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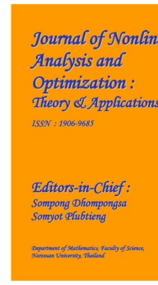

PLASTIC-CHAR COMPOSITE AS A PARTIAL REPLACEMENT OF CEMENT IN CONCRETE TO IMPROVE THE COMPRESSIVE STRENGTH

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ABSTRACT:
One obvious source of carbon dioxide emissions worldwide is concrete. In order to improve the mechanical properties and carbon capture capability of cement composites, a variety of pulverized biochar materials have been utilized recently [**1**].The increased carbon footprint of the construction industry has created a need to manage and reduce CO2 emissions [**2**]. Carbon dioxide emissions in the construction industry are affected by many factors, such as raw material production, cement production, and especially the construction process. The release of plastic waste into the environment is considered a serious problem due to its low biodegradability and large quantities [**3**]. Almost 4.2 billion tons of single-use plastic waste accumulates every year around the world and it has become one of the biggest problems of the moment, so one way to solve this problem is to check the possibility of using plastic waste in concrete partial replacement of cement [**4**]. This work investigates the possibility of using a plastic carbon composite as a partial substitute for cement, which is a carbon-rich and porous solid by-product obtained from the collision of biomass and low-density polyethylene plastic (LDPE) under controlled conditions [**5**]. In concrete the physical and chemical properties of the plastic carbon compound are analysed, and then it is added to the concrete mix as a substitute for cement in different weight percentages of cement 1%, 3%, 5%, 7%. of concrete [**6**]. The effects of replacement of cement with plastic-char composite will be evaluated based on changes in the physicochemical and mechanical properties of concrete, as well as on the internal matrix microstructure as compared to a reference concrete of M30 grade [**7**].Keywords: Plastic-char, plastic char concrete cubes, Compression strength

INTRODUCTION

Concrete is the most commonly used building material in the world due to its high compressive strength and low cost [**8**]. As countries develop, the demand for concrete is huge. Concrete structures have been developed since 6500 BC, and over time this material has undergone many changes [**9**]. In the 19thcentury, concrete was mostly used material in industrial buildings. As the demand for concrete increased, newer methods were developed [**10**]. Concrete damages the surface of the earth. Concrete is a mixture of cement, aggregates and water, in addition, chemical mixtures are added if necessary [**11**]. Global demand for new concrete buildings is growing rapidly in line with urban development. Recycling plastic is possible, but burning plastic releases toxic substances that dissolve large amounts of plastic [**12**]. It can be used for new plastic waste after processing. The use of LDPE waste in concrete is a partial solution to the environmental problem [**13**]. Polyester It has stronger material properties, harder, opaque and more resistant to high temperatures. Polyester is used in a variety of applications, including plastic bottles, milk jugs, shampoo bottles, bleach bottles, cutting boards and pipes [**14**]. Polyester plastic has a high impact resistance and melting point [**15**].

1. MATERIALS USED

- Cement: It is a binding material is used for construction. Cement binds other materials together fastly. Cement is seldom used on its own, but rather to bind fine aggregate and coarse aggregate together [**16**]. In construction of the structures OPC and PPC cements are used.
- Fine aggregates: Fine aggregates are sand which is made by erosion or broken pebbles and weathering of rocks which is transported from land or seas or rivers or any other marine environment. Sand ranging in size from 0.06mm to 2mm [**18**].
- Coarse aggregates: Coarse aggregates are the granular materials and irregular which is gravel, crushed stone and used for preparing concrete. These aggregates are naturally occurred and obtained by blasting quarries or crushing them by hand or crushers. These coarse aggregates are particulates that are greater than 4.75mm [**19**]. Ranging in size is between 9.5mm and 37.5mm in diameter [**20**].
- Water: water is the key component which is used to form as a paste when mixed with cement that binds the aggregate together [**22**]. Water is used because it causes the hardening of concrete through a process called hydration [**24**]. The amount of water in concrete controls many fresh and hardened properties of concrete including workability, compressive strength, permeability, durability and weathering for cracking [**25**]. Water cement ratio of the weight of water to the weight of cement used in a concrete mix. Water cement ratio that is used is 0.4 to 0.6 [**26**].
- Plastic char: Plastic biochar is a material produced by pyrolyzing (heating in the absence of oxygen) plastic waste at high temperatures. The process converts plastic into a stable form of carbon known as biochar [**28**], which can be used in various applications such as soil amendment for agriculture or as a carbon sink. The intention behind plastic biochar is to provide a sustainable solution for managing plastic waste while also creating a useful product

2. MIX CALCULATION

A. Design mix for M30 for $1m^3$

1. Calculation of target mean strength

$$fck = fck + 1.65x5$$
$$= 30 + 1.65*5$$
$$= 38.25\ N/mm^2$$

2. Water-cement ratio [**30**]
   Consider water-cement ratio=0.40 to 0.45 (From IS 10262, Table-5)
3. Size of aggregates
   Consider Fine aggregates = 4.75mm
   Coarse aggregates = 20mm
4. By reference of IS 10262-2009 CODE BOOK IS 456-2000
   Volume of cube =0.15*0.15*0.15 =$0.003375m^3$
   Water cement ratio =0.45

Slump value = 100mm
Refer IS 456 and IS 10262-2009
Max Water Content For 20mm Aggregate = 186liters (for 20-50mm slump)
Max Water Content For 100mm slump = 186 + 6/100 x 186 = 197 litres
Cement Content = 197/0.45= 437 Kg
Cement content in m^3 = 437/3.15 x 1/1000 = 0.138 m^3
Water content in m3 = 197/1000 = 0.197 m^3
Total Aggregates = 1- (0.138 + 0.197) = 0.665 m^3
Material weight [**32**] = material volume x percentage of total volume x material specific gravity x 1000
Fine aggregates = 0.665 x 0.3 x 2.72 x 1000= 542.64 kg
Coarse Aggregate = 0.665 x 0.4 x 2.8 x 1000= 744.8 kg
Dry Concrete = 1m
Wet Concrete = 1 x 1.52= 1.52 m^3
Cement content = 0.138 x 1.52 = 0.209 m^3
Mass of cement = 660.744 kg
Water = 0.197 x 1000 x 1.52 = 299.44 litres
Coarse aggregates = 744.8 x 1.52= 1132.096 kg
Fine aggregates = 542.69 x 1.52 = 824.88 kg
Quantities For 1 Cube:
Volume Of Cube = 0.003375m^3
Cement content = 0.003375 x 660.744= 2.23 kg=2.4 kg
Water content = 0.003375 x 299.44= 1.01 litres
Coarse Aggregates= 0.003375 x 1132.096 = 3.8 kg
Fine Aggregates = 0.003375 x 824.88 = 2.8 kg

3. METHODOLOGY

A. Materials and grade of mix
- For this mix required materials are woodchips, low density polyethylene plastic (LDPE) [**35**], cement, fine aggregates, coarse aggregates.
- Now select the appropriate mix design and calculating the proportioning of materials in the ratios.
- Now take the mix proportions are mentioned in the above calculations

B. Preparing the surface of cubes
- Initially take the required amount of materials as per the mixed design.
- Cast the cubes [**36**] of size 150mm*150mm*150mm in 1%,3%,5%,7%,9%.
- Dry them for 24 hours and then removed the moulds. Place the cubes in water for curing.
- Test the cubes for 3days, 7days & 28days to obtain the results [**37**].

C. Measuring of materials
- Calculate the required quantity of materials for the cubes as per the mixed design ratio.
- Now measure the material quantities and measure the cubes accordingly.

D. Mixing of Concrete
- Initially mixing should be done by placing and mixing all ingredients withoutany water [**38**].
- After uniform mix place the water as per the water cement ratio and mix the ingredients with in time of 5 min of pouring water.
- Mixing should be done fastly to gain good strength and reduces the slump also [**39**].

E. Placing of concrete
   - Then place concrete in the moulds which previously prepared with in 30 min of mixing and fixed the moulds tightly to avoid the leakages of water [**40**].
   - If placing is delayed the concrete becomes harder and reduces the properties of concrete like strength and durability [**41**].

F. Compacting and Finishing
   - Now compacting should be done to avoid pores and compaction improves the strength of the concrete. It should be done machine or hand compaction [**42**].
   - For smooth surface the finishing should be done by the trowels and removing the excess of concrete to make even surface [**44**].

G. Demoulding and Curing
   - After 24 hours the demould the moulds and remove the cubes [**45**].
   - Then curing will takes place where curing should be done in the period of 3 days, 7 days & 28 days by placing the cubes in water [**46**].
   - The curing time should be maintain accurately because the proper curing leads to increase in strength and reduces shrinkage and cracks [**48**].

H. Testing the cubes
   - Remove the cubes from water and dry the cubes before the test [50].
   - Now place the cubes carefully in the middle [**52**] of Compression Testing Machine (CTM).
   - Now SWITCH ON the machine and then apply load gradually [**53**] on the cube and observe the cube when it started to crack [**54**].
   - Note down the readings from CTM where the cracks are observed on the cubes.

4. RESULT

M30 CONCERTE CUBES WITH PLASTIC CHAR									
S.NO	MIX RATIO	% PALSTIC CHAR USED	GRAMS	COMPRESSION STRENGTH(N/mm^2)			% INCREASE IN STRENGTH(N/mm^2)		
				3 DAYS	7 DAYS	28 DAYS	3 DAYS	7 DAYS	28 DAYS
1	1:0.75:1.5	0	0	15	18	31	-	-	-
2	1:0.75:1.5	1	25	16	25	33	6	38	6
3	1:0.75:1.5	3	75	19	22	35	26	22	13
4	1:0.75:1.5	5	125	12	15	25	-20	-16	-19
5	1:0.75:1.5	7	175	10	14	24	-33	-22	-22
6	1:0.75:1.5	9	225	8	12	20	-46	-33	-35

TABLE 1: - COMPESSIVE STRENGTH OF NORMAL & PLASTIC CHAR CUBES& PERCENTAGE INCREASED

Fig1: - COMPARSION OF 1% PLASTIC CHAR CONCRETE CUBE WITH NORMAL CONCRETE CUBE

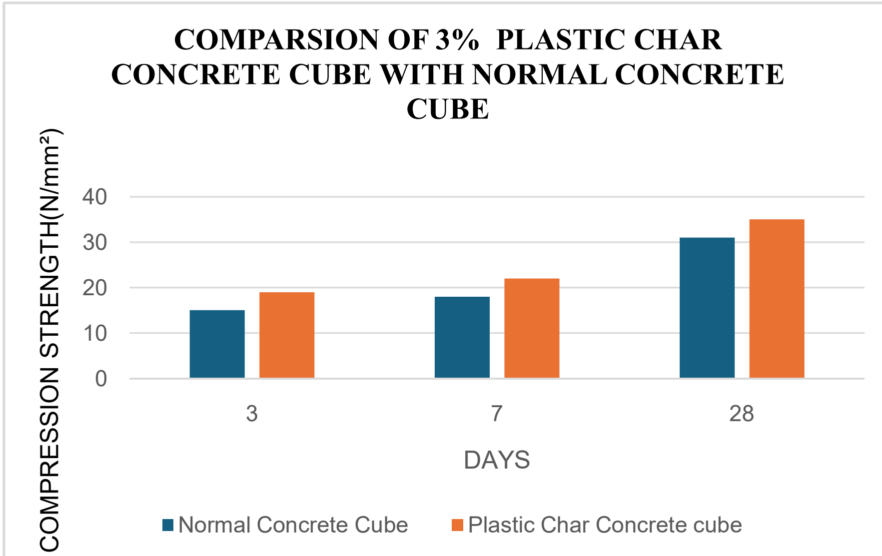

Fig2: - COMPARSION OF 3% PLASTIC CHAR CONCRETE CUBE WITH NORMAL CONCRETE CUBE

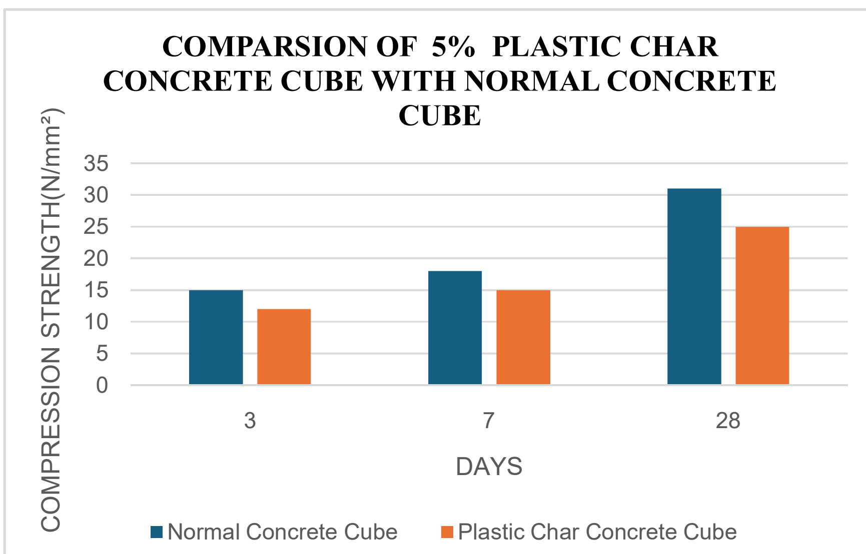

Fig3: - COMPARSION OF 5% PLASTIC CHAR CONCRETE CUBE WITH NORMAL CONCRETE CUBE

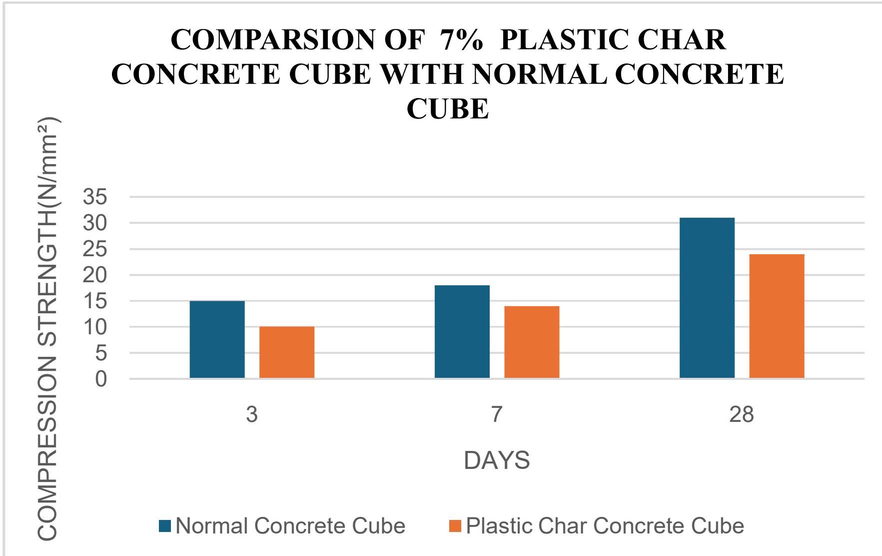

Fig4: - COMPARSION OF 7% PLASTIC CHAR CONCRETE CUBE WITH NORMAL CONCRETE CUBE

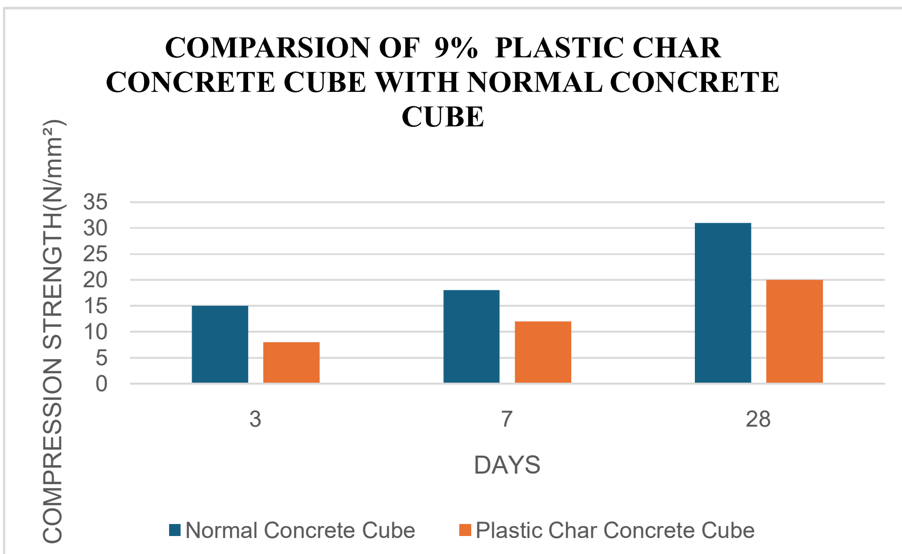

Fig5: - COMPARSION OF 9% PLASTIC CHAR CONCRETE CUBE WITH NORMAL CONCRETE CUBE

5. CONCLUSION

Plastic char is done by the combination of wood chips and plastic to shows the strength. The efficient use of plastic char in cement concrete cubes are maximum at 1%,3% of its weight, then by adding more than 3% of plastic char in cement concrete cubes it loses its original characteristic strength. The above table show us the characteristic compressive strength of cement concrete cubes(150mmX150mmX150mm) With some % replacement of plastic char of its weight, The cement concrete cubes with 1% ,3% replacement of plastic char with its weight (25gm and 75gm) help to gain its original characteristic compressive strength, if we add more than 3% plastic char in cement concrete, the concrete cube loses its original strength.

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