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EXTENDED ABSTRACT

Investigation of the Effect of Chips Orientation on the Shear Strength of Sand-Rubber Chips Mixture

Moslem Alikhani, Mohsen Asadi *

Faculty of Civil Engineering, University of Sirjan, Sirjan, Iran

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1. Introduction

Mixing the tire shred and tire chips, derived from scrape tires, to sand is an option to use scrape tires. Based on the ASTM (2017) there is no environmental risk for embankments made from tire derived aggregates. In the past three decades several experimental investigation have been reported on the sand-rubber chips mixture behavior (Edil et al., 1990; Zornberg et al., 2004; Neaz Sheikh et al., 2012).

Since the ration of area to thickness of chips is large, they tend to become horizontal when being mixed with the sand and subsequently would not be parallel to the probable failure surface of a foundation or a trench. This point has been investigated limitedly in the literature (Foose et al., 1996; Gotteland et al., 2005).

In the present paper, an innovative mold is used to compact the sand-rubber chips mixture where the chips are inclined. The experimental program was carried out to investigate the effect of rubber chips orientation in the sand-rubber chips mixture.

2. Material

The sand used in this study is prepared from firoozkooh mine with the mean diameter of 1.1mm. The rubber chips with the dimension of 40×80×5mm are derived by cutting a rubber roll.

3. Sample preparation and test conduction

The different rubber chips, RC, contents were 0, 20, 40, 60, 100 by volume of mixture. The sand and rubber chips are weighted to maintain the desired specific weight.

In order to maintain the chips orientation a new mold was built (Fig. (1-a)). The mold could stand with different angles with the horizon and is enough firm for compacting the mixture in. The mixture is compacted in three layer in the mold (Fig. (1-b)). After compaction the thin inner shell is pulled out from the outer one and the mixture is carried to be placed in the shear box (Fig. (1-c)). Then the normal stress is applied and after a negligible rate of settlement is achieved the shearing phase is initiated. The loading rate was selected as 4mm/min.

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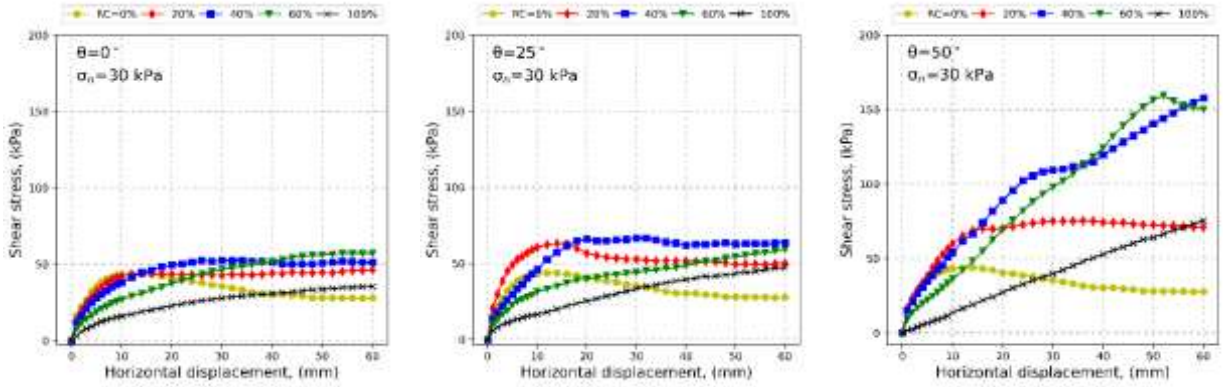
* Corresponding Author
E-mail addresses: alikhanym@ymail.com (Moslem Alikhani), m.asadi@sirjantech.ac.ir (Mohsen Asadi).

(a) (b) (c)

Fig. 1. a) The mold used for specimens preparation, b) compaction of the mixture in mold, c) direct shear machine



(a) (b) (c)

Fig. 2. Shear stress-displacement response of sand-rubber chips mixture for chips orientation of: a) zero degree, b) 25 degrees and, c) 50 degrees. θ is chips orientation.

4. Results and Conclusions

The shear stress versus horizontal displacement are shown in Fig. 2 for normal stress of 30kPa. The observation of stress-strain plots reveals that by increase in chips orientation, θ, the stress-strain shape changes from hyperbolic to linear; for larger θ an upward curvature is observe. The other main conclusions obtained from this research are as following:

1- The sample with 20% rubber chips exhibits initial stiffness equal to pure sand and for larger strains a higher shear strength rather than pure sand is observed.
2- For all θ, the sample with 60% rubber chips shows the highest shear strength at tested horizontal displacement range.
3- As well as the θ increases, the shear strength increases. This is attributed to the angle between shear plane and chips alignment leading to a reinforcing action of fibers. This founding has been also mentioned previously in the other mixtures of fiber and granulated material.
4- The chips orientation effectively improves the strength properties of sand. The results shows that this material can be used in retaining walls and landfills.

5. References

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