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To Study the Effect on Concrete Strength by Adding Waste Rubber Material from Worn Out Tires

Muhammad Aleem[1]*, Naeem Ejaz[2], Nasir Sadiq Janjua[3], Tanveer Gill[4]
Muhammad Yasir Sadiq[5]

[1*] *Department of Civil Engineering, National University of Modern Language Rawalpindi Pakistan,* E-mail address: engrm.aleem@gamail.com,
[2,3,4] *Department of Civil and Environmental Engineering University of Engineering and Technology Taxila Pakistan,* E-mail address: naeem@uettaxila.edu.pk, naeem@uettaxila.edu.pk, nasirsadiqjanjua@gmail.com, tanveergill495@gmail.com
[5] *Department of Civil and Environmental Engineering East Carolina University the US*
E-mail address: yasirsadiquol@gmail.com

Abstract: This paper introduces a study of concrete structures with a broken tire and a flat tire as a complete overhaul. The materials used to make concrete in this study are solid aggregate, cement, sand, flat tire, broken wheel, drinking water, and Ordinary Portland Cement. A total of 6 main compounds were thrown into solid cylinders and replaced by 0% as a controller followed by 5% and 10%. The cylinder pressure test of the concrete is done by applying the same pressure to the cylinders until a failure occurs. The results of the pressure test show that by applying 5% aggregation the pressure decreases. In Crumb wheel joints, the compression force decreases constantly as the percentage change increases. Therefore, the crumb wheel is not recommended for use as a complete replacement due to its compressive church power.

Keywords: mechanical strength, cracked tire, crumb tire, pressure tests, concrete, aggregates

1. INTRODUCTION

Over the years, tire disposal has become one of the biggest problems in the area, and landfills are becoming increasingly unacceptable due to the rapid depletion of available landfills. These reservoirs are not only a threat to potential natural hazards but also to fire hazards and provide mosquito breeding grounds. Used tires need to be repaired before settling. New solutions to address the challenge of tire disposal have long been developed, with options promising the use of rubber wheels on compound compounds, the burning of worn-out tires to produce electricity or steam, and the re-use of low tires. rubber by number. of plastic and rubber products. (Tarun R. Naik et al, 2002) [2].

In addition, discarded tires can also be used as fuel for cement furnaces, as carbon dioxide stocks, and as natural marine equipment. Due to the huge investment involved, using gasoline-like tires is a possibility but economically less attractive. The use of rubber wheels to make black carbon eliminates the cost of grinding and milling, but carbon black from the pyrolysis wheel is more expensive and has a lower quality than that found in petroleum oil. (Raghvan, D. et al, 1998) [10]. At present, waste from various physiological and chemical processes is a major challenge in industrialized and developing countries. An in-depth investigation into waste recycling is being done to minimize the damage done to the site. In this regard, construction. (Toutanji et al, 1996) [12]. Researchers, like other recycling and manufacturing industries, have also made progress in using these waste products. One of the recyclable items that come in place is car tires. Investigations show that used tires are made of non-perishable materials under natural conditions and cause significant pollution. Burning is the decay of their decay; however, gas leaks due to tire burns cause dangerous pollution. Based on testing, one way is to use tires in concrete. This leads to the development of mechanical and flexible structures such as advertising strength, ductility, and resistance to cracking. However, this may result in a reduction in the compression strength of the concrete which will be compensated by adding Nano silica to the rubber concrete. (Mohammad Reza et al, 2011) [7]. At present, waste from various physiological and chemical processes is a major challenge in industrialized and developing countries. An in-depth investigation into waste recycling is being done to minimize the damage done to the site. In this regard, construction researchers, like other recycling and manufacturing industries, have also made progress in using these waste products. One of the recyclable items that come in place is car tires. Research shows that used tires are made of non-perishable materials under natural conditions and cause significant pollution. Burning is the decay of their decay; however, gas leaks due to tire burns result in dangerous pollution. (Ali, N. A., Amoset al, 2000) [13].

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2 DETAILS EXPERIMENTAL:

2.1 Materials and Procedures:

2.2 Materials:

The materials used to make concrete for this experiment are:

1. Coarse aggregate
2. Cement
3. Sand
4. Shredded and crumb tyres
5. Potable water.

The cement used was Ordinary Portland Cement. The coarse aggregate was selected from crushed stone, which is about 20 mm in size. Natural sand having a fineness modulus of 2.3 was used as fine aggregate. Chip rubber was produced by shredding automobile tyre with a cutter to 50 – 100 mm in dimension. The wires were removed and later converted into small dimensions by cutters. Crumb rubber was manufactured by special mills which change big rubbers into smaller torn particles. (El-Gammal, 99) [1].

2.2.1 Portland Cement:

Type I General Purpose

Type II Moderate heat of hydration and sulfate resistance ($C3A < 8\%$): general construction, seawater, mass concrete

Type III High early strength ($C3A < 15\%$): emergency repairs, precast, winter construction.

Type IV Low heat (C_3S < 35%, C_3A < 7%, C_2S > 40%): mass concrete

Type V - sulfate resistant (C_3A < 5%): sulfate in soil, sewers. (P.K. Mehta et al,2001) [14].

2.2.1.1 Main Components of PC:

Components	Amount	Notes
C3S	50%	very reactive compound, high heat of hydration, high early strength
C2S	25%	low heat of hydration, slow reaction
C3A	10%	problems with sulfate attack, high heat of hydration
C4AF	10%	gypsum 5% used to control the set of cement

2.2.2 Aggregate:

2.2.2.1 Aggregate Type by size:

- Coarse aggregate > 3/16 in. - 4.75 mm (No. 4 sieve)
- Fine aggregate < 3/16 in. and > 150 (No. 200 sieve)

2.2.2.2 Aggregate Type -mineralogy:

2.2.2.2.1 Sedimentary Rocks:

- (Cost-effective - near the surface), about 80% of aggregates
- Natural sand and gravel
- Sandstone, limestone (dolomite), chert, flint, greywacke

2.2.2.2.2 Metamorphic Rocks:

- I.e. slate, gneiss
- Excellent to poor

2.2.2.2.3 Igneous Rocks:

- Intrusive (plutonic): coarse-grained; granite
- Shallow Intrusive: fine-grained; rhyolite, andesite, basalt
- Extrusive: fine-grained; tuff, pumice, basalt hard,
- Tough, strong: excellent aggregate. (Eldin, Neil N. & Senouci, A. B) [4]

I)

II)

2.3 Composition:

In terms of particle size as used by geologists, sand particles range in diameter from 0.0625 mm (or 1⁄16 mm) to 2 mm. An individual particle in this range size is termed a sand grain. Sand grains are between gravel (with particles ranging from 2 mm up to 64 mm) and silt (particles smaller than 0.0625 mm down to 0.004 mm). (Moncef Nehdi and Ashfaq Khan est all 2001) [3]

2.3.1 sub-categories based on size:

1. Very fine sand (1⁄16 – 1⁄8 mm diameter),
2. Fine sand (1⁄8 mm – 1⁄4 mm),
3. Medium sand (1⁄4 mm – 1⁄2 mm),
4. Coarse sand (1⁄2 mm – 1 mm),
5. Very coarse sand (1 mm – 2 mm).

Table 1. Materials used for concrete

Material	Specifications
Cement	The cement used was Ordinary Portland Cement EN 197-1-CEM152.5N as the certificate of compliance with CE - 0770 - CPD - C02 / 23.
Sand	Natural sand with a 2.31 fineness modulus was used as a fine compound (1⁄8 mm - 1⁄4 mm).
Gravel	A 19 mm thick natural stone is used as a solid aggregate (3/4 inch sieve)
Rubber	Carved rubber is used to replace Coarse aggregate. Size cubes 25-40 mm by hand cutting.

2.4 Concrete Mixtures:

A total of six large compounds were thrown as hard cylinders replaced by 0% followed by 5% and 10% of 10% rubber compounds combined with salts. Mixing is done by hand, a mixture of coarse, sand, rubber mixture, cement, and water are added slowly and evenly until the mixture is even. A shovel was used to mix the mixture to get the desired performance. Blending is done by a person. After 24 hours of molding, the samples are immersed in water for treatment for up to 28 days of testing. [(El-Gammal et all, 2010) [1] Note: The content of the test is summarized in Table 2. It should be noted that the following codes are used in Table no 2:

C: represents ordinary concrete (plain).
CR5: represents 5% crumbly rubber in concrete replaced by solid aggregate.
CR10: represents 10% crumbly rubber in concrete replaced by solid aggregate

Table 2. Mix proportions for concrete cylinders

Sr #	**Rubber %**	**mixture proportion**	**wt of cylinder (lb)**	**weight in (kgs)**	**ratio**	**cement content (kg)**	**fine aggregate (kg)**	**wt of coarse aggregate (kg)**	**coarse agg - % rubber (kg)**	**water content (kg)**	**rubber content (kg)**
1	CR5	1.2.4	30	14	0.4	2	4	8	7.6	0.8	0.4
2	CR5	1.2.4	30	14	0.4	2	4	8	7.6	0.8	**0**.4
3	CR10	1.2.4	30	14	0.4	2	4	8	7.2	0.8	0.8
4	CR10	1.2.4	30	14	0.4	2	4	8	7.2	0.8	0.8
5	C	1.2.4	30	14	0.4	2	4	8	8	0.8	**0**
6	C	1.2.4	30	14	0.4	2	4	8	8	0.8	**0**
		Total	**180**	**84**	**2.4**	**12**	**16**	**48**	**45.6**	**4.8**	**2.4**

2.5 Preparation and casting of specimens:

The amount of mixture that needs to be adjusted for this study is about 84 kg of mixing and this includes adjusting the sample of 6 cylinders (6 inches X 12-inch height) for pressure testing. All samples were prepared for standard concrete and aggregate replacement with 0%, 5%, and 10% crumb rubber. Samples were classified according to the age of the concrete on the day of the test and the content of the rubber. For each rubber content (0%, 5%, and 10%) 3 cylinders were tested for pressure after 7 and 28 days immersed in water to cure. (Read, J., Dodson, T., and Thomas, 1991).

3 RESULTS AND DISCUSSION:

3.1. Compressive strength:

Stress tests were tested at 7 years and 28 days. Results are shown in Figures 1 and 2. It is noted that there has been a 35% reduction in stress values when a coarse amount is replaced by crumbly rubber compared to the control mixture. (Khorrami et al 2006) [8]. This is due to the compressive strength The Portland cement control mixture relies heavily on solid mixing, density, size, and hardness. Because coarse mass is replaced by crumb rubber, a decrease in strength is expected. Based on the result, the maximum compression strength of rubber concrete decreases from 7 years to 28 days and decreases by increasing the number of rubber crumbs from 0% to 10%. Although there has been a decrease in the amount of compressive strength, observations have shown that crumb rubber concrete reduces the total strength of the concrete.

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3.2. Weight of Cylinder:

After curing cylinders for 7 days, each sample was measured with 0%, 5%, and 10% different rubber. It was found that the weight was increased, as the rubber density was similar to that of Fig 3:

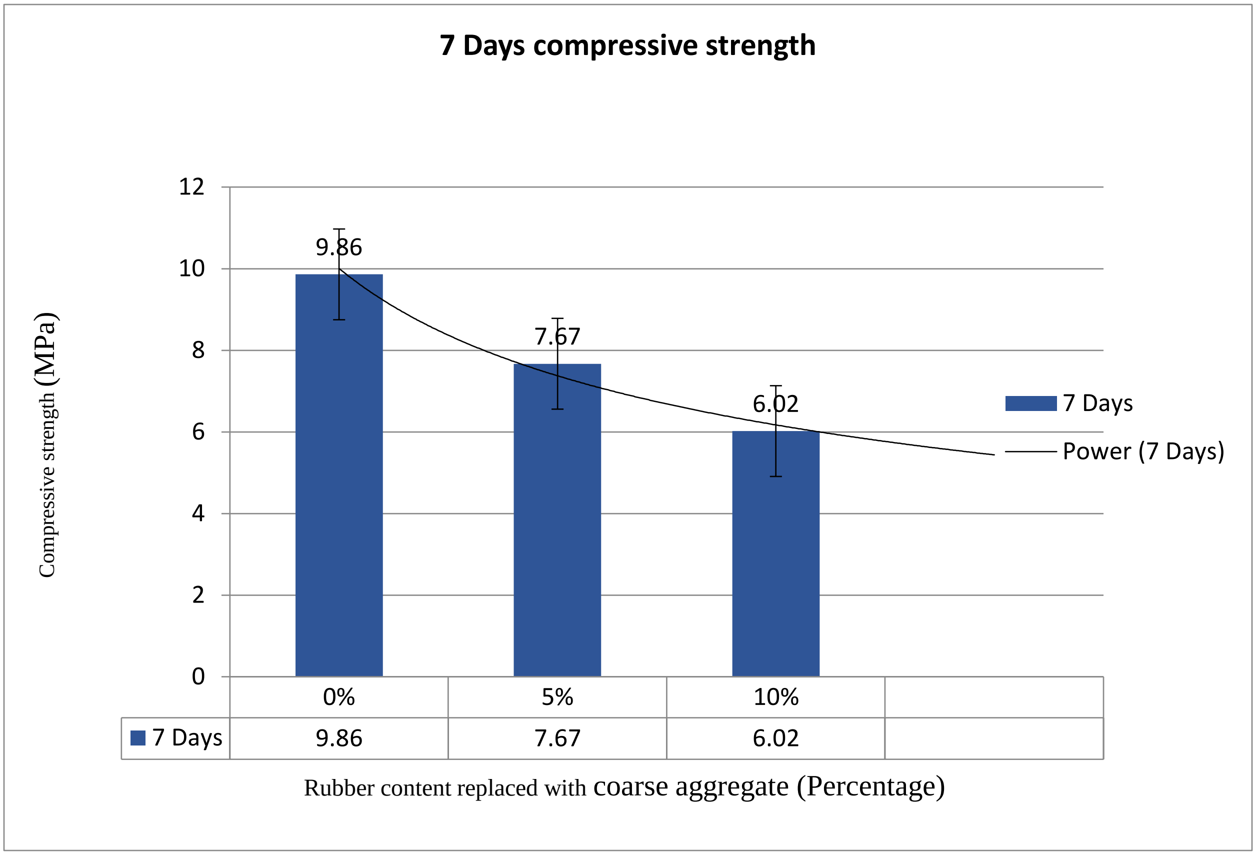

Figure 1. 7 Days compressive strength results

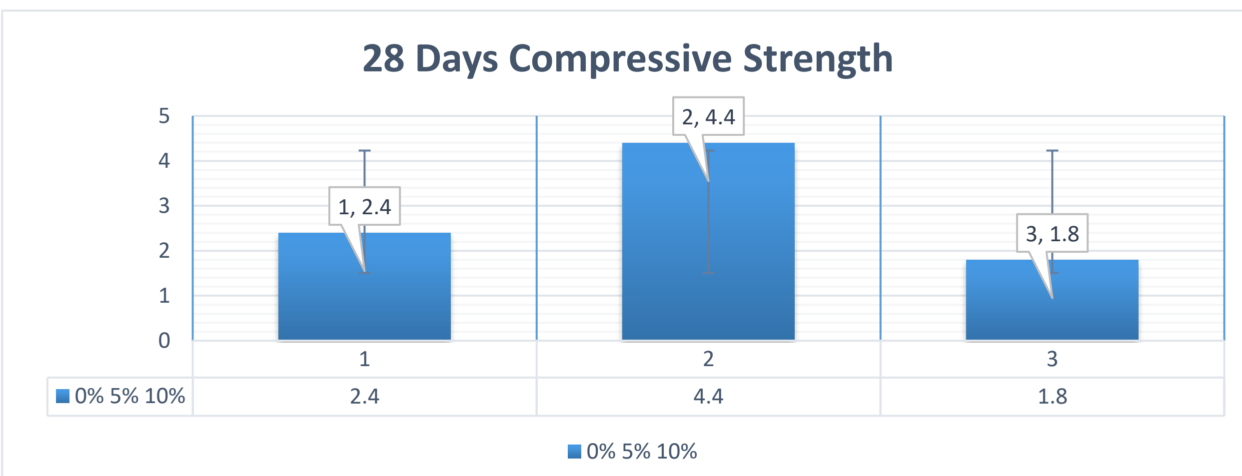

Figure 2. 28 Days compressive strength results

Rubber content % (Percentage) vs weight of cylinder

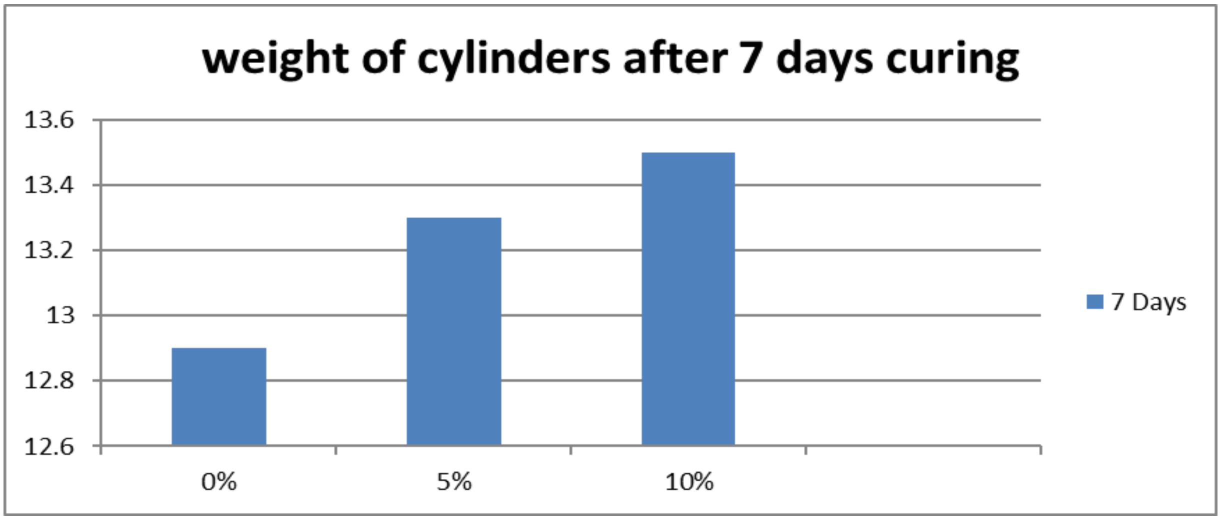

Figure 3. Cylinders weight comparison after 7 days

4 CONCLUSIONS:

1. The strength of the 28-day concrete will increase by adding rubber particles if the size of the rubber particles is much smaller than those used in this study. This can only be achieved by using a granulator that converts tires into rubber particles of particle size between 4.5mm-9mm. [Moayyad-Al-Nasraest al (2001)] [6]

2. By using smaller-sized rubber materials, the weight will be reduced due to the lower rubber content than the solid aggregate. [Moayyad-Al-Nasraest All (2001)] [6].

5 RECOMMENDATIONS:

With the use of certain compounds with crumb rubber, the strength of the concrete pressure will also increase. For example.

1. The 7-day pressure and 28-day pressure sample increased with the addition of silica smoke to concrete containing broken rubber. This is due to the strong filling of fine silica fume particles as well as good adhesion between the rubber and the cement paste. (Reda Taha, l, Abdel-Wahabest al 2003) [9]

2. The addition of 2 and 3% nano-silica to rubber-containing images results in an increase of 7 days and a pressure of 28 days compared to those containing only fragments.

3. rubber. The reason for this increase is that nanomaterials can fill nanovoids and provide a dense structure, thus compensating for the negative impact of rubber crumbs on compression forces.

4. Addition of silica fume and nano-silica did not have a significant effect on 7-day durability, while 28-day durability increased significantly. The increase in compression strength of the rubber concrete in the presence of silica smoke was greater than that of nano-silica and its compounds. (Eldin, N.N., Senouci, a. Best al 1993) [11]

REFERENCES

[1] El-Gammal, A .; Abdel-Gawad, A. K .; El-Sherbin, J.
[2] Tarun R. Naik and Rafat Siddique's CBU-2002-06 REP-459 February 2002
[3] Moncef Nehdi and Ashfaq Khan Cementitious Composites Containing Reconstructed Tire Rubber: An Overview of Engineering Structures and Potential Applications for Cement, Concrete, and Combinations, CCAGDP, Vol. 23, No. 1, June 2001, pages 3-10.
[4] Eldin, Neil N. & Senouci, A. B., "Rubber-tired Particles as Concrete Aggregate," Journal of Materials in Civil Engineering, 5 (4), 478-496, 1993.
[5] Read, J., Dodson, T., and Thomas, J., “Test project - use of broken tires to lightweight, Oregan Department of Transport, Post Construction construction report for Project No. DTFH -71-90-501-OR-11, Salem, Oregan, 1991
[6] Mechanical Concrete Buildings, Moayyad-Al-Nasra, (2001)
[7] Experimental Study of the Strengthening Strength of Concrete Containing Rubber, Mohammad Reza Sohrabi, Mohammad Karbala, 2011.
[8] Khorrami, M .., Feasibility Study on the use of rubber waste in concrete construction, Housing, and Construction Research Center, publication number: G - 447,2006.
[9] Reda Taha, l, Abdel-Wahab, The strength of concrete fractures including rubber tire particles, Icpm, new construction period, Cairo, Egypt, Feb. 18-20,2003.
[10] Raghvan, D., Huynh, H., Ferraris, c.f., Operations, Mechanical properties and chemical stability of composite cement filled with recycled rubber, Scientific journal, vol. 33, no. 7, pp. 1745-1752,1998.
[11] Eldin, N.N., Senouci, a. b., Particles of rubber wheels as a concrete compound, Asce journal of building materials in civil engineering, vol. 4, pp. 478-496, 1993.
[12] Toutanji, H. A. (1996), “The use of rubber wheel particles in concrete to replace mineral aggregates.” Journal of Cement & Concrete Combinations, ELSEVIER, 18, 135-139.
[13] Ali, NA, Amos, AD, and Roberts, M., 1993, “Use of Ground Rubber Tires in Portland Cement Concrete,” in Proceedings, International Conference on Concrete 2000, University of Dundee, UK, pp. 379–390