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Geotechnical Reuse of Shredded Scrap Tires to Reinforce the Karewa Soils of Kashmir

Sumira Farooq[1], and Er. Ashish Kumar[2]

[1] M. Tech Scholar, Department of Civil Engineering, RIMT University, Mandi Gobingarh, Punjab India
[2] Assistant Professor, Department of Civil Engineering, RIMT University, Mandi Gobingarh, Punjab India

Correspondence should be addressed to Sumira Farooq; sumairafarooq147@gmail.com

ABSTRACT- Wasted tyres have become a growing disposal problem throughout the world which is caused by increasing the number of vehicles on the roads. On the other hand, Karewa soils exhibit generally undesirable properties. They tend to have low strength, compressible, swell when wetted and shrink when dried. To overcome this problem, the present study is being conducted to investigate the effect of shredded scrap tires on the strength parameters of Karewa soils of Kashmir. In this thesis work, the shredded tire content taken is 0%, 2%, 4%, 6%, 8% and 10% by weight of soil and the size of shredded scrap tires taken is 10mm to 40mm in length and 10mm to 15mm in width. First the tests such as sieve analysis, specific gravity and Atterberg's limits of Karewa soil has performed. To assess the behaviour of Karewa soils reinforced with shredded tyres, Proctor compaction test, CBR test and UCS tests were conducted. Test results show that due to the addition of shredded tyres to Karewa soil, the CBR value of soil increases continuously with the addition of shred tyres while its peak value was founded at 8% of shred tyres. At 8% addition of shredded tyres, its CBR value increases by 173.44% as compared to un-reinforced soil. The proctor compaction test results show that with the addition of shred tyres to soil, its Optimum Moisture Content (OMC) increases while Maximum Dry Density (MDD) decreases continuously. The Unconfined Compression test (UCT) results shows that with the addition of shred tyres, the unconfined compression strength increases upto 8% shred content and then declined at 10% shred content. Thus 8% is the optimum shred content at which both CBR and UCS shows better results as compared to unreinforced soil. The results have shown both numerically and graphically in this thesis work.

KEYWORDS- Karewa soil, Tire shred size, Atterberg`s limits, OMC, MDD, CBR, UCT

I. INTRODUCTION

Soil is a broad word used in geotechnical design applications that recalls all the free stores of material for the world's exterior that are produced by enduring and disintegrating buried rocks. Soil is used in geotechnical design applications. The contact is continuous and maintains the soil in constant alteration despite the fact that surviving takes place over a geological scale. Structured soils have a broad range of characteristics because to the complex interplay of physical, chemical, and biological cycles. Plant and creature workouts induce crumbling of buried stone strata as a result of physical enduring. Synthetic enduring degrades rock minerals via the processes of oxidation, decrease, hydrolysis and carbonation. Geotechnical design is heavily influenced by soil, since every new construction depends on a solid foundation, which in turn relies on readily available soil on site. Geotechnical experts have found it unexpected on a few occasions to carry out construction on such locations where the soil strength is not adequate. So, in order to replace the already available soil, a sizable amount of money is required, making the enterprise unfeasible. For geo-specialized architects, soil support is their only option for a specialty. Soil support is a method for enhancing soil's strength and hardness. Many methods exist for constructing soil, including mixing readily accessible dirt with a variety of other materials to strengthen the readily available weak soil. One of the newest options discovered recently is soil constructed from discarded damaged tires. End-of-life tires have grown to be a significant problem. There are many countries having verified stockpiles that should be handled with to reduce the risk of fire and environmental concern from leachate in reserves, apart from the ongoing age of new end-of-life tires. Land filling is perhaps the simplest way to organize tires. Because of the large quantities and the fact that they are elastic and almost non-degradable, tires should never be dumped in landfills. This increases the risk of landfill fires. Ecologists in a number of countries have noted the growing problem of waste disposal, and legislation has been passed to encourage the use of alternatives to land filling. Tire shreds are expected to control a considerable amount of landfill storage space; thus scientists want to enlist the help of geotechnical experts in repurposing old tires. In many parts of the globe, including India, this technique is used. Unsolved issues with tires have been discussed within the United Nations Environmental Program (UNEP), leading to specific BMP regulations for waste tires (2002). Tire shreds as development material is one of the listed options in the specific regulations. The recycling of used tires has been around since the invention of elastic tires, when they were utilized as harbor guards, shoe bottoms, and playground swings for children in less developed countries. Other than using tire shreds or whole tires as development material and landfills, common large-scale waste disposal options include energy recovery, such as in the concrete industry, or burning. These possibilities will always be available as alternatives to other uses, but their burning capacity and transportation costs are limited.[6]

A. Shredded Tyres

End-of-life tires, mostly from passenger cars but sometimes from large vehicles, are shredded to make tire shreds. A shredder creates the discontinuity. Before being sent to measures of recovery or removal, tires are essentially destroyed to reduce their bulk. Coarse shreds are sieved and re-destroyed, reducing the size of the individual shreds. Tire shreds range in size from 100 to 300 millimetres in the first pass, and another 100 to 150 millimetres in the second pass, with the better ones being re-handled until the material reaches the optimum sifter size. The end result is steel rope-protruding circle-moulded tire shreds. Fig. 1 shows a more moderate tire shred with significant steel thread protruding from it, in contrast to the coarser pieces.

Figure 1: Different sizes of tyre shreds

For at least the last two decades, tire shreds have been used in structural design and development projects. Additional than the entrance of iron, manganese, and zinc, and the limited introduction of natural mixes such phenol and PAH chemicals via filtration, no other natural effects have been seen during this period. Due to the elastic material's vulcanization interaction, which effectively binds the natural mixes together and delays delivery viably, this poor delivery is the result. Because of the slow delivery, both biological and synthetic corruption are able to undermine the intended effect. Iron hydroxides, for example, are used to balance out metals in tire shred leachate, which reduces metal delivery to a base. The age of discarded tires is constantly increasing all around the world. Growing waste tire volumes have sparked an interest in finding improved methods for recycling them. [2]

Figure 2: Destroyed tyre shreds

The disintegration of elastic tires is not a problem-free process. Despite the fact that it hinders things in the natural world, this characteristic may be useful in the design world for certain materials. In order to minimize environmental impact while increasing the maintenance of normal assets, the usage of waste tires should be limited. To tell the truth, engineers studying the characteristics of soil-shred mixes came to the conclusion that it might be used in a wide range of design projects. When tires are shredded, they may be utilized as a low-cost, high-performance lightweight geometries with better engineering characteristics than just using soils alone. To find out how damaged waste tires (or more specifically, shreds) affect the strength and conductivity of locally accessible soils, the study's objective is to examine the effects stated above. Waste tires that have been chopped into bits between 10 and 50 mm in size are used to make tire shreds. Vibration dampening qualities are excellent and the material is efficiently compressed despite its small weight. Sand, rock, and lightweight material substitutes have been found in them. Lightweight, low pressing factor, low warm conductivity, and free depleting are just a few of the advantages they provide when used as a fill material. Because of these advantages, they've been put to use on more than a hundred different roadway improvement projects. When used for highway purposes, the anticipated effect on groundwater quality is small. Since tire shreds are non-biodegradable and therefore more durable, using them as a lightweight fill in bank or holding partition has many benefits.[3] It's also less expensive than other types of lightweight material.

Approximately 40 to 60 million waste tyres are now stored in various places throughout the globe, with an estimated 2 to 5 billion tyres already in storage across the country. Tyre piles pose a public health and environmental concern all around the globe. The recycling of discarded tyres, for example, has been extensively studied as an alternative to land filling and stockpiling

Figure 3: Large Stockpiles of Waste Tyres

Geo-engineering techniques such as soil reinforcement are used to increase the stiffness and strength of the soil. Constructing structures such as buildings and other structural designs on weak or fragile soil is very dangerous since such soil is highly compressible and susceptible to differential settlements. The geotechnical engineering profession has a significant difficulty when building on soft ground. Different techniques of soil enhancement have been used to improve the design characteristics of soil. Because of its affordability, simplicity, and repeatability, soil support by fiber material, polymers, and other admixtures is seen as an effective ground improvement method. As a result, the support material for the present study is damaged tires. With this investigation, we want to learn more about the soil's ability to sustain heavy loads when loaded with various types of trash. Shear resistance to displacement increases as shred content and size increase in both strength and ductility.[5]

II. LITERATURE REVIEW

- Reddy and Krishna (2015) showed that the holding divider inlayed with sand-tire total combinations reduced the even removals and sidelong earth pushing factors by about 50-60 percent compared to the holding divider with granular soil refill.
- Yasuhara (2007) informs about late Japanese experiences with geotechnical uses of rejected tire. Tire shreds and chips may be divided into two categories: those that are mixed with soil and those that are not. Non-concrete treated tire chips are anticipated to reduce liquefaction potential during earthquakes by being mixed with soil that has been treated with concrete with high pliability and strength.
- Youwai and Bergado (2003): also considered damaged elastic tire-sand blend strength and deformity characteristics and discovered that when sand extent grew, thickness, unit weight, and shear strength also expanded; nevertheless the compressibility decreased with the sand extent.
- Zornberg (2002) is advocating the use of a distinct system that handles soil and filament commitments separately. Fiber support shear strength for various soil kinds, fibre perspective proportions and fibre substance were exactly predicted by the suggested structure.
- Lee et al. (1999) The effect of altering limiting pressing variables has been studied using triaxial testing with pure tire shreds and tire shred – sand mixes. The experimental procedure made use of tire shredders without steel belts. There was a roughly straight pressure strain response for all binding pressing variables for unadulterated tire shred instances, and the reaction between unadulterated tire shreds and unadulterated sand examples was in the center.[7]
- Tatlisoz et al. (1998) analyzed the geosynthetic support and fill material cooperation coefficients, which were tire chips, sand, and elastic sand combinations. Communication coefficients greater than 1.0 indicate that the fill and geosynthetic support have a strong relationship, which is often the case when obstructions such as strike-through and restricted dilatancy are present in the soil. Controlled dilation leads to more notable degradation due to greater usual anxiety whereas strikethrough increases pulloutlimit through rib bearing.
- Bernal et al. (1997) the coordination coefficients between the geogrid support and the fill material were determined via pullout testing on three different types of adaptable geogridsAs fill materials, only pure damaged tires and elastic sand mixes were used. It was apparent based on test results that soil and geogrid cooperation coefficients were lower than basic ones between damaged tire fill and geogrid.
- Ahmed (1993) conducted triaxial experiments on various mix proportions of tire shred-soil blends (tire shred size = 25 mm). For the best shear strength values at low to medium limiting loads, a tire shred-soil combination ratio of 40:60 by dry weight (65:35 by volume) was used. Although the percentage of tire shreds to soil that provides the highest shear strength varies depending on the size of the shreds, the combination proportion referred to above may be used as a sort of perspective in determining the tire shred-soil blend proportion used in the construction of banks.[1]
- Benson and Khire (1994) the shear strength of sand and HDPE strips with different length to width ratios (viewpoint proportions) was evaluated by using a large scope of direct shear tests. They hypothesized that adding HDPE strips will increase the composite's peak shear strength and residual shear strength.[4]
- Dark and Al-Refeai (1986) experiments on dry sand using randomly allocated discrete strands and permanent texture layers for triaxial pressure. They discovered that as the fiber concentration increased, so did the peak shear strength.
- Bressette (1984), Autonomous directed triaxial testing on tire chips. From 2mm to 38mm, the materials were tested. Except for Wu et al. (1997), who directed pressure dumping experiments, all tests were led in a pressure stacking mode. All pressure stacking experiments revealed a consistent pressure strain response. The results of these tests varied widely due to the wide range of binding pressing factors and the difference in testing method (pressure stacking vs. dumping). A six-degree increase in erosion and an eight-kPa increase in attachment-catch shift take place simultaneously.
- Dim and Ohashi (1983) sand supported by typical and designed strands were subjected to direct shear testing. Fiber support increased pinnacle shear strength and reduced post-top shear strength loss, according to the study's findings.

III. MATERIALS AND METHODOLOGY

A. General

Soil and shredded tyres are mainly utilized in this thesis project. The soil was obtained from the Kashmiri village of PULWAMA. This soil is a special type of soil in Kashmir known as Karewa soil. The sample was taken after the top 0.5m of the ground surface was removed. A soil sample of 10 kg was collected and dried for 24 hours following collection. In order to remove organic materials and stones from the dried product, an IS Sieve was used to sieve it. The shredded tyres weighing 10 kg were bought from Srinagar at a cost of Rs. 10 per kilogram.

B. Soil

Rock or mineral particles, water, and air all combine to make soil. The characteristics of soil differ from one region to the next depending on these components. In addition, different types of soils react differently to development activities. Construction plans and prices are affected by the kind of soil used for a construction site. As a result, looking at the soil helps determine whether or not further work is required to prepare the land for development. To ensure a stable growth, unusual soil types require many institutions. The establishment of the structure will require the development of containing dividers for sandy soils, in order to make sure that the sand remains in place; however, dirt sand will necessitate additional materials because the mud will either expand or evade, depending on how much water is present in the establishment. This will result in dividers breaking and the development building needing to be established.

C. Work Carried Out

Dry Sieve Analysis: Different-sized particles in varied numbers compose soil.Table 1 Shows Sieve analysis of soil The distribution of particle sizes and shapes in a soil affects the engineering characteristics of the soil. According to IS2720 Part 4, grain size analysis is performed by passing soil through a series of sieves stacked one on top of the other. Particle size distribution curves are used to depict it visually. Fig. 4: sHOWS Grain size distribution curve of Karewa soil

Table 1: Sieve analysis of soil

IS Sieve No.	Wt. Retained (g)	Cumulative Weight Retained (g)	Percent (%) Weight Retained (g)	Percent (%) Weight Passing or Percent Finer
4.75 mm	0	0	0	100
2.00 mm	1.30	1.3	0.086	99.91
1.00 mm	1.89	3.19	0.213	99.78
425 µ	2.50	5.69	0.379	99.62
212 µ	4.32	10.01	0.667	99.33
150 µ	10.76	20.77	1.384	98.61
75 µ	32.19	52.96	3.531	96.46

Total sample taken = 1500 gm
Gravel = 0 %
Coarse fraction = 3.53 %
Fine fraction = 96.47 %
Silt + Clay = 96.47 %

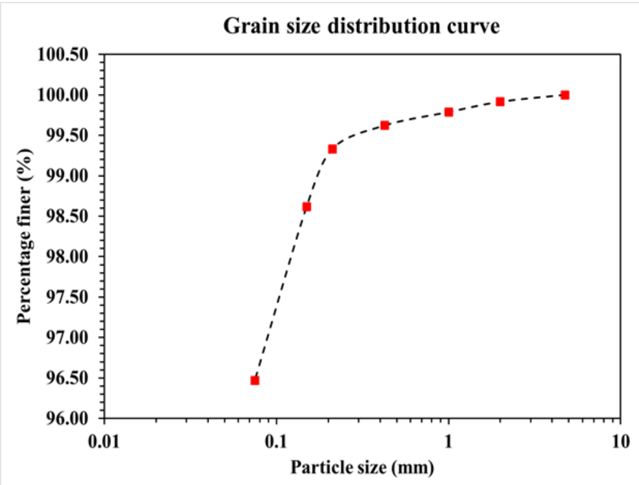

Figure 4: Grain size distribution curve of Karewa soil

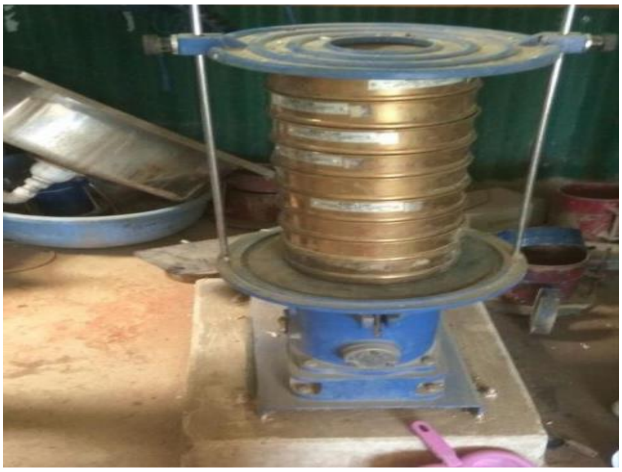

Figure 5: Mechanical sieve shaker

D. Liquid Limit

It is the soil's water substance in the transitional stage between the fluid and plastic states.Table 2Shows Liquid limit of soil

It's sometimes referred to as the water content at which soil has minimal shearing power against streaming, even when it's in a fluid condition. In accordance with IS2720 PART 5, the Casagrande's equipment in the laboratory estimates it to be true. Fig. 6 Shows Liquid limit of soil

Table 2: Liquid limit of soil

Trail No.	1	2	3	4
Weight of container (g)	25.93	20.97	21.65	20.42
Weight of container +Wet soil (g)	40.70	33.94	33.66	50.37
Weight of container +Dry soil (g)	36.43	30.3	30.35	43.78
W=Ww x 100/Ws	40.66	39.01	38.05	28.21
Number of blows	14	19	26	37

Liquid Limit =36 %

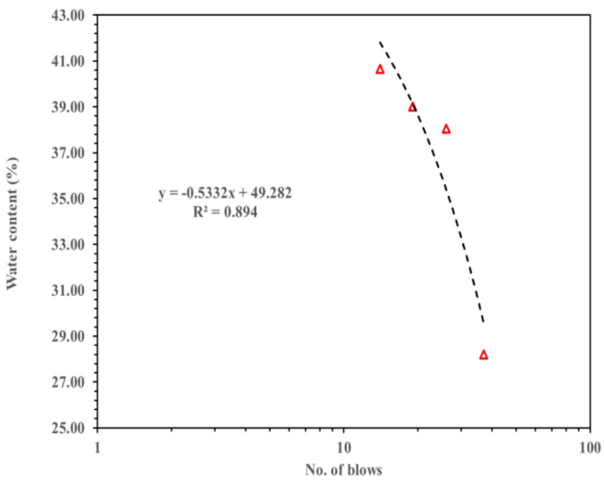

Figure 6: Liquid limit of soil

E. Plastic Limit

Table 3: Plastic limit

Trail No	1	2	3
Weight of container (g)	18.42	19.53	20.11
Weight of container + Wet soil (g)	50.95	43.12	42.08
Weight of container + Dry soil (g)	44.79	38.62	37.92
W=Ww x 100/Ws	23.36	23.57	23.35

Plastic Limit = (23.36+23.57+23.35)/3 = 23.43%
Thus as, liquid limit=36%
Plastic limit=23.43%
Therefore, Plasticity Index=12.57%, i.e., the soil is of medium plastic.
Also, the equation of A line is Ip=0.73(Liquid Limit-20) = 0.73(36-20) =11.68
As liquid limit is greater than 35%, thus from the plasticity chart it can be concluded that the Karewa soil used is CI.Table 3 Shows Plastic limit
Specific Gravity: The substance's specific gravity tells us when it's heavier than water. IS 2720 PART 2 specifies the density bottle technique for determining soil specific gravity. Table 4 shows Specific gravity of dredged soil

Table 4: Specific gravity of dredged soil

Weight of empty bottle + lid, W1	36
Weight of bottle + lid + soil, W2	46
Weight of bottle + lid + soil + water, W3	94.30
Weight of bottle + lid + water, W4	87.94
Specific gravity G=(W2-W1)/[(W2-W1) - (W3-W4)]	2.74

F. Properties of Karewa soil

Table 5 shows Properties of Karewa soil

Table 5: Properties of Karewa soil

S. No.	Properties of soil	value
01	Liquid Limit	36%
02	Plastic Limit	23.43%
03	Plasticity Index	12.57%
04	Plasticity Index (A Line)	11.68%
05	Specific Gravity	2.74
06	OMC	20.69%
07	MDD	1.81 g/cc
08	Soil Type (Plasticity Chart)	CI

IV. EXPERIMENTAL PROGRAM

A. General

Various laboratory tests have been performed on all samples, and their findings have been tabulated, after the production of all samples of local soil with shredded tyres at various percentages. The following tests were run:

- CBR test
- Compaction test
- Unconfined compression test.

B. Meaning of C.B.R.

For a typical round cylinder to move at a speed of 1.25 mm/min through soil, it takes 1.25 times as much power per unit area as a normal material does.Table 6 shows Standard values for CBR

C.B.R. = Test load / Standard load

Table 6: Standard values for CBR

Penetration of Plunger (mm)	Standard Load (kg)
2.5	1370
5.0	2055
7.5	2630
10.0	3180
12.5	3600

With a C.B.R. of 100 percent, the following table shows the standard burdens received for different entries to the standard material.

C. Preparation of Test Specimen

1) Undisturbed specimen

Make a connection between the foreground and the shape, then gently press it into the soil. Remove the dirt from the pushed-in form's exterior viewpoint. When the form is overflowing with soil, don't use the form or any other field method near the area to gauge the soil.

2) Remoulded Sample

Using Proctor's most extreme dry thickness or another thickness where C.B.R> is needed, set up the remolded example for testing. The example may be continued at a desired wetness content or at a certain field dampness level. A 20-mm I.S. screen should be used, however the material used should be retained on a 4.75-mm I.S. strainer. Using either powerful or static compaction, create an example. The remolded sample should be set up at Proctor's maximum dry thickness or at a thickness where C.B.R> is needed. Continue the example at the optimum content of wetness or the dampness of the field as necessary. Ideally, the material used should pass through an i.s. sifter of 20 mm, but it should be retained on an i.s. sifter of 4.75 mm to prevent splintering. Using either unique compaction or static compaction, set up an example.

3) Dynamic Compaction

Take approximately 4.5 to 5.5 kg of dirt and mix it with the required amount of water in a blender until well-blended. Assemble the augmentation collar and base plate and make sure they are in place. Place the spacer circle on top of the foundation. Locate the channel paper on the spacer circle's highest point and adhere it there. Light compaction or considerable compaction may be used to reduce the soil mix size. Light compaction was achieved by layering the soil in three equal levels and running the 2.6 kg rammer 55 times through each layer. The 4.89 kg rammer was used to compress the soil in five levels, with 56 strikes on each layer. Trim the dirt and remove the collar. Remove the base plate and the displacer circle by flipping the design over. Determine the mass and dry thickness of the soil by measuring the shape's contours with compacted dirt. Brace the perforated base plate on channel paper and place it on the topmost point of the compacted soil (the collar side).

4) *Static compaction*

Decide on the appropriate thickness while including the typical example volume in the articulation's form by measuring the soil's heaviness when it's moist.
W is the required dry thickness, which is equal to 1 plus w.
W is the soil's weight when it's moist, thus
w denotes the desired water concentration.
V is the example's volume in cubic meters, which is equal to 2250 cm3 (according to the form accessible in lab). Use a spotter to locate the mix soil's weight W (as previously calculated) in the form. A channel paper and a soil displacer circle should be placed at the top of the soil's elevation. So as to keep the form together, use a static stacking edge and decrease it using a displacer plate squeezed to its maximum extent. Keep the pile for a time and then dispose of it. Remove the displacer circle from the equation. Both sprayed and unsoaked circumstances may be used in the test. Put a piece of channel paper on the dirt's highest point, and then place the moveable stem and perforated plate there. Increase the weight of the base material and asphalt with annular loads to produce a new charge. Every 7 cm of growth is equal to 2.5 kg of weight. There should be a minimum of two loads placed. Douse for 96 hours the shape collection and loads in water. Remove the form from the tank and dispose of it. The example's union is something to be aware of.

5) *Penetration-Testing System*

Look for the infiltration test machine's form collection with the additional charge loads. Place the infiltration cylinder in the centre of the model with the least amount of weight possible, but no more than 4 kg so that the cylinder has complete contact with the model. Check to see whether the anxiety dial is set to zero. The heap should be applied to the cylinder such that the ingress rate is about 1.25 mm/min. Make a tally of how much material is entering the pile at each of the following intervals: 0, 5, 10, 15, 20, 25, 30, 40, and 50 mm. The highest load and infiltration will be seen for an entry smaller than 12.5 mm in diameter. Separate the form from the accumulating components by enclosing it. Determine the amount of moisture in a sample of soil by taking 20 to 50 g from the top 3 cm of the soil pile. For infiltrations of 2.5 mm and 5 mm, the C.B.R. values are usually calculated Since 2.5 mm is more common than 5 mm, the previous will be used as the C.B.R. for configuration purposes. C.B.R. esteem at 2.5 mm is more common than 5 mm. It is necessary to repeat the test if the C.B.R. for 5 mm exceeds that for 2.5 mm. If the results are same, the C.B.R. for a 5 mm infiltration should be used as a guide. Fig. 7: Shows CBR in soaked condition

Figure 7: CBR in soaked condition

The specimens of unconfined compressive strength test were also prepared using a similar procedure.

V. RESULTS

A. *Compaction Test Results*

Using conventional proctor tests, the OMC and MDD were calculated for soil mixes with varying moisture contents. To ensure the accuracy of the results, they were run according to Indian Standards. Maximum and lowest dry densities of soil with mixes were established via vibratory testing by changing shred content from 0% to 10% in 5 increments of 2%. Indian Standards (IS: 2720 Part 14 – 1983) were used to conduct the testing.Table 7 Shows Values of OMC & MDD of soil with shred tyres

Table 7: Values of OMC & MDD of soil with shred tyres

Percentage of shred tyres in soil	OMC (%)	MDD (gm/cc)
0	20.69	1.81
2	20.93	1.75
4	21.14	1.72
6	21.35	1.68
8	21.62	1.65
10	21.86	1.63

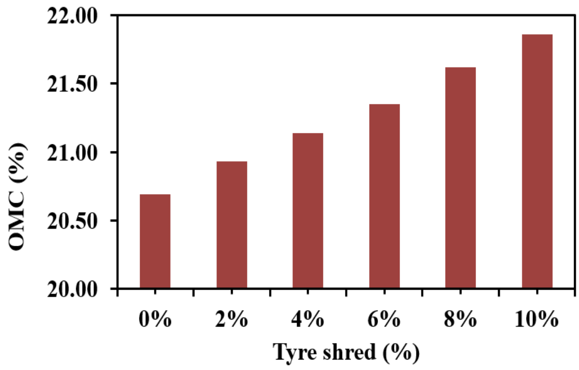

Figure 8 Shows Variation of OMC of soil with shred tires

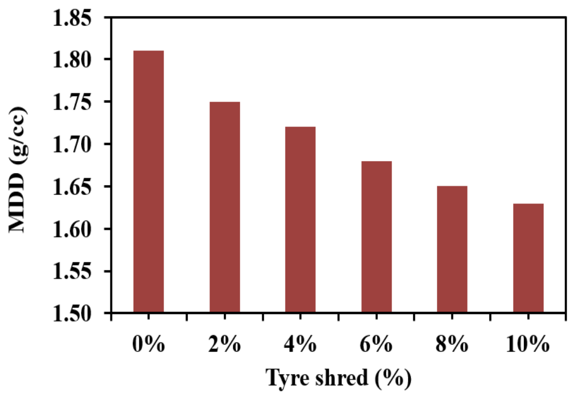

Figure 9: Variation of MDD with shred tyres

B. CBR Test Results

As shown in Fig. 10, the load versus penetration curve was produced under the soaked condition when the CBR test was conducted without any reinforcement of the shred tyre composition (unstabilized). The CBR was found to be 2.41 percent at a penetration depth of 2.5 mm. At an 8 percent rubber tyre shred content, the highest CBR value was achieved for 2.5 mm penetration, and the CBR was 6.59 percent. The CBR value drops to 5.90 percent as the proportion of shredded tyres rises. Table 8 Shows CBR values of soil reinforced with shred tyres. Fig. 10 Shows Variation of CBR values of soil reinforced with shred tyres

Table 8: CBR values of soil reinforced with shred tyres

S. No.	Shred tyres (%)	CBR value (%)
01	0	2.41
02	2	4.37
03	4	5.01
04	6	5.81
05	8	6.59
06	10	5.90

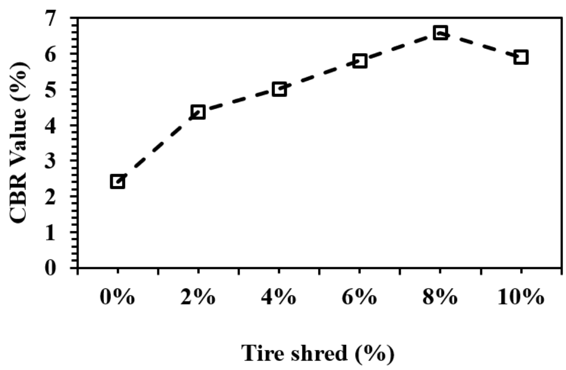

Figure 10: Variation of CBR values of soil reinforced with shred tyres

C. Unconfined Compression Test Results

Table 9 Shows Unconfined compression test results and Fig. 11 Shows Variation of CBR values of soil reinforced with shred tyres

Table 9: Unconfined compression test results

S. No.	Tire Shred Content (%)	UCS (kPa)
01	0	126.3
02	2	159.4
03	4	184.7
04	6	217.8
05	8	242.6
06	10	176.6

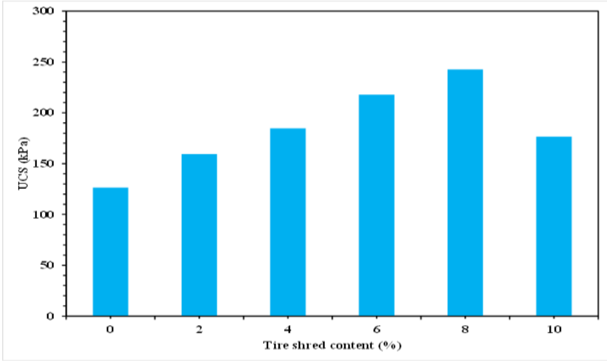

Figure 11: Variation of CBR values of soil reinforced with shred tyres

VI. CONCLUSIONS

The following findings have been reached after analysing the results of all soil tests reinforced with shred tyres:

- Compaction experiments have shown that adding shred tyres constantly raises the optimal moisture level of the soil. The OMC increases 1.15%, 2.17%, 3.19%, 4.49% and 5.65% respectively on addition of 2%-10% shredded tire content. This is because tire shreds have some water absorption capacity. This means that soils are still workable and un-sticky and can be compacted well even for water contents higher than OMC of untreated soils.
- Compaction studies have shown that adding shred tyres reduces the soil's maximum dry density, this is because tire shreds are low in weight i.e., having low specific gravity as compared to parent soil. Decrease in MDD will prove beneficial in soil retaining structures because of reduced lateral pressure and light weight precast units made of Karewa soils.
- According to CBR Test findings, the CBR value of soil rises continuously up to 8% when shred tyres are added to it. The CBR value of soil rises by 173.44 % when it contains 8 % shred as compared to parent soil, thus lowers the thickness requirement of pavements which leads to economy, development, time saving etc.
- Up to an increase of 8% in shred content, the unconfined compression strength rises, and then begins to decline at 10% shred content. The inclusion of 8% tire shred resulted in the highest value of 242.6 kPa.
- 8% is an optimal shred content level at which both CBR and UCS tests perform best.
- Thus, rubber tire shreds can be utilized in improving the properties of Karewa soils of Kashmir and thereby minimising their impact on environment.

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