



## Investigation of the effect of Sizes Crumbed of worn Tires in shear strength parameters of Sandy soil

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**ABSTRACT:** Due to the spread of the automotive industry worn tires are being consider as one of Environmental pollutants in recent decades because of the lack of decomposition in nature. The use crumbed tires with mixed soil is provided as one of the solutions to prevent environmental hazards caused by tire burial. According to the tires properties, such as elastic behavior, low water absorption, and the appropriate cost to use it in the form of crushed, they can be used in arming and improving the properties of earth materials. In this article, the optimal percentage of crumbed tires in the sand to increase its shear strength parameters as well as the effects of adding crumbed tires on the Displacement-load curve by using a large-scale direct shear test (box 30×30 cm) has been studied. For this purpose, sand with percentages 5%,10%,15%,20% and25% of crumbed tires with dimensions of 2×2 and 2×4 under normal stress of 30,60 and 120 Kpa have been tested in direct shear test and amount of percentages and dimensions of optimal crumbed tires which the shear strength is maximum for it determined. Since the shear strength of soils is because of the angle of internal friction and viscosity, the effect of crumbed tires on each of these parameters is studied. The results show that the optimum condition is the sample with 15% of 2×4 crumbed tires that increase the angle of internal friction up to 27%. also adding crumbed tire cause to increase the capacity of sand plasticity.

### 1- Introduction

The development of cities and increasing number of new vehicles, also the phase-out of old cars caused that waste and old tires to be considered by researchers as one of the health and Environmental pollutants. The use of tires as one of the important elements of human life is increasing day by day. Overall soils reinforcement elements are placed into the soil in two ways:

Use of reinforcement which is continually placed in soil, like plate or strip reinforcement, which follows a particular rule and law to placed.

And other use of reinforcement that are widely placed in the soil, such as fibers and crumbed tires that are combined randomly and without a specific rule with the soil.

Research conducted to contribute to these two types of polymeric materials which have Acceptable strength and durability in soil. In addition, the crumbed tire is consumed in industries such as automotive parts, oil, and Tubes and rubber production, and shipping. [1]

Pamukuchu & Akbulute In 2006 to improve the soil dynamic parameters at low strain, on a mixture of Ottawa sand and crumbed tires, conducted a series of controlled tests. Their research results indicate a simultaneous increase in the shear modulus and damping coefficient of sand samples, for

an optimal volume of the crumbed tires. [2]

Hyodo And colleagues in 2007, according to undrained cyclic triaxial tests, and Uchimura and Hazarika according to Shaking table tests, reported a slower increase in pore water pressure and a significant increase in resistance to liquefaction of soil-tire mixtures with increasing amounts of tire. [3]

Edincliler et al, in the year 2010 did a series of consolidated drained triaxial tests on different percentages of tire pieces compounded with sand and concluded that The increase in the crumbed tire to sand will improves the drained behavior of the samples. [4]

Shahin et al, in 2011 did a number of consolidated drained triaxial tests, density, and porosity of the mixture of Sand and crumbed tire crumb. Results indicated that The mixture of soil and tires has a high potential to Use as a lightweight aggregate in civil works. [5]

Anastasio Anastasiadis et al, in 2012 did research on the mixture of river sand-recycled tires, by High range torsional resonance column device, in two ways dry and saturated. [6]

Manafi (1390) did a number of tests by Shaking a table on the mixture of sand and tire pieces that shows tire pieces caused improved dynamic properties of sand and reduce its liquefaction potential. [7]

Bahadori and Mohammadi (1391) to examine

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the effect of adding Tires powder on the saturated sand behavior, did undrained monotonic triaxial tests on the mixture with different amounts of tires. [8]

Saba et al (1395) using direct shear tests, the difference in shear strength of pure sand and gravel reinforced with granulated rubber worn out with weights 0 ,5% ,٪ 2/5 ,٪ 7/5%, and 10٪ pellets under three stress normal 30, 60 and 120 were examined. [9]

In this paper, the optimal percentage of Crumbed tire used to increase the shear strength parameters of sandy soil tried to be determined. For this purpose, large- scale direct shear tests (box 30x30cm) with different percentages of crumbed tire soils without crumbed tires are done. Results of the impact of different percentages of crumbed tires in sandy soil on shear strength and shear strength parameters of soil, and force-displacement behavior of soil with different percentages of crumbed tiress have been investigated separately and few suggestions are provided.

## 2. materials

The soil used in all tests was the sand from the beach of KELACHAY city which is located on the south shores of the khazar Sea. According to the density test on the mentioned sand sample, the maximum amount of specific weight of dry soil 16.4 and minimum specific weight of dry soil 14.8 are measured and Also specific soil mass is measured as  $G_s = 2.65$ .

According to the gradation curve, the Intended sand was almost uniform and are with particle sizes between 0.06 and 0.42mm. According to the Uniform classification System (ASTMD 2487-11) [13], tested sand is classified as soil with poor grading (SP).

Crumbed tire pieces were selected in 2 sizes (2× 2cm) and (2×4cm) which have been cut by scissors and it has a solid grain density of 1/25.

## 3. Results and Discussion

In different vertical stresses, with increasing the percentage of tire crumb in the mixture the amount of shear stress will increase. According to observations which have been done by adding (2×2cm)crumbed tire to the sand , shear stress of the mixture in the sample under the vertical stress of 30 kpa up to 45.7% , under vertical stress of 60 kpa up to 30.6% and under vertical stress of 120 kpa up to 28.4% will increase. Also by adding (2×4cm) crumbed tire to sand shear stress of mixture under vertical stress of 30 kpa up to 91.4% , under vertical stress of 60 kpa up to 52.8%, and under vertical stress of 120 kpa up to 54.5% will increase.

## 4. Conclusions

The criteria in this study, for selecting the appropriate percentage and dimensions of crumbed tires was to achieve the most appropriate shear strength. Since the shear strength of the mixture is depend on parameters of internal friction angle and cohesion, so the purpose of this study was to survey these parameters. Also due to the type of testing soil (sand), where in the sandy soil internal friction angle has more importance than cohesion, the main criteria for diction appropriate percentage of crumbed tire, would be the internal friction angle. The internal friction angle for the samples with

2x4 crumbed tire is more than samples with 2x2. The Reason for further increase for crumbed tires with sizes of 2x4 is the higher amount of effective length with more possibility of presence in the failure surface.

1- By increasing the weight percentage of crumbed tire from 5 to 25%, the internal friction angle in samples with 2×2 and 2×4 crumbed tire increased respectively in the range of 6/5% to 17/5% and 11/4% to 31/8% so that the maximum increase in internal friction angle, observed in samples with 25% crumbed tire. Also cohesion is increase from 2/2 kPa to 6/6 kPa and 10/1kPa respectively.

2. According to the results, can conclude that the shear strength of sandy soil is in direct relation with the increase weight percentage of crumbed tires and normal stress.

3. The optimum case is samples containing 15% of 2×4 crumbed tire that increase internal friction angle to 27%.

4. distinguishes of this paper from the other articles that presented about crumbed tires is the difference in sizes of used crumbed tires, that in this paper the purpose was to compare the effect of crumbed tires in two sizes of 2×2 and 2×4 in the soil of the Caspian seashore sand.

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