International Journal of Scientific Research in Civil Engineering
© 2016 IJSRCE | Volume 1 | Issue 1 | ISSN : 2456-6667

Exploration on Rubber Fortification In Concrete

K. C. Denesh*[1], V. Naveenraj[2], S. K. Gowtham[3]

[1,2,3]Department of Civil Engineering. Nandha Engineering College (Autonomous), Erode, Tamilnadu, India

ABSTRACT

Throughout the world, the disposal of used tires is a major environmental problem causing environmental hazards such as breeding ground for mosquitoes, producing uncontrolled fire and they are contaminating the soil and vegetation. Therefore, there is an urgent need to identify alternative outlets for these tyres, with the emphasis on recycling the waste tyre. Now, the use of waste tires in concrete has become technically feasible and the concrete is being considered as lightweight concrete. This study reviews the feasibility of using waste tires in the form of chips and fibers with different sizes in concrete to improve the strength as well as protecting the environment. The purpose of this research is based on the investigation of the use of fibers in structural concrete to enhance the mechanical properties of concrete. The objective of the study was to determine and compare the differences in properties of concrete containing without fibers and concrete with fibers. The different ratio of the fiber was carried out like 0.5%, 1.0%, 1.5%, 2.0% in the grade of M30 and M40 grade of concrete was used in this investigation. In this experimental investigation compressive strength, tensile strength and flexural strength tests was carried out at the age of 7, 28 days. Compare the results of conventional and fiber reinforced concrete (FRC).

Keywords: Rubber Fortification, M30 & M40 Grade of Concrete, Mechanical Properties

I. INTRODUCTION

Concrete is the most frequently used construction material in the world. However, it has low tensile strength, low ductility, and low energy absorption. An effective way to improve the toughness of concrete is by adding a small fraction (usually 0.5–2% by volume) of short fibers to the concrete mix during mixing. After extensive studies it is widely reported that such fiber reinforcement can significantly improve the tensile properties of concrete. Orders of magnitude increases in toughness (energy absorption) over plain concrete are commonly observed. Another application of fiber reinforcement is for the reduction of the shrinkage and shrinkage cracking of concrete associated with hardening and curing. By using FRC instead of conventional concrete, section thickness can be reduced and cracking can be effectively controlled, resulting in lighter structures with a longer life expectancy. FRC is currently being used in many applications, including buildings, highway overlays, bridges, and airport runways.

Rubber Tyre Fibers

The concrete mixed with waste rubber tyre in different volume proportions is called rubberized concrete. Small quantity of rubber tyre fibers is mixed to concrete to reduce the unit weight of concrete. The recycled rubber tyres from cycle, car, trucks etc. are used. the length of the fiber as 80 mm, diameter as 2 mm and aspect ratio as 40. The dosage of of rubber tyre fibers is 0.5, 1, 1.5, 2% of volume of fraction. The rubber tyre fiber is to absorb more energy, to reduce shrinkage cracks.

Fiber length	: 80 mm
Diameter	: 2 mm
Aspect ratio	: 40 mm

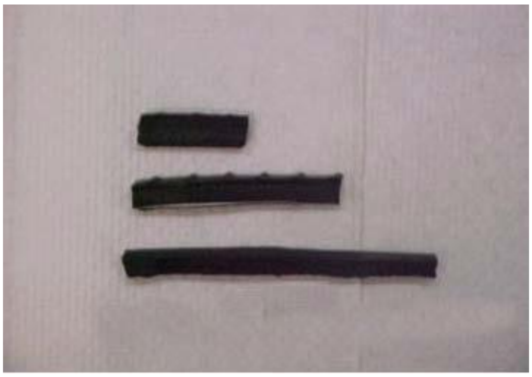

Figure 1. Rubber Tyre Fibers

Advantages

- Recycling of scrap tires suggesting an environmental solution.
- Reduction of plastic shrinkage cracking
- Diminishment of the vulnerability of concrete to catastrophic failure
- Improve mix cohesion, improving pump ability over long distances

Binding Wire Fiber

Binding wire fibers consists of cast iron plain steel are to be used. The binding wire fiber is same type of same type of steel fibers. The binding wire fiber mixed to the concrete is increasing the mechanical properties of the concrete ie compressive strength, tensile strength and flexural strength. The length of the fiber as 50 mm, diameter of fiber as 1 mm and aspect ratio as 50.

Fiber length : 50 mm ; Diameter: 1 mm
Aspect ratio : 50 mm; Dosage : 0.25 %, 0.5 %, 0.75 %, 1% of volume of concrete

Application of FRC

- Floors, driveway and side walls to reduce shrinkage and cracking problems are desirable.
- Increase of toughness in fiber-reinforced concrete is ideal for buildings and pavements subject to shatter, impact, abrasion and shear.
- Its use in crack control and shrinkage for water retaining and reservoir structures to reduce the permeability and freeze-thawing conditions.
- Its replacement for temperature steel in sanitary sewer tunnels prevents corrosion and improves ductility.
- Runways are made more resistant to fuel spills with less permeable and shatter resistant fiber-reinforced concrete.
- Pumped concrete project gets easy and safe with fiber, making concrete more cohesive and prevent segregation.

II. MATERIALS AND METHODS

In order to increase the performance of concrete, many types of fibers are added. Addition may change the performance in the green stage and hardened stage. Therefore, it is very essential to evaluate the effect of fibers on mechanical properties of concrete. This chapter deals with the properties of materials used in this investigation, methodology, and preparation of test specimens are performed.

The following are the materials used in our experimental study,

- Cement
- Fine aggregate
- Coarse aggregate
- Water
- Rubber Tyre Fiber
- Binding Wire Fiber
- Silica fume (Admixture)
- Super plasticizer (Conplast SP 430)

Cement

Cement is the binding materials used in all kinds of mortars and also in concrete and that sets and hardens independently, and can bind other materials together. There is a variety of cement available in the market and type is used under certain conditions due to its special properties. In this, we have few percentage of fibers mix the concrete by its volume. Even though the test results are satisfactory with it is significant. Consistency test on cement is 40 %, Specific gravity of cement is 3.15.

Fine Aggregate

The materials are smaller than 4.75 mm size is called fine aggregate. Natural sand is used as fine aggregate. Specific gravity of aggregate is also required in calculating the compaction factor in connection with the workability measurements.

Coarse Aggregate

The coarse aggregate is the strongest and least porous component of concrete. It is chemically stable material. Coarse aggregate are obtained by crushing of granites, schist, crystalline, limestone and good quality sand stones. Hard broken granite stone72 % of 20 mm size and 38 % of 10mm size are used as coarse aggregate.

Silica Fume (Admixture)

Silica fume can make a significant contribution to early-age strength of concrete. One pound of silica fume produces about the same amount of heat as a pound of Portland cement, and yields about three to five times as much compressive strength. Grey in colour. Silica fume improves concrete in two ways the basic pozzolanic reaction, and a micro filler effect. As micro filler, the extreme fineness of the silica fume allows it to fill the microscopic voids between cement particles. This greatly reduces permeability and improves the paste-to-aggregate bond of the resulting concrete compared to conventional concrete. The dosage is 8 % of weight of cement is used as admixture in the investigation.

Super Plasticizer

In this investigation Conplast 430 are used as super plasticizer. These super plasticizers are reduce 21 % of water content. The dosage is 0.5 % of weight of water is used. Colour of conplast430 super plasticizer as brown.

Table 1. Concrete Mix Design

Mix Ratio	Water	Cement	Fine Aggregate	Coarse Aggregate
M30	0.45	1	1.75	2.24
M40	0.4	1	1.65	2.62

III. PREPARATION OF SPECIMENS

Mixing

Mixing of concrete may be done by any one of the conventional method of hand mixing or machine mixing. External vibration may be preferable to prevent segregation, the mixing was done by hand as the specimen mould was small and quantity of mix was less. Correct quantity of cement, fine aggregate, coarse aggregate and water required for batched were weighed accurately. Cement and fine aggregate were mixed with coarse aggregate. Then the correct quantity of rubber tyre fibers, binding wire fibers, admixtures was added to the necessary proportions. In dry state, water and super plasticizer was added finally and mixing was done gradually.

Table 2. M30 & M40 – Grade Concrete

Materials	Consumption for M40 Grade of Concrete in Kg/m^3	Consumption for M30 Grade of Concrete in Kg/m^3
Cement	400	438
Fine Aggregate	660	766
Coarse Aggregate (20 mm)	701	589
Coarse Aggregate(10 mm)	467	392
Water	160	197
Rubber Tyre Fibers	0.25,0.5,0.75,1%	0.25,0.5,0.75,1%
Binding Wire Fibers	0.25,0.5,0.75,1%	0.25,0.5,0.75,1%

Figure 2. Casting of Specimens

Casting

The concrete cubes of size 150 x 150 x 150 mm, the concrete cylinders of size 300 mm in length and 150 mm in diameter and the concrete beams of size 500 x 100 x100 mm were casted in both conventional and also in FRC for comparison of the test results. The full compaction of the concrete is filled into the mould in layers. After the top layer has been compacted the surface is brought to the finished level with the top of mould using trowel.

Figure 3. Casting of Specimens

Curing

The specimens are demoulded after 24 hours. Necessary identification marks were made and kept under water in curing tank. The concrete specimens were kept under water for 7 days, 28 days. After curing, they were taken out from the curing tank and air dried before testing.

Figure 4. Curing of Specimens

IV. EXPERIMENTAL INVESTIGATION

TESTS ON HARDENED CONCRETE

The various investigations that are to be carried out an hardened concrete are,

- Compressive Strength Test.
- Tensile Strength Test.
- Flexure Strength Test.

The specimens were tested for two different periods of curing such as

- 7 Days & 28 Days curing.

Compressive Strength Test

Figure 5. Compression Test on Specimens

Flexural Strength Test

Figure 6. Flexural Strength Test on Specimens

Split Tensile Strength Test

Figure 7. Spilit Tensile Strength Test on Specimens

Table 3. Compressive Strength of Fiber Reinforced concrete – M30Grade of Concrete

S.No	% of Fibers Added	Compressive Strength (N/mm^2)	
		7 Days	28 Days
1	0.5 %	32.26	49.63
2	1 %	34.08	50.26
3	1.5 %	33.15	48.19
4	2 %	32.61	46.14

V. CONCLUSION

Based on the experimental investigation the mechanical properties of the concrete are studied, with and without Fibers. The results are obtained from the tests. For adding rubber tyre fibers are absorb more energy, to increasing toughness and reducing the shrinkage, crack in the concrete, but reducing the strength. Adding of binding wire fibers to the concrete to increasing the strength.

- ✓ The maximum compressive strength, occurs at 1.0 % fibers added to the concrete was 41.35Mpa at 28 days for M30 grade of concrete. The compressive strength are increased to 6.58 % on FRC compare to the conventional concrete.
- ✓ The maximum tensile strength occurs at 1.0 % fibers added to the concrete was 4.63Mpa at 28 days for M30 grade of concrete. The tensile strength are increased to 9.72 % on FRC compare to the conventional concrete.
- ✓ The maximum flexural strength occurs at 1.0 % fibers added to the concrete was 4.97Mpa at 28 days for M30 grade of concrete. The flexural strength are increased to 8 % on FRC compare to the conventional concrete.
- ✓ Based on this experimental investigation optimum dosage is 1.0% of fibers.

VI. REFERENCES

[1]. Biel, T.D. and H. Lee, 1994. Use of recycled tire rubbers in concrete. In: Proceedings of ASCE 3rd Material Engineering Conference Infrastructure: New Materials and Methods of Repair, San Diego, CA pp: 351-358.

[2]. Chung,K., and Hong, Y. (1999). Introductorybehavior of rubber concrete." Journal of Applied Polymer Science, 72, pp: 35-40.

[3]. FuminoriTomosawa, Takafumi Noguchi and Masaki Tamura, 2005. The way concrete recycling should be. J. Concrete. Technology, 3 pp: 3-16.

[4]. Gregory GRRICK, 2004. Analysis of waste tire modified concrete. In: 2004 ME Graduate student Conference, Louisiana State University.

[5]. Guoqiang Li, Michael, A. Stubblefield, Gregory Garrick, John Eggers, Christopher Abadic and Baoshan Huang, 2004.Development of waste tire modified concrete, J. Cement. Concrete. Res., 34 pp: 2283-2289.