Standard Proctor method ASTM D698-91, optimum humidity is equal to 13.8 percent and maximum dry special weight is 1.5 grams' cubic centimeters. According to ASTM D854-92 Standard, the density of soil's aggregate (G_s) was determined 2.699.

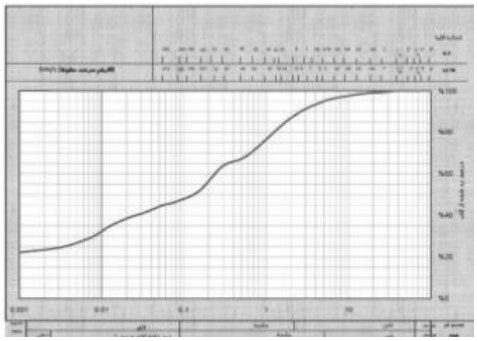

Figure2. *Sand gravel curve*

Table1. *Soil's characteristic of experiment*

Standard	Amount	Characteristics
AASHTO	(A-2-4)	Type of soil
ASTM-D2487	SM based on Unified Category	Category
	Silty sand	Kind of Ingredient
ASTM 854	2.669 Gram cube centimeters	Special aggregate density
ASTM-D4318	28.5%	Liquid limit
ASTM-D4318	21.79%	Plastic limit
ASTM-D4318	6.71%	Plastic indicator

Fibers

Used fibers to reinforce, fibers of polypropylene were equal to measure of 6 and 12 and 19 millimeters and weight percent of 0.05 and 0.1 and 0.15 and 0.25. Properties of mentioned fibers are presented in table (2).

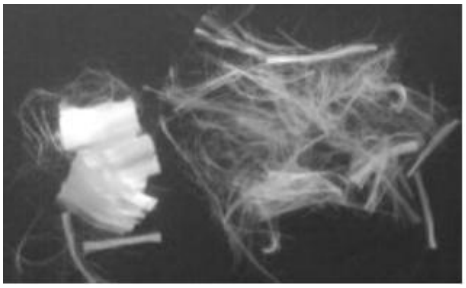

Figure3. *Polyprotein fibers consumed*

Table2. *Characteristics of used fibers*

Amount	Characteristics
White	Apparent color
Single	Type of fibers
1	Special weight(g/cm^3)
23	Diameter (micron)
400	Tensile strength (MPa)
160-165	Fusion limit(centigrade)
Low	Thermal conduction
Low	Electricity conduction
High	Strength against acids and sodas
High	Strength against salt

PREPARATION OF SAMPLES

To investigate of polypropylene fibers effects on silty-sand soil, totally 12 test were investigated that each test is repeated three times. Fibers were added to 5 kilograms' soil with required amount of optimum water by random. Then they were slammed in CBR formats in light compression in 3 layers and were investigated after 24 hours.

Figure4. *Sample preparation*

Figure5. *Mix the fibers randomly*

Figure6. *Insert samples under the CBR device*

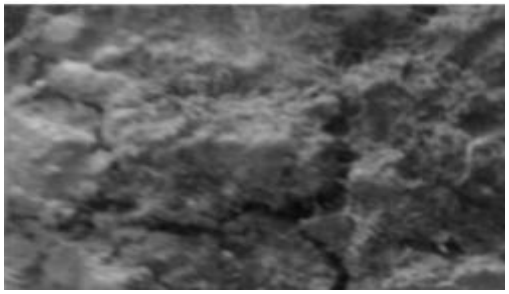

Figure7. *The surface of the gypsum reinforced surface view after loading*

PRESENTATION AND INTERPRETATION OF CONCLUSIONS

CBR experiment is done on sample and the conclusions are expressed in two following figures. In figure (8) is illustrated that by length of fibers and different percent, how amount of CBR change and in figure (9) optimum of each length is compared with each other.

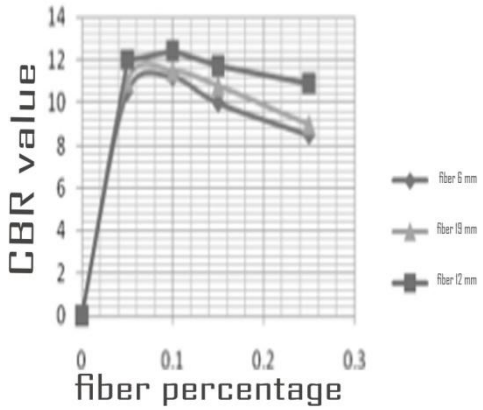

Figure8. *Changes in the amount of CBR with different fiber percentages*

As it's observed in above diagrams, with increasing the amount of fibers till 0.1 percent, amount of CBR is increased and after that is decreased. This order shows this content that in fibers by 12 millimeters of length, the best amount of CBR will be achieved.

CONCLUSION

The presented conclusions in this case of study can be summarized as follows:

Mechanical behavior of kind of reinforcement sandy soil with Polymeric fibers was studied by random method and is used to evaluate the behavior of tension. Conclusions show that soil's behavior affected desire by fibers presence by rate of CBR and finding optimum rate of fibers.

- According to obtained conclusions in this research, reinforced soil has less elasticity modulus than unreinforced soil and has ductility behavior. In the other words, unreinforced soil has behavior like crispy and fragile materials and its behavior become softer and more formable by adding fibers. This change in behavior can be inferred by decreasing firstly gradient of curves and increasing of strain in maximum tension point (rupture strain). It's clear that changing soil behavior from crispy state to ductile state, with increasing soil strength is an impressive advantage in changing behavior of reinforced soil.
- Soil's CBR 717 percent increasing with 12 millimeters fibers with optimum 0.1 weight percent that is very high for such a weak soil like this. Increase of soil loading till 0.1 weight percent of fibers and its reduction from its more rate.

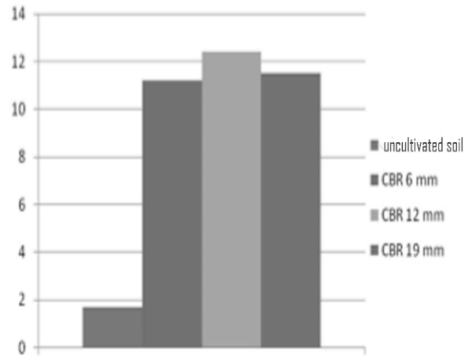

Figure9. *Compare CBR value in different sizes of fibers*

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