Experimental Investigation of Steel Waste Generated From Lathes as Fiber Reinforced Concrete

Gopalsamy.P[1] Sundar V[2] Yasar Arafath N[3] Harif Khan M[4] Rajeshkumar.T.T[5]
[1,2,3,4,5]Department of CivilEngineering
[1,2,3,4,5]MAMCET, Trichy, Tamilnadu, India-621105

Abstract— This project is achieved to study the effect of using industrial steel wastes that resulted from lathes as fiber reinforced concrete. Lathe waste is mild steel quality material which is representing an environmental issue and its management by recycling it with concrete is considered to be a good solution. This steel lathe waste is bought at a cost of Rs 10/kg. Experimental investigation for the materials is performed based on the experiments done, we decided to make four types of cubes conventional cube, cube with 2% of lathe steel waste as fiber, cube with 4% lathe steel waste as fiber, cube with 6% of lathe steel waste fiber. To know the spilt tensile strength and flexure strength, cylinder and beam specimens were casted with the same 2%, 4%, 6% in addition of fibers. These cubes, beam, cylinder is made with mix design of M25 and left for 14days and 28 days curing. The results shows that the addition of lathes steel waste fibers into the plain concrete mixture enhanced its compressive strength while it decreased the workability of the fresh concrete containing the steel waste fibers.

Key words: Lathe waste, Split tensile strength, Flexure strength, Compressive strength

I. INTRODUCTION

A. General:

Conservation of natural resources and preservation of environment is the essence of any development. Nature has a way of clearing off some of mess by process of biodegradation but not certain products have come up which are non-biodegradable. One way of reducing such wastes is the process of recycling and this is a solution in many areas. Great quantities of steel waste fibers are generated from industrial lathes per year especially when lathes are existing in a large numbers sited in industrial zones. This really represents an environmental problem since that steel waste fibers are difficult in biodegradation and need a large area if it will store. A good management of such a solid waste is to find the way to make use of it in addition to dispose it. Fiber reinforced Concrete (FRC) is a composite material consisting of hydraulic cement, sand, coarse aggregate, water and fibers. In this composite material, short discrete fibers are randomly distributed throughout the concrete mass. The behavioral efficiency of this composite material is far superior to that of plain concrete and many other construction materials of equal cost. Due to this benefit, the use of FRC has steadily increased during the last two decades and its current field of application includes: airport and highway pavements, earthquake-resistant and explosive-resistant structures, mine and tunnel linings, bridge deck overlays, hydraulic structures, rock-slope stabilization. Extensive research work on FRC has established that addition of various types of fibers such as steel, glass, synthetic, and carbon in plain concrete improves strength, toughness, ductility, post-cracking resistance, and etc . Literature survey indicated that very limited studies have been conducted on FRC using industrial waste fibers. Furthermore, with increasing in population and industrial activities, the quantity of waste fibers generated from various industries will increase manifold in the coming years. These industrial waste fibers can effectively be used for making high-strength low-cost FRC after exploring their suitability.

B. Objective:

The prime objectives of the study are

- To study the mechanical characteristics of the lathe waste.
- Analyzing the behavior and failure characteristics of lathe waste based composite material with well-accepted destructive testing technique.
- Correlating the results obtained from destructive testing of the lathe waste added concrete cube and ordinary cube with different mix design, which are kept under curing for 14 & 28 days.
- Minimizing the cost incurred in the construction of special structures in concreting.
- To complement the usage of admixtures with that of the steel lathe waste.

II. PROPERTIES OF MATERIAL

A. Cement:

Ordinary Portland cement of 43 grades in one lot was procured and stored in air tight container. The cement used was fresh i.e. used within three months of manufacture. It should satisfy the requirement of IS12262. The properties of cement are determined as per IS4031:1968 & results are tabulated.

S.No	Properties	Values
1	Fineness	10%
2	Initial Setting Time	28min
3	Final Setting Time	2-3hours
4	Standard Consistency	29%
5	Specific Gravity	3.15

Table 1: Properties of Cement

B. Water:

Ordinary drinking water available in the construction laboratory was used for casting all specimens of this investigation. Water helps in dispersing the cement even, so that every particle of the aggregate is coated with it and brought into ultimate contact with the ingredients. It reads chemically with cement and brings about setting and hardening of cement. It lubricates the mix and compact property. Potable water, free from impurities such as oil, alkalis, acids, salts, sugar and organic materials were used. The quality of water was found to satisfy the requirement if IS456-2000.

C. Lathe Waste:

Waste steel fibers which are cutting in uniformly pieces 2mm wide, 1mm thick and length of 50mm (straight or spiral as results in cut machines), are shown in Figure

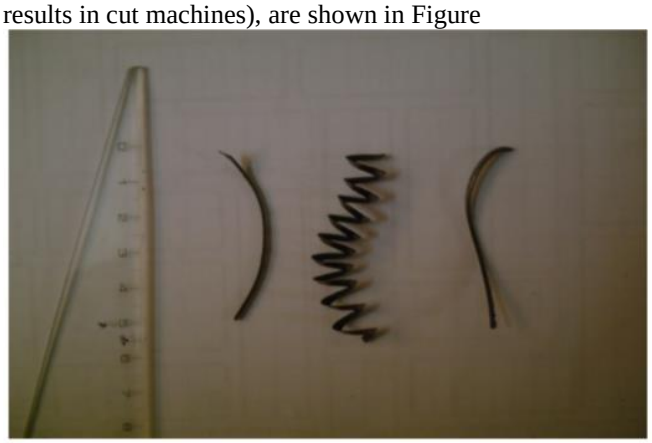


Fig. 1: Fiber lathe steel waste

Mild steel is a type of steel alloy, which contains a high amount of carbon as a major constituent. An alloy is a mixture of metals and non-metals, designed to have specific properties. Alloys make it possible to compensate for the shortcomings of a pure metal by adding other elements.

S.No	Consituents	Percentage
1	Manganese	1.65%
2	Copper	0.6%
3	Silicon	0.6%
4	Carbon	0.16% To 0.19%

Table 2: Chemical property of lathe steel waste

S.No	Property	Charcterstics
1	Density	7.85 Gm/Cm^3
2	Young's Modulus	210,000 Mpa
3	Aspect Ratio	40

Table 3: Physical property of lathe steel waste

III. EXPERIMENTS

A. Cube Compression Test:

The cubes of size 150x150x150mm are placed in the machine such that load is applied on the opposite side of the cubes as casted. Align carefully and load is applied, till the specimen breaks. The formula used for calculation

Compressive Strength= total failure load / area of the cube

B. Split Tensile Test:

The test is carried out by placing cylinder specimen of dimension 150mm diameter and 300mm length, horizontally between the loading surface of compression testing machine and the load is applied until failure of the cylinder along the vertical diameter. The failure load of the specimen is noted.

C. Flexural Test:

The test is carried out to find the flexural strength of the prism of dimension 100 x 100 x 500 mm. The prism is then placed in the machine in such manner that the load is applied to the uppermost surface as cast in the mould. Two points loading adopted on an effective span of 400 mm while testing the prism. The load is applied until the failure of the prism.

IV. RESULTS AND DISCUSSIONS

A. Compression Strength Test:

Initially the conventional specimens cube, cylinder, beam were casted for the comparison of test results of fiber added specimens. One set of specimens were taken out of the curing tank at the 14 days period completion the remaining specimens are taken after the 28 days period completion. The fibers added in concrete at three different ratios they are 2%, 4%, 6%.the test results of the conventional specimens are compared with fiber added specimens.

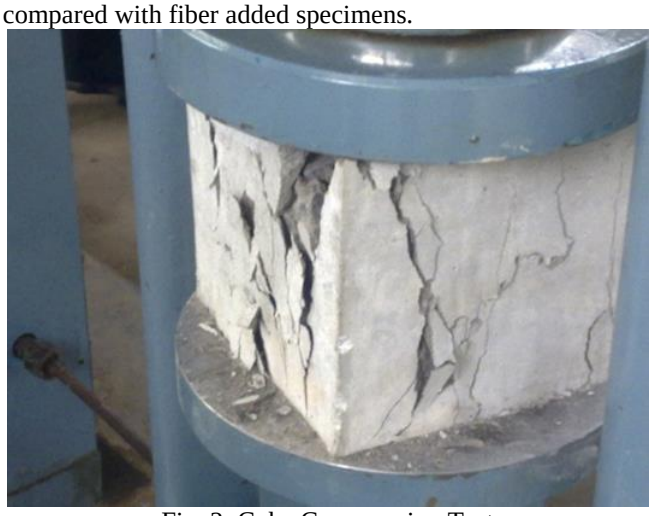
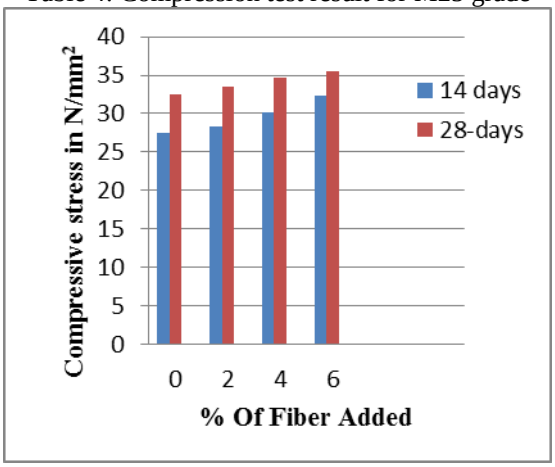


Fig. 2: Cube Compression Test

S.No	% of Fiber Added	Compressive strength Mpa (14days)	Compressive strength Mpa (28days)
1	0%	27.5	32.5
2	2%	28.3	33.5
3	4%	30.2	34.6
4	6%	32.4	35.5

Table 4: Compression test result for M25 grade



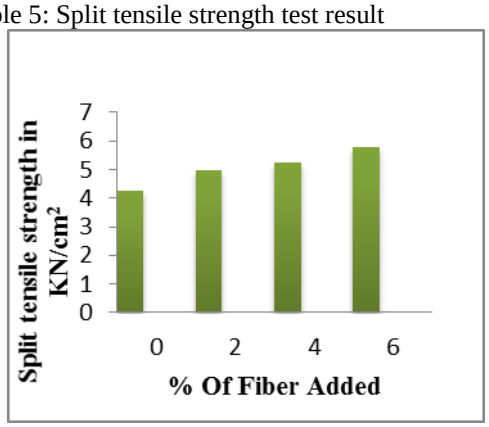
Graph.1: Compressive Strength test for 14 days & 28 days

B. Spilit Tensile Strength Test:

Initially the conventional specimens cube, cylinder, beam were casted for the comparison of test results of fiber added specimens. The casted specimens are allowed to under gone 28 days curing period. The fibers added in concrete at three different ratios they are 2%, 4%, 6%.the test results of the conventional specimens are compared with fiber added specimens.

S.No	% of Fiber Added	Split Tensile KN/mm^2 (28days)
1	0%	4.25
2	2%	4.98
3	4%	5.25
4	6%	5.78

Table 5: Split tensile strength test result



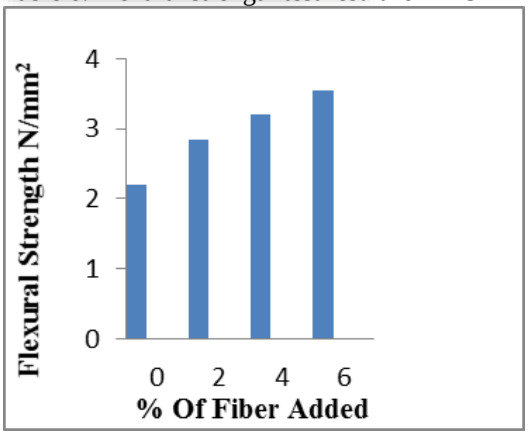
Graph 2: Split tensile strength test

C. Results for Flexural Strength Test:

Initially the conventional specimens cube, cylinder, beam were casted for the comparison of test results of fiber added specimens. The casted specimens are allowed to under gone 28 days curing period. The fibers added in concrete at three different ratios they are 2%, 4%, 6%.the test results of the conventional specimens are compared with fiber added specimens.

S.No	% of Replacement	Flexural strength N/MM^2 (28days)
1	0%	2.20
2	2%	2.85
3	4%	3.20
4	6%	3.55

Table 6: Flexural strength test result for m25 mix



Graph 3: Flexural strength test 28 days

V. Conclusion

Based on this experimental investigation the behavior of steel lathe waste and concrete was concluded below

- In terms of strength, it can be used for construction of structures subjected to seismic loading, impact loading, dynamic loading, etc loading.
- It is possible to make FRC with good strength.
- Adding of steel lathes waste fibers in plain concrete enhance its strength under compression.
- It may be a good environmental management of lathes steel wastes since a large quantity of steel wastes are generated from industrial lathes (3-4 kg/Day). The recycling represents a solution of that waste and makes use of it.

VI. Suggestion for Future Work

1) The percentage of adding fibers can be further increased above 6% up to in which specimen satisfied the project scope and their characteristics can be studied and use in the concrete construction works.
2) The steel lathe waste can be used in various grades of concrete.
3) There is scope for doing further investigation to increase the strength by analyzing durability properties.
4) Further this experiment can be extended to the field conditions, real time condition also.

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