EXPERIMENTAL INVESTIGATION ON FIBRE REINFORCED CONCRETE USING WASTE MATERIALS

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ABSTRACT:
Advancements in technology enhances not only human comforts but also damages the environment. Use of metals as containers has become popular and safe now, especially to carry the liquids. Inspite of the inherent advantages and disadvantages existent in its disposal. Today the construction industry is in need of finding cost effective materials for increasing the strength of concrete structures. Hence an attempt has been made in the present investigations to study the influence of addition of waste materials like lathe waste, soft drink bottle caps, empty waste tins, waste steel powder from workshop at a dosage of 1% of total weight of concrete as fibres. The lathe waste, empty tins, soft drink bottle caps were deformed into the rectangular strips of 3mm width and 10mm length. Experimental investigation was done using M25 mix and tests were carried out as per recommended procedures by relevant codes. The results were compared with conventional concrete it was observed that concrete blocks incorporated with steel powder increased its compressive strength by 41.25% and tensile strength by 40.81%. Soft drink bottle caps reinforced blocks exhibited an increase in flexural strength of concrete by 25.88%.

KEY WORDS: *fibre, fibre reinforcement, metal wastes, waste disposal.*

1. INTRODUCTION
Use of admixtures to concrete has long been practised since 1900. In the early 1900s, asbestos fibres were used in concrete, and in the 1950s the concept of composite materials came into being and fibre reinforced concrete was one of the topics of interest. There was a need to find replacement for the asbestos used in concrete. By the 1960s, steel, glass (GFRC) and synthetic fibres such as polypropylene fibres were used in concrete, and research into new fibre reinforced concrete continues today. Concrete in general weak in tensile strength and strong in compressive strength. The main aim of researchers or concrete technologists is to improve the tensile strength of concrete. To overcome this serious defect partial incorporation of fibres is practised. Great quantities of steel waste fibers are generated from industries related to lathes, empty beverage metal cans and soft drink bottle caps. This is an environmental issue as steel waste fibres are difficult to biodegrade and involves processes either to recycle or reuse.

Fibre reinforced concrete is an interesting topic discussed by numerous researchers in the last two decades. Venu Malagavelli and Neelakanteswara Rao Paturu (2011), investigated the impact of cement bags waste (High Density Polyethylene (HDPE)) on concrete, and found that when the percentage of fibre in concrete was 3.5% its compressive and tensile strength increased considerably [1]. Zainab and Enas (2010) observed that the mixture of iron filings and plastic waste materials could be used successfully as partial substitutes for sand in concrete composites [2]. Kandasamy.R and Murugesan.R (2011)added 0.5% by volume of polythene (domestic waste polythene bags) fibre to concrete and the cube compressive strength, increased by 5.12%,3.84% and 1.63% respectively[3]. In the current investigation the effects on the properties of concrete when added with different steel fibres are studied.

2.EXPERIMENTAL PROGRAM
2.1 MATERIALS
2.1.1. Cement: Pozzolona Portland Cement is used in this experiment. The properties of Cement are as follows:

Table 1: Properties of Cement

Property	**Specific Gravity**	**Fineness**	**Initial Setting Time**	**Final setting Time**	**Standard Consistency**	**Compressive Strength**
Value	3.00	97.80	1hr 08min	9hr 28min	30.00%	54.28 N/mm^2

2.1.2 Fine Aggregate: Clean River sand is used as fine aggregate. The specific gravity and fineness modulus were found to be 2.65 and 2.54 respectively. The properties are tested as per IS 383:1970.

2.1.3 Coarse Aggregate:
Machine crushed granite obtained from a Local Quarry was used as coarse aggregate. Its properties are tested as per IS 383:1970andare given in the table.2.

Table 2: Properties of Coarse Aggregate

Property	**Specific Gravity**	**Fineness modulus**	**Crushing strength**	**Impact value**	**Abrasion value**	**Water absorption**
Value	2.70	6.45	2.57 N/mm^2	7.2%	4.05%	0.5%

2.1.4 Waste materials:
The metallic wastes obtained from various sources such as mild steel lathe waste, empty beverage tins, soft drink bottle caps are deformed into the rectangular form with an approximate size of 3mm wide and 10mm long as in the form of fibres. These fibres are added in the concrete with 1% by weight of concrete.

Fig 1: Various Waste Materials

2.2 MIX PROPORTIONS
The concrete mix is designed as per IS 10262 – 2009 [11], IS 456-2000 [12] and SP23 [13] for the normal concrete. The grade of concrete which we adopted wasM25 with the water cement ratio of 0.45.

2.3 TEST SPECIMENS:
Cubes of size 150mm X150mm X150 mm, cylinders with 150mm diameter X 300mm height and prisms of size100mmX100mmX500 mm were prepared using the standard moulds. The samples are casted using the four different waste materials. The samples are demoulded after 24 hours from casting and kept in a water tank for 28 days curing. A total of 45specimens are casted for testing the properties such as compressive strength, split tensile strength and flexural strength. The details of the specimen and their notations are given below in table.3.

Table: 3. List of Specimens

S. No	Notation	Cube (nos)	Cylinder (nos)	Prism (nos)
1	C (conventional)	3	3	3
2	W1 (soft drink bottle caps)	3	3	3
3	W2(beverage tins)	3	3	3
4	W3 (steel powder)	3	3	3
5	W4 (mild steel lathe waste)	3	3	3

3. RESULT AND DISCUSSION

After the detailed investigation on different strength parameters has been done, the following result has been achieved.

1. The specimens added with the waste metals have a significant result over the compressive strength. The compressive strength for the specimens W1, W2, W3, W4 were found to be 19.04%, 11.11%, 41.25% and 21.43% respectively greater than that of the conventional concrete, as shown in fig.2.

Table: 4 Different strength values after 28 days of curing

S.No	Notation	Compressive Strength N/mm^2	Split Tensile Strength N/mm^2	Flexural Strength N/mm^2
1	C	28	2.72	3.4
2	W1	33.33	3.42	4.28
3	W2	31.11	3.44	3.73
4	W3	39.55	3.83	4.2
5	W4	34	3.43	3.84

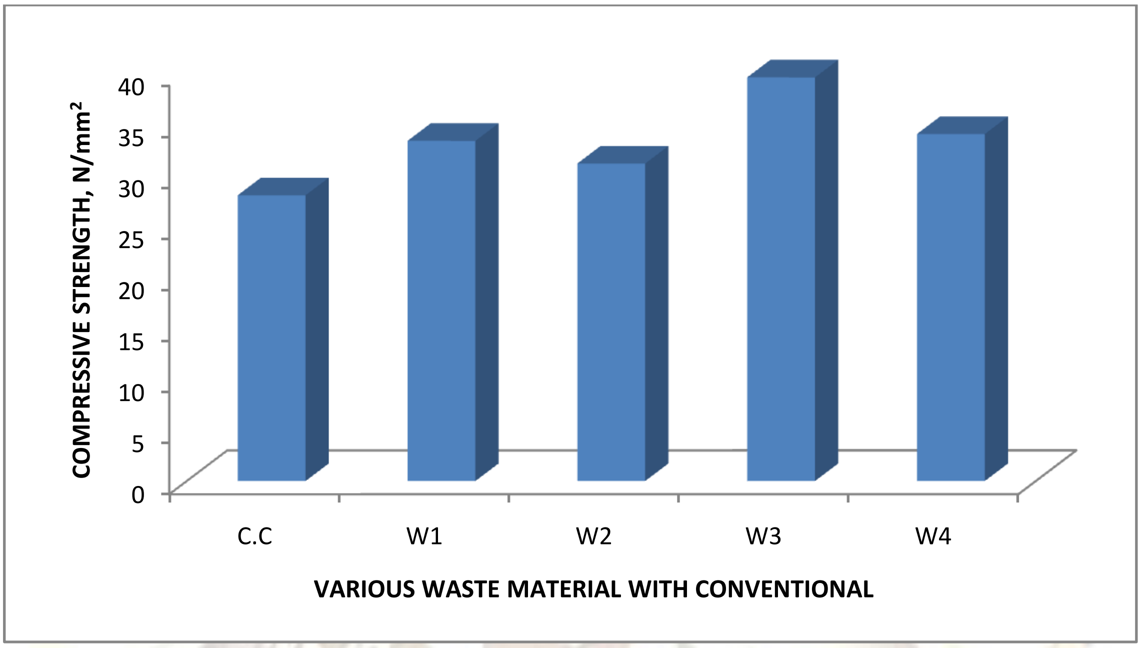

Fig 2: Compressive Strength of Concrete vs Various Waste Material

2. The specimens W1, W2, W3, W4 also have a positive effect on the split tensile property. The tensile strength of those specimens were found to be 25.74%, 26.47%, 40.81% and 26.10% greater than that of the conventional concrete and is shown in fig.3.

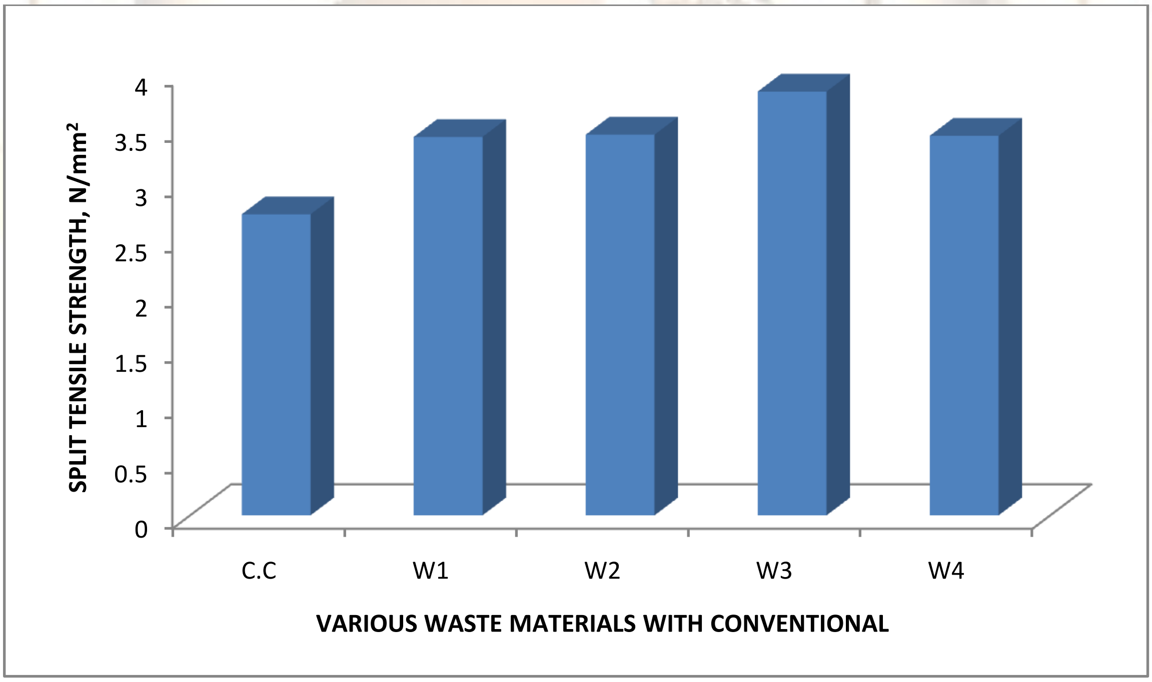

Fig 3: Split tensile Strength of Concrete vs Various Waste Material

3. Similarly the flexural strength also has been increased due to the addition of those waste materials. The percentage increase of flexural strength of the specimens W1, W2, W3, W4 were found to be 25.88%, 9.70%, 23.53% and 12.94% respectively, as depicted in fig.4.

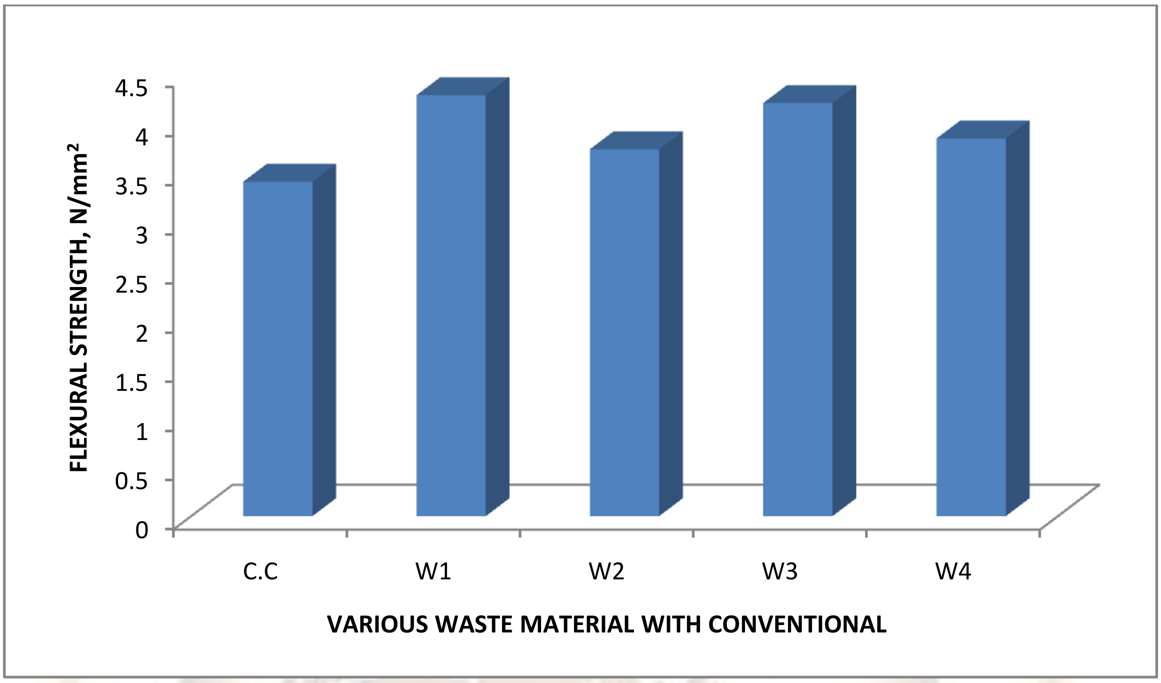

Fig 4: Flexural Strength of Concrete vs Various Waste Materials

Fig 5: Failure Modes of Specimens

4. CONCLUSION

The following conclusions have been made based on the results obtained from the experimental investigation.

1. The specimen with steel powder as waste material was found to be good in compression which had the compressive strength of 41.25% more than the conventional concrete.

2. Better split tensile strength was achieved with the addition of the steel powder waste in concrete. The strength has increased upto 40.87% when compared to that of the conventional concrete specimen.

3. In flexure the specimen with soft drink bottle caps as waste material was found to be good. While adding the soft drink bottle caps the flexural strength increased by 25.88% that of the conventional concrete.

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