An Experimental Work on Green Blocks Composed of Locally Available Waste Materials with Polypropylene Fiber.

Comparison of compressive strength in between Normal mix & Green concrete.

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Abstract—More recently fibers such as those used in traditional composite materials have been introduce to increase it's toughness or ability to resist crack growth. Compared with full-dispersed polypropylene fiber has advantages in its thinness, large amount, non-water absorbency, strong acid & alkali resistance and similar elastic modulus with that of concrete. Mainly application is Increase seepage resistance, Improve steel protection, Increase cracking resistance, Increase fire resistance, Strengthen spurt & fatigue, Improve plastic deformity. And It's uses are Projects like concrete road, bridge, airport road and factory floor which strictly require cracking resistance. In this research study aim is comparison of compressive strength between normal mix concrete & green concrete blocks composed by locally available waste materials with Polypropylene fiber and reduce the cost of concrete. In this research study the (OPC) cement has been replaced by waste wooden chips & fine aggregate (sand) has been replaced by waste tyre rubber accordingly in the 15% by weight of M-30 grade concrete and also used polypropylene fiber as a additional material. Concrete mixtures were produced, tested and compared in terms of compressive strength to the conventional concrete. These tests were carried out to evaluate the mechanical properties for 3, 14 and 28 days. Then after 3, 14, & 28 days of curing work, we will perform analysis and measure compressive strength in normal mix concrete and green blocks with polypropylene fiber concrete.

Keywords- Waste wooden chips, Waste tyre rubber, Polypropylene fiber, Compressive Strength, Eco-Friendly, Locally available Waste, Low Cost, OPC Cement, Sustainable.

I. INTRODUCTION

Management of waste-tyre rubber is very difficult for municipalities to handle because the waste tyre rubber is not easily biodegradable even after long-period of landfill treatment (Guneyisi et al. 2004). However, recycling of waste tire rubber is an alternative. Recycled waste-tyre rubber have been used in different application. It has been used as a fuel for cement kiln, as feedstock for making carbon black, and as artificial reefs in marine environment (Siddique and Naik, 2004). It has also been used as a playground matt, erosion control, highway crash barriers, guard rail posts, noise barriers, and in asphalt pavement mixtures (Toutanji, 1996). Over the past two decades, research had been performed to study the availability of using waste tyre rubber in concrete mixes (Eldin and Senouci, 1993, Toutanji, 1996, Khatib and Bayomy, 1999, Siddique and Naik, 2004, Batayneh et al, 2008, Aiello and Leuzzi, 2010, and Najim and Hall, 2010). [1]
The discharge of waste tyres is expensive and the continuously decreasing numbers of landfills generates significant pressure to the local authorities identifying the potential sapplication for this waste products. The growing problem of waste tyre disposal in the world can be alleviated if new recycling routes can be found for the surplus tyres. One of the largest potential routes is in construction, but usage of waste tyres in civil engineering is currently very low. Ali and Ali (1996) found the evaluation of properties and failure characteristics of Portland cement concrete filled with different contents of fine rubber particles, replacing an equal amount of fine aggregate. [2]

In many countries, the wood industries generate a large amount of waste products. The low costs, the proximity of the sources and the potential pollution from wood wastes have led to studies into the possible use of the wood chippings as fibers in concrete. These types of material have several potential applications such as acoustic and thermal insulation, fire resistance cladding ect. This composite material also displays good thermal and insulating properties. [3]
The recycling of wood chippings, an industrial waste product, has a potential use in the production of a lightweight concrete. In modern countries, the low cost and the proximity of supply makes this material a good candidate for local building applications. This study aims to examining the ability of enhancing of a wood fibre lightweight concrete strength by reinforcing it with lathe scrap from lathe industry. [3]

II. EXPERIMENTAL MATERIALS

2.1 Standard Concrete Materials:

2.1.1 Cement (OPC):

The Ordinary Portland Cement of 53 grades conforming to IS: 8112 is being used. [4]

Table-1.Physical properties of Cement (OPC) [4]

Property	**IS CODE (IS : 8112 – 1989)**
Specific Gravity	3.12
Consistency	33
Initial setting time	30 minimum
Final setting time	600 maximum

2.1.2 Aggregate:

Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is a good gradation of aggregates. Good grading implies that a sample fraction of aggregates in required proportion such that the sample contains minimum voids. Samples of the well graded aggregate containing minimum voids require minimum paste to fill up the voids in the aggregates. Minimum paste means less quantity of cement and less water, which are further mean increased economy, higher strength, lower shrinkage and greater durability. [4]

2.1.3 Coarse Aggregate:

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 is being use. The Flakiness and Elongation Index were maintained well below 15%. [4]

2.1.4 Fine aggregate:

Those fractions from 4.75 mm to 150 microns are termed as fine aggregate. The river sand is used in combination as fine aggregate conforming to the requirements of IS: 383. The river sand is washed and screen, to eliminate deleterious materials and oversize particles. [4]

Table-2.Properties of fine aggregate, Course aggregate [4]

Property	**Fine Aggregate**	**Coarse Aggregate (20mm down)**	**Coarse Aggregate (10 mm down)**
Fineness modulus	3.35	7.54	3.19
Specific Gravity	2.38	2.76	2.69
Bulk Density (gm/cc)	1753	1741	1711
Water absorption (%)	1.20	1.83	1.35

2.1.5 Water:

Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since it helps to from the strength giving cement gel, the quantity and quality of water are required to be looked into very carefully. [4]

2.2 Waste Materials:

2.2.1 Waste tyre rubber:

Crumb rubber that replaces for sand (Figure 1), is manufactured by special mills in which big rubbers change into smaller torn particles. In this procedure, different sizes of rubber particles may be produced depending on the kind of mills used and the temperature generated (Ganjian et al.,2009). Sieve analysis for the sand and the crumb rubber was performed according to the ECP 203-2003 to determine the gradation of these materials. [1]

Figure 1. Waste crumb tire rubber [1]

2.2.2 Waste wooden chips:

Pine wood chippings passing from sieve of 600 micron. The network of capillaries in wood, which allow sap circulation, is responsible for the hydrophilic nature of wood. When mixed directly with cement, the wood chippings could potentially affect the water cement ratio, this could limit the water available for hydration due to migration of water into the wood particles. [3]

Figure 2. Waste wooden chips

2.3 Additional Material:

2.3.1 Polypropylene fiber:

Commercial success of polypropylene fibers as a filler material in Portland cement concrete (PCC) is due to their advantageous properties. The fibers are chemically inert, have hydrophobic surfaces, are very stable in the alkaline environment of concrete and resist plastic shrinkage cracking. Nevertheless, they also have some disadvantages – including poor fire resistance, sensitivity to sunlight and oxygen, a low modulus of elasticity, and poor bonding with the concrete matrix. The use of relatively low-modulus PP fibers does not yield substantial improvement of the tensile strength – but does significantly improve the flexural strength, toughness and ductility. Concrete reinforced with collated fibrillated PP-fibers (at relatively low volume fractions <0.3%) are used for: secondary temperature shrinkage reinforcement, overlays and pavements, slabs, flooring systems, crash barriers, precast pile shells and shotcrete for tunnel linings, canals and reservoirs. [5]

Figure 3. Polypropylene fiber

III. DESIGN MIX

A mix M30 grade was designed as per Indian Standard method (IS 10262-2009) and the same was used to prepare the test samples. The design mix proportion is done in Table 4.

3.1 Quantity of Normal mix M30 (As per IS code method):

Table-3. Quantity of Normal mix M30

Name of Materials	Quantity of 9 Cube	Quantity of 9 Cylinder
Coarse Aggregate: 20mm	25Kg	39Kg
Coarse Aggregate: - 10mm	10Kg	16Kg
Fine Aggregate	17Kg	27Kg
Cement	15Kg	23Kg
Water	6lit.	10lit.

3.2 Quantity of Green concrete M30:

Waste Wooden chips use dosage: cement to be replaced by 15% of total weight.
Waste Tyre rubber use dosage: sand to be replaced by 15% of total weight.
Polypropylene fiber use dosage 3% to 5% of cubic meter of concrete.

3.2.1 Quantity of 9 Cubic moulds:

Table-4. Quantity of Green concrete M30 for 9 cubic moulds

Name of Materials	Total Quantity	Name of Waste Materials	Replaced % of Waste Materials	Replaced Quantity of Waste Materials	Final quantity of Material
C.A.(20mm)	25 Kg	Nil	Nil	Nil	25 Kg
C.A.(10mm)	10 Kg	Nil	Nil	Nil	10 Kg
F.A.	17 Kg	Tyre rubber	15%	2.55Kg	14.45 Kg
Cement	15 Kg	Wooden chips	15%	2.25 Kg	12.75 Kg
Water	6 lit.	Nil	Nil	Nil	6 lit.

3.2.1 Quantity of 9 Cylindrical moulds:

Table-5. Quantity of Green concrete M30 for 9 cylindrical moulds

Name of Materials	Total Quantity	Name of Waste Materials	Replaced % of Waste Materials	Replaced Quantity of Waste Materials	Final quantity of Material
C.A.(20mm)	39 Kg	Nil	Nil	Nil	39 Kg
C.A.(10mm)	16 Kg	Nil	Nil	Nil	16 Kg
F.A.	27 Kg	Tyre rubber	15%	4.05 Kg	23 Kg
Cement	23 Kg	Wooden chips	15%	3.45 Kg	20 Kg
Water	10lit.	Nil	Nil	Nil	10lit.

Where, C.A. = Coarse Aggregate, F.A. = Fine Aggregate

After calculate the all quantity, we have to perform the concrete mix in mixer as per the above quantity and prepare 18 cubes(9 Normal mix, 9 Green concrete) & 18 cylinder(9 Normal mix, 9 Green concrete).

IV. RESULT & SUMMARY

4.1 Comparison of compressive strength in between normal mix and green blocks after 3, 14 & 28 days curing of cube.

Table-6. Comparison of compressive strength in between normal mix and green blocks after 3, 14, & 28 days curing of cube.

	NORMAL MIX	GREEN BLOCK
No. of Days	**Average Compressive Strength (N/mm^2)**	**Average Compressive Strength (N/mm^2)**
3	12.00	2.44
14	19.40	4.21
28	27.10	5.41

4.2 Comparison of compressive strength in between normal mix and green blocks after 3, 14 & 28 days curing of cylinder.

Table-7: Comparison of compressive strength in between normal mix and green blocks after 3, 14 & 28 days curing of cylinder.

	NORMAL MIX	GREEN BLOCK
No. of Days	**Average Compressive Strength (N/mm^2)**	**Average Compressive Strength (N/mm^2)**
3	16.31	4.52
14	20.27	5.68
28	27.07	5.75

4.3 Chart of Compressive strength v/s no. of days curing

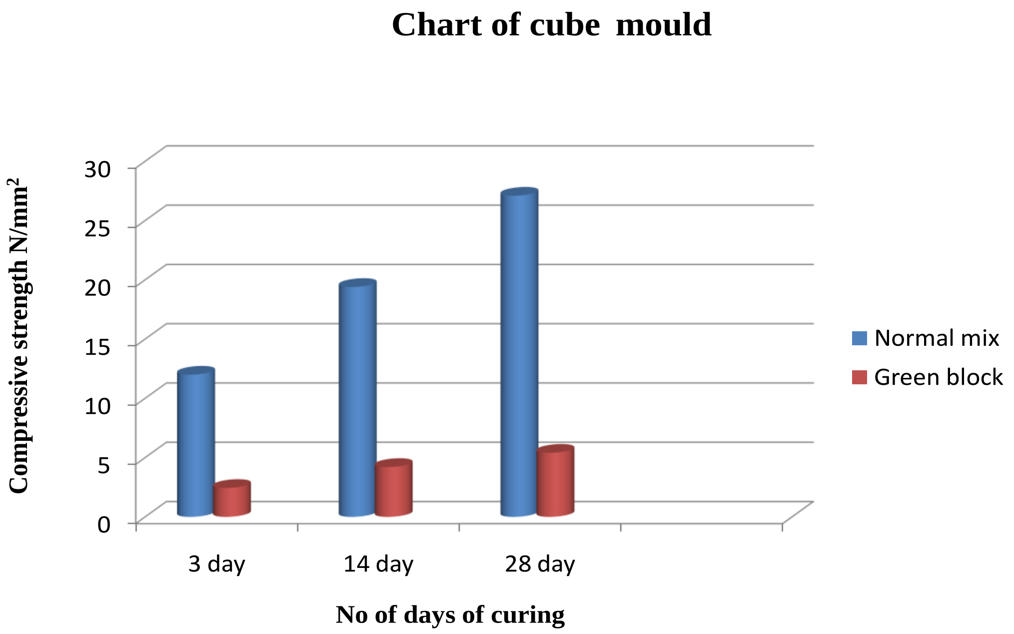

Figure 4: Chart of Compressive strength v/s no. of days curing for cube

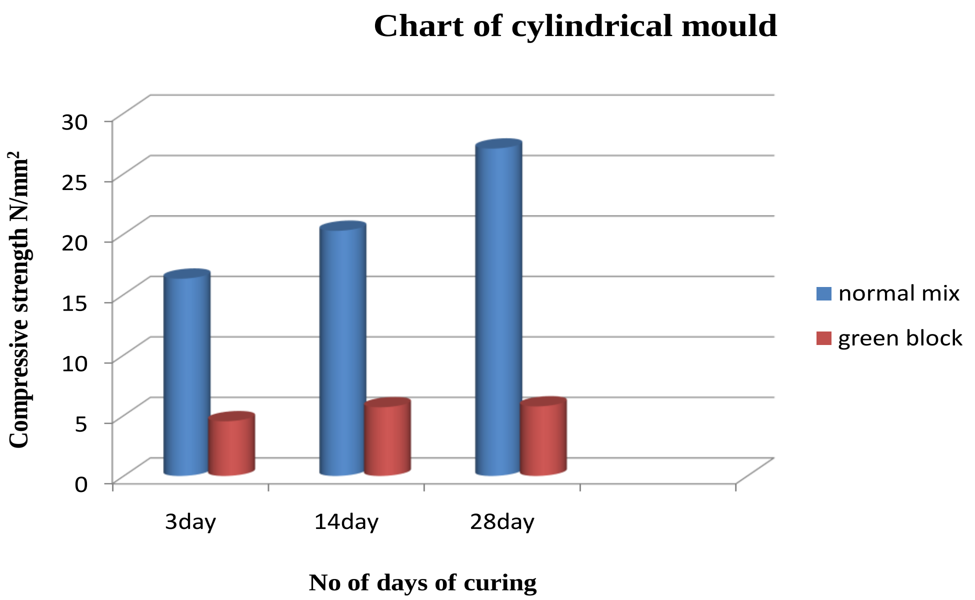

Figure 5: Chart of Compressive strength v/s no. of days curing for cylinder

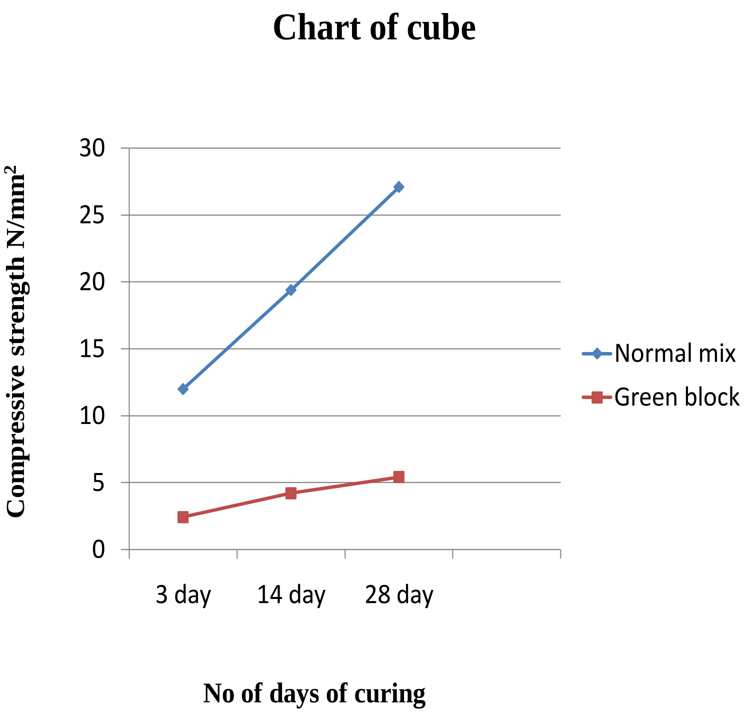

Figure 6: Chart of Compressive strength v/s no. of days curing for cube

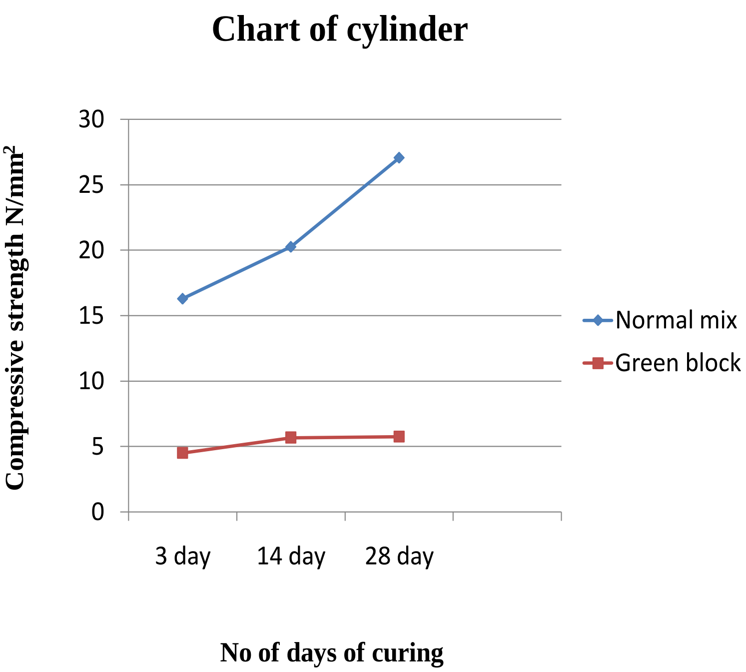

Figure 7: Chart of Compressive strength v/s no. of days curing for cylinder

V. CONCLUSION

Based on the above discussions the research concluded the following:
1. In this paper an experimental work on green blocks, we conclude that after 28 days of curing, green blocks composed of locally available waste materials with polypropylene fiber, which gives lower compressive strength at 3, 14 and 28 days compare to normal mix concrete. Therefore, we cannot use this type of green blocks in any type of construction.

2. We can use locally available green material with polypropylene fiber but there is no increase in compressive strength of green concrete blocks.

3. After experiment of green blocks we have getting only 17% compressive strength of green blocks compare to the compressive strength of normal mix M30.

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