ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

A STUDY ON USING RECYCLED TYRE RUBBER AS PARTIAL REPLACEMENT OF FINE AGGREGATE IN CONCRETE

A.R.PRADEEP
Asst.Profesor
Dept. of Civil Engg,
SSIT, Maraluru
Tumakuru,Karnarnaaka,India
arpradeepmtech@gmail.com

M.I.BASAVA LINGANA GOWDA
Asst.Profesor,
Dept. of Civil Engg
R.Y.M.E.C.,Cantonment
Ballari,Karnarnaaka,India
gowda.basava@gmail.com

ANIL KUMAR.H.M
Asst.Profesor,
Dept. of Civil Engg,
BITM,Allipur,
Ballari ,Karnarnaaka,India
anilkumarcv401@gmail.com

I. ABSTRACT

Solid waste disposal is a worldwide problem. If not properly disposed, these materials become sources of environmental pollution and the problems related to it. Various studies are done worldwide to dispose these solid waste materials by using them for partial or complete replacement of aggregates in cement concrete. Discarded tyre rubber is an important solid waste material that destroys the ecological environment.

The suitability of waste tyre rubber in cement concrete as a partial replacement for natural river sand. M40 grade of concrete is designed as per IS 10262: 2010, with water/cement ratios of 0.4. Water–cement ratios of 0.45 were studied. The designated mix contain 0%, 10%, 20%, 30%, 40% and 50 % of partial replacement of crumb rubber with fine aggregate by weight .Finally compared with normal concrete .The specimens with 0% discarded tyre rubber were taken as control mix. Tests were done to determine the compressive strength, flexural strength in concrete specimens. Test results of the hydraulic transport properties revealed that the addition of rubber particles tends to restrict water propagation in the cement matrix and reduces water absorption of the composite .The effects of rubber sand on workability, setting time, bleeding, density, strength, impact energy, impact load, toughness, ductility, shrinkage, abrasion resistance, freeze/thaw resistance, fire resistance, thermal insulation, carbonation resistance, corrosion resistance, water absorption, porosity, chloride ion penetration ,resistance to aggressive environmental, energy absorption, sound absorption, electrical resistance and cracking resistance of rubberized concrete.

Keywords – Rubber tyre,wire mesh, concrete element, compressive strength, Flexural behavior.

II.INTRODUCTION

A. Definition of concrete:

Concrete is defined as the combination the binding material cement, fine aggregate , coarse aggregate and water in defined ratio which is proposed for required strength.

B. Types of concrete:

- Normal concrete
- High strength concrete
- Stamped concrete
- Shortcrete
- High performance concrete
- Pervious concrete
- Limecrete
- Glass concrete
- Asphalt concrete
- Aerated concrete
- Rubberized concrete

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

- Geopolymer concrete
- Rapid strength concrete
- Fiber reinforced concrete

C, Rubberized concrete:

Rubberized concrete is a type of concrete in which the rubber is replaced by aggregates. This type of concrete is used to make the pavement blocks, wall facing panels, interlocking blocks etc.

D. **Need for replacement:**

Every year, large number of vehicle tires is used worldwide. In the year 2000 alone, approximately 250,000 metric tons of rubber products were consumed in Thailand and about 38% of that was vehicle tires. Wasted tiers are not easy to decompose, the simplest way to get rid of them is by burning but this method generates many problems and pollution (due to smoke).

- Therefore, the burning method is unacceptable and in some countries it is prohibited by law. The easier solution is to leave them piling up on empty lands (Fig. 1.1a), which indirectly generates several other problems because they are simply turn into fire source or insect and animal habitation (Fig .1.1b).

- **Fig. 1.(a) Abandoned Tires Left Piling Up in Thailand,Fig.1.1 (b) Fire Accident at a 25-Million Tire Dump in Central Ohio's Wyandot County**

Fig.2 (a) Excavation of sand at river banks, Fig.1.2: (b) Transporting sand from river banks.

Excavation of sand from river banks is one of the main cause for disasters. Sand excavation directly causes of erosion, and impacts the local wildlife. Disturbance of underwater and coastal sand causes turbidity in the water, which is harmful to the aquatic organisms. Removal of physical coastal barriers such as dunes leads to flooding of beachside communities.

India is a developing country, it proposes multipurpose development projects. Every budget proposal involves large construction of roads, bridges, dams, irrigation schemes, public health engineering schemes

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

,educational buildings and residential buildings etc. all these construction schemes demand optimum and efficient use of construction resources. Mostof the modern heavy constructions require huge quantity of cement concrete causes depletion of natural resources such as river sand and rock strata. Costof river sand and crushed rock particles are rapidly increasing because of inadequate raw materials and rise of transport cost due to the hike in fuel price and other inputs.

Further mining of river sand causes severe environmental damage by lowering ground water table and disintegration of rock strata causes landslide and earthquake. This emerging problem obliges contemporary material usage to balance the ecology. In this essence the abundant availability of waste tyre rubber can be utilized as an effective replacement for natural aggregate which will be beneficial for both circumstances. Hence this research project investigates the use of waste tyresin various aspects of construction. There has been a few number of rubber based concrete projects developed in all the corners of Civil Engineering. Acritical review of the existing literature on the utilization of waste rubber is presented in the following areas:

i) Civil Engineering Applications of Scrap (Waste) Tyres
ii) Waste Tyres in Road Construction
iii) Waste Tyres in Concrete
iv) Waste Tyres in Hollow Blocks
v) Applications and Advantages of Tyre Rubber Aggregate Concrete (TRAC)

III.MATERIALS

A.ORDINARY PORTLAND CEMENT: -

Is the most common type of cement in general use around the world, because it is a basic ingredient of concrete, mortar, stucco and most non-specialty grout. It is a fine powder produced by grinding Portland cement clinker (more than 90%), a limited amount of calcium sulphate which controls the set time, and up to 55 minor constituents (as allowed by various standards).

•The cement used for our experimental work is zuari cement (OPC 43-Grade). Conformed to the quality provisions of Indian standard specification.

•The specific gravity of the cement was 3.15

B. FINE AGGREGATE:-

Locally available sand passed through 4.75mm IS sieve is used. The specific gravity of 2.75 and fineness modulus of 3.338 are used as fine aggregate. The loose and compacted bulk density values of sand are 1360 and 1620 kg/m3 respectively,

C. COURSE AGGREGATE:-

Crushed aggregate available from local sources has been used. The coarse aggregates with a maximum size of 20mm having the specific gravity value of 2.885 and fineness modulus of 7.386 are used as coarse aggregate.

D.WATER:

Potable water used for the experimentation.

E.CRUMB RUBBER (CR)

The crumb rubber achieved after different processes has a nominal size between 4.75mm to less than .075mm. The crumb rubber used in this study was obtained from a local industrial unit in India. The crumb rubber was used in the concrete mix to partially substitute for fine aggregates (sand) in various percentages of 0%,10%,20%,30%,40% and 50%.The specific gravity of crumb rubber is 0.73.

F.Casting & Testing of Concrete

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
***Available online at** www.ijartet.com*

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

Fig 3: Casting of concrete cubes

IV. RESULTS

A. Loading:

The specimens are placed between the bearing blocks on the machine and loaded at a uniform rate of 2 kg/cm2/sec until failure. The maximum load carried by the specimen is recorded from the machine.

Fig 4: Compressive testing machine

B. Calculations:

The compressive strength of each individual specimen is calculated by dividing the maximum load at failure by the cross-sectional area of the specimen. The average of the three individual compressive strengths is accepted as the compressive strength of that batch of concrete. [4] proposed a system, this fully automatic vehicle is equipped by micro controller, motor driving mechanism and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV. The speed of rotation of DC motor i.e., velocity of AGV is controlled by the microprocessor controller.This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

Fig 5. Failure of cubes during compressive test

C. COMPRESSION STRENGTH TEST

Weight of materials used in 36 Concrete cubes

materials	Cement ,kg	Fine aggregates, Kg	Coarse aggregates, kg	Rubber, kg
Mix 1 0%	9.33	13.98	23.4	----------------
Mix 2 10%	9.33	12.58	23.4	0.69
Mix 3 20%	9.33	11.19	23.4	2.79
Mix 4 30%	9.33	9.70	23.4	4.19
Mix 5 40%	9.33	8.38	23.4	5.59
Mix 6 50%	9.33	6.99	23.4	6.99

Table 1: Weight of materials for cubes

D SPLIT TENSILE STRENGTH TEST

Amount of materials used in 24 cylinders of concrete

Materials	Cement ,kg	Fine aggregates, kg	Coarse aggregates, kg	Rubber, kg
Mix 1 0%	14.7	22.2	24.52	----------------
Mix 2 10%	14.7	20.6	24.52	1.6
Mix 3 20%	14.7	19.2	24.52	3
Mix 4 30%	14.7	17.6	24.52	4.6
Mix 5 40%	14.7	16.08	24.52	6.12

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

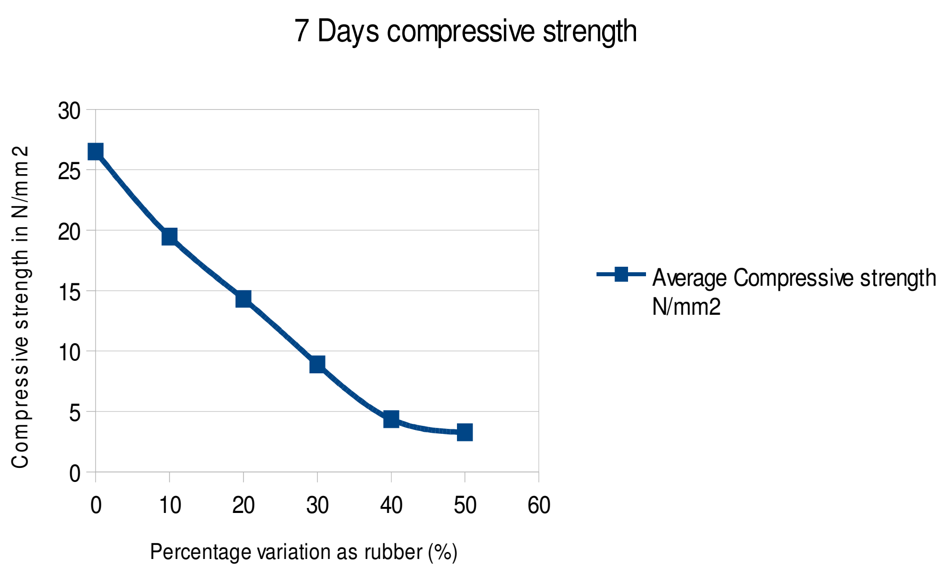
Mix 6 50%	14.7	14.56	24.52	7.64

Table 2 Weight of materials for cylinders

E 7 days compressive strength for various percentage of crumb rubber

Sl no	Percentage variation as rubber (%)	Average Compressive strength N/mm^2
1	00	40.80
2	10	32.60
3	20	27.03
4	30	18.82
5	40	14.82
6	50	7.90

Table 3: Compressive strength (7days)



Graph 1: Compressive strength (7days)

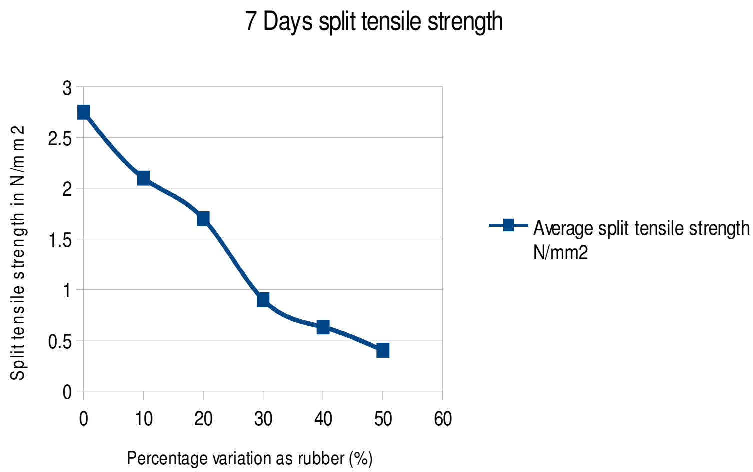
F 7 days split tensile strength for various percentage of crumb rubber

Sl no	Percentage variation as rubber (%)	Average split tensile strength N/mm^2
1	00	2.75
2	10	2.10
3	20	1.70
4	30	0.90
5	40	0.63
6	50	0.40

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

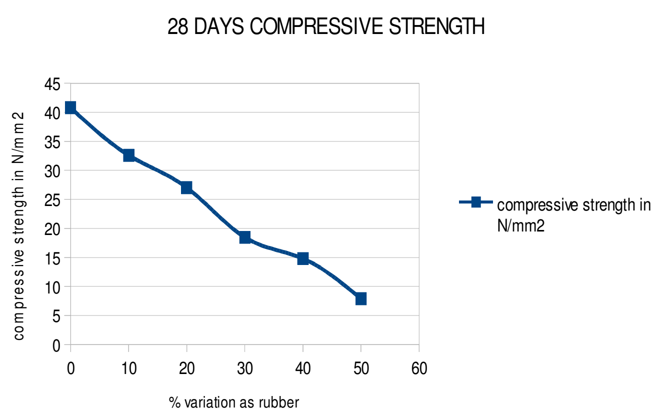
Table 4: Split tensile strength (7 days)



Graph 2: Split tensile strength (7 days)

Sl no	Percentage variation as rubber (%)	Average Compressive strength N/mm^2
1	00	40.80
2	10	32.60
3	20	27.03
4	30	18.82
5	40	14.82
6	50	7.90

Table 5: Compressive strength (28 days)



ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

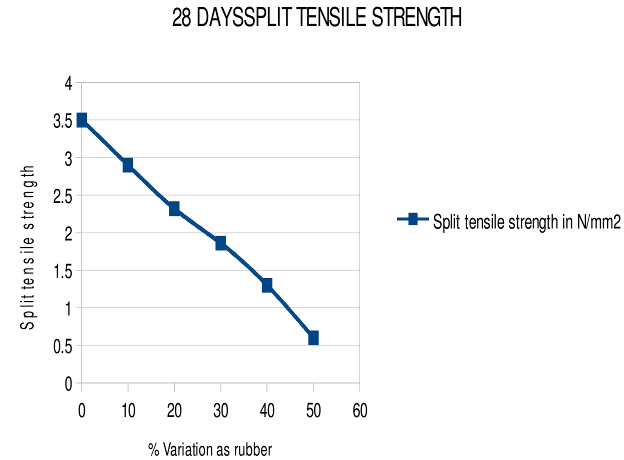
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

Graph 3: Compressive strength (28 days)

Split tensile strength for 28 days curing

Sl.No	Percentage variation as rubber (%)	Average split tensile strength N/mm^2
1	00	3.5
2	10	2.9
3	20	2.32
4	30	1.86
5	40	1.3
6	50	0.6

Table 5: Split tensile strength (28 days)



Graph 4: Split tensile strength (28 days)

V .CONCLUSIONS AND APPLICATIONS

A. Compressive strength decreases as the percentage of waste crumb rubber increases.

So these can include non-primary structural applications of medium to low strength requirements benefiting from other features of this type of concrete. Even if rubber tyre aggregate was used at relatively low percentages in concrete, the amount of waste tyre rubber could be greatly reduced due to the very large market for concrete products worldwide. Therefore the use of discarded tyre rubber aggregates in concrete shows promise for developing an additional route for used tyres.

B. Workability decreases as the percentage of waste crumb rubber increases.

During the tests it was noted that as the percentage amount of shredded tires increased, the amount of energy required for casting specimens increased substantially, because of the reduction of workability in the concrete.

C. Self weight decreases as the percentage of waste crumb rubber increases.

Although synthetic lightweight aggregates specially shredded tires are more expensive, the increased strength-to-weight ratio offers sufficient overall saving in materials through the reduction of dead load to more than offset the higher aggregate cost per cubic meter of the concrete. Lower total loads mean reduced supporting sections and foundations, and less reinforcement.

The light unit weight qualities of rubberized concrete may be suitable for architectural application like, interior construction, interlocking blocks, and stone baking.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

VI REFERENCE

1.Marques et al. (2008) partially replaced natural sand in mortar mixtures with rubber (passed in sieve 0.8 mm) at levels of 0% and 12%, by volume.

2.Topc¸u and Demir (2007) studied the workability, by flow, of mortar mixtures containing rubber with particles sizes of either 1–0 mm or 4–1 mm as natural sand replacement at levels of 0%, 10%, 20%, 30% and 40%, by volume.

3.Blackwell (2003) partially replaced natural fine aggregate in mortar mixtures with crumb rubber (size 0.6 mm) at levels ranging from 32% to 57%, by volume

4. Christo Ananth, M.A.Fathima, M.Gnana Soundarya, M.L.Jothi Alphonsa Sundari, B.Gayathri, Praghash.K, "Fully Automatic Vehicle for Multipurpose Applications", International Journal Of Advanced Research in Biology, Engineering, Science and Technology (IJARBEST), Volume 1,Special Issue 2 - November 2015, pp.8-12.

5.Bravo and de Brito (2012) reported a reduction in the fresh density of concrete mixtures containing rubber made from used tyres (with the same size of the nat- ural sand) as natural sand replacement at levels of 0%, 5%, 10% and 15%, by volume.

.