Detailed Investigation on Strengthening of Concrete Using Waste Rubber Tyres

Punithavathy.U
PG scholar, Department of Civil Engineering, Prist University, Trichy-Thanjavur Highway, Vallam, Thanjavur, Tamilnadu, India.

Chandru.P
Assistant Professor, Department of Civil Engineering, Prist University, Trichy-Thanjavur Highway, Vallam, Thanjavur, Tamilnadu, India.

Abstract – Concrete is a construction material. It is made by mixing of cement, fine aggregates, coarse aggregate and water in the proper proportions. Recycled waste tyre rubber is a promising material in the construction industry because of its lightweight, elasticity, energy absorption, sound and heat insulating properties. One such application that could use old rubber tires is rubberized concrete. Concrete is made cheaper by replacing some of its fine aggregate with granulated rubber crumbs from used rubber tires.

Light weight masonry of this type of concrete has a positive economic effect on total cost of the construction, it reduces the dead weight loading, giving smaller supporting sections and foundations as well as saving in transport and construction costs .In this work tensile and flexural strength was studied for crumb rubber and combination of crumb rubber and wood ash replacement of fine aggregate

Tensile and flexural strength increases when the percentage of replacement of crumb rubber increases. The 7- days and 28- days Tensile and flexural strength of the specimens increased by addition of wood ash to concrete containing crumb rubber.

Index Terms – Concrete, Tyre, Energy, Economic.

1. INTRODUCTION

Concrete which is a synthetic construction material is made by mixing of cement, fine aggregates, coarse aggregate and water in the proper proportions. Recycled waste tyre rubber is a promising material in the construction industry especially due to its lightweight, elasticity, energy absorption, sound and heat insulating properties. One such application that could use old rubber tires is rubberized concrete. Concrete is made cheaper by replacing some of its fine aggregate with granulated rubber crumbs from used rubber tires. These granulated rubber crumbs are a result of the process called continuous shredding, that are necessary to create crumbs small enough to replace an aggregate as fine as sand. Such kind of concrete is used in manufacture of reinforced pavement and bridge structures. They have better resistance to frost and ice thawing salts. The main objective of this work is to study the tensile and flexural behaviour of crumb rubber, crumb rubber and wood ash based concrete.

2. MATERIALS USED

ORDINARY PORTLAND CEMENT

Ordinary portland cement with specific gravity 3.15 and initial and final setting time of 30min and 10hrs was used.

COARSE AGGREGATE

Coarse aggregate is a strength giving material which occupies the major portion. 20mm aggregate was used. Specific gravity of coarse aggregate was found to be 2.85

FINE AGGREGATE

Locally available free of debris and nearly riverbed sand is used as fine aggregate. Fineness modulus was found to be 2.9, specific gravity of river sand was found to be 2.62

WATER

Water free from hazardous materials confirming to IS 456:2000 was used in this work.

CRUMB RUBBER

It is the processing of the tyre into fine granular or powdered particles using mechanical or cryogenic processes. And it was obtained from tanjore and used as fine aggregate replacement size was found to be less than 4.75mm. Specific gravity 1.2

WOOD ASH

Wood ash is a residue which is left after combustion of wood. It is obtained from local industries .specific gravity 1.72

MIX PROPORTION

Mix Ratio for M30 Grade of concrete with ratio 1:1.42:2.67 was used. Table 1 shows the mix combination.

Table 1 % of Replacement of crumb rubber and wood ash for fine aggregate

Crumb rubber Replacement (%)	Crumb Rubber + Wood ash
0	5% +10%
5	
10	
15	
20	
25	

3. TESTING OF CONCRETE

SPLIT TENSILE STRENGTH TEST

The test consists of applying a compressive line load along the opposite generators of concrete cylinder placed with its axis horizontal between the compressive platens. Due to the compression loading a fairly uniform tensile stress is developed over nearly 2/3 of the loaded diameter as obtained from an elastic analysis. The magnitude of this tensile stress given by the formula $2p/\pi dl$. split tensile strength was performed as per IS 516:1959

Size of specimen 150mmx300mm .The results are shown in Table 2 and 3

Table 2 Split Tensile Strength of Concrete for 7 & 28 days

Crumb Rubber (%)	7 Days (N/mm^2)	28 Days (N/mm^2
0	1.89	2.69
5	2.83	3.24
10	2.29	3.52
15	1.78	3.69
20	1.96	3.36
25	1.54	2.94

Table 3 Split Tensile Strength of Rubber Concrete for 7 & 28 days

Crumb Rubber + Wood ash	7 Days (N/mm^2)	28 Days (N/mm^2)
5% +10%	1.97	2.96

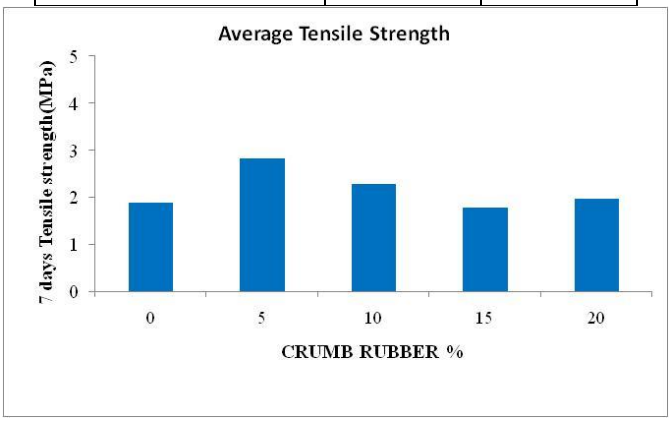

Figure 1 7days split tensile strength of concrete

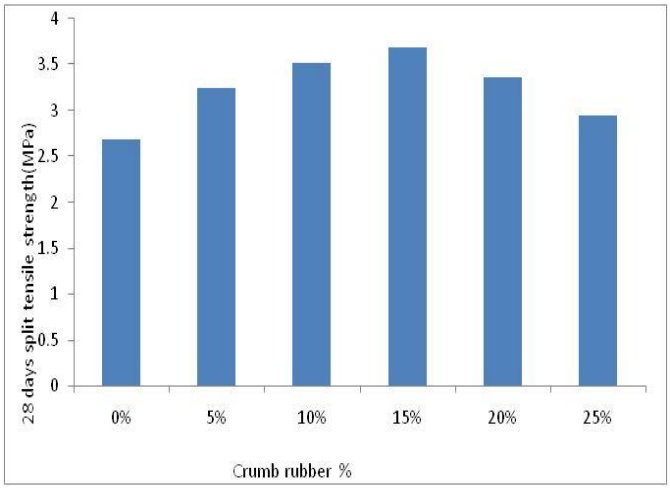

Figure 2 28days split tensile strength of concrete

4. FLEXURAL STRENGTH OF CONCRETE

In the symmetrical two point loading, the critical crack may appear at any section, not strong enough to resist the stress within the middle third, where the bending moment is maximum. It can be expected that the two point loading will yield a lower value of modulus of rupture than the centre point loading.

Flexural strength, $F = Pl/bh^2$

Beam size of 15x15x70cm were casted and tested as per IS 516-1959. The results are shown in Table 4 and 5

Table 4 Flexural Strength of Rubber Concrete

Crumb Rubber (%)	7 Days (N/mm^2)	28 Days (N/mm^2)
0	2.49	2.82
5	3.32	6.86
10	3.13	6.2
15	3.27	7.5
20	3.28	7.26
25	2.66	6.8

Table 5 Flexural Strength of Concrete

Crumb Rubber + Wood ash	7 Days (N/mm^2)	28 Days (N/mm^2)
5% + 10%	3.64	5.32

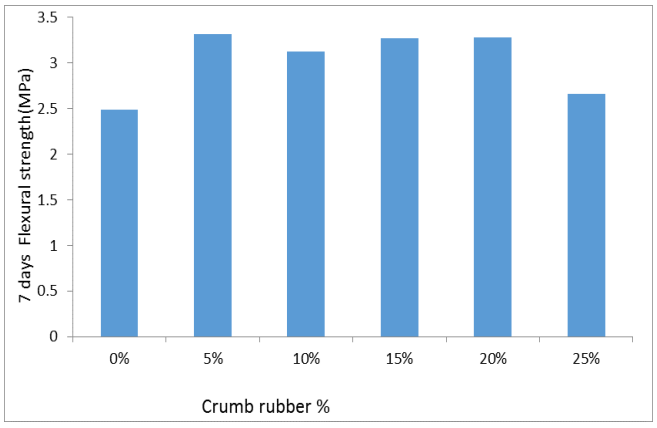

Figure 3 7 days Flexural strength Test

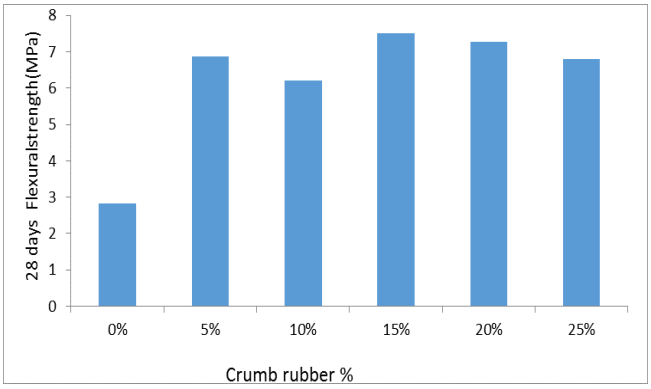

Figure 4 28 days Flexural strength Test

5. CONCLUSION

1. Flexural strength of concrete increases when crumb rubber replaces up to 25% in fine aggregate.

2. The 7- days and 28- days split tensile strength of the specimens increased by addition of wood ash to concrete containing crumb rubber.

3. The analysis of the experimental results showed that replacing 15% of fine aggregate by crumb tyre slightly increased the strength of the concrete but replacing more than 25%, reduces the concrete strength.

4. 15% replacement of crumb rubber proves exceptionally well in compression

And Split tensile strength and follow all the tests in M30 grade of concrete.

5. Finally by replacing fine aggregate by crumb rubber we can save our environment and natural sources.

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