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Effect of Lathe Machine Waste on Strength of Concrete

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ABSTRACT

The amount of lathe waste generated by lathes and CNC machines is 1200 million tons per year, and they are difficult to recycle. The effect of adding Lathe machine waste without pre-cleaning (covered with production lubricants and cooling oils) on the properties of concrete was investigated. A total of 24 number of concrete castings were cast out of which 6 were without fibres and remaining 18 were with fibre dosage of 0.4%, 0.8% ,and 1.2% by weight of cement for the concrete of M30 grade and were tested for their compressive strength and split tensile strength as per relevant Indian standard specifications The slump cone, air content, pH value, density, compressive strength, tensile strength, tensile splitting strength, elastic modulus, Poisson's ratio and thermal parameters were tested. The results of the slump cone test indicate the addition of different weight dosages of lathe scrap fibres to concrete has various effects on the ultimate workability of the concrete. The results of the compressive strength test shows that the compressive strength gradually increases when the percentage of fibre weight dosage is increased, it has a maximum value of compressive strength for 1.2% fibre weight dosage. Furthermore, Tensile strength test shows that different dosage of lathe scrap fibres also affect the ultimate capacity of concrete in tension. It shows that 0.4% fibre weight dosage rate was the optimum dosage applied to concrete.

Keywords– *Lathe waste; Concrete; Workability; Compressive Strength; Tensile Strength*

1. INTRODUCTION

Concrete is the most important construction material, which is manufactured at site. Concrete required for extensive construction activity can always be made available since all the ingredients of concrete are materials of geological origin. Various research and efforts have been made to obtain a durable, strong and economical concrete mix. The investigation reported in this project was carried out to study the feasibility of waste scrap fibres generated from lathe machines used in fibre reinforced concrete. This project work emphasis on the study of using lathe scrap as fibre reinforced concrete in the innovative construction industry. Every day about 10 to 20 kg of lathe waste are generated by each lathe industries and dumped in the barren soil there by contaminating the soil and ground water, which creates an environmental issue. Hence by adopting proper

management by recycling the lathe scrap with concrete is considered to be one of the best solutions as it also enhances the mechanical, physical chemical properties of concrete. Hence waste fibre from lathe industry were collected and used in this investigation. A total of 24 number of concrete castings were cast out of which 6 were without fibres and remaining 18 were with fibre dosage of 0.4%, 0.8%, and 1.2% by weight of cement for the concrete of M30 grade and were tested for their compressive strength and split tensile strength as per relevant Indian standard specifications.

1.2 Lathe waste

Generally concrete consists of cement, fine aggregate, coarse aggregate, water and Lathe waste. Their proportion in the concrete is predicated on grade of concrete and it determines the strength also. Now-a-days use of resources in the construction industry is high. This project is to replace the material in concrete for better improvement of concrete properties. The main aim of for this project is to increase the strength of the concrete. The characteristics of concrete with partial replacement of sand by steel lathe waste to standard M30 grade concrete are investigated in this study. Various other experimental studies conducted on lathe waste concrete

showed that there is considerable increase in the compressive strength when compared to conventional cement concrete. In this study, fine aggregate is being replaced with lathe waste at various percentages like 0.4%, 0.8% and 1.2% and characteristics of concrete like compressive strength, split-tensile strength are to be studied.

2. OBJECTIVE

To find the effect of lathe machine waste on the strength of concrete.

3. MATERIALS USED

3.1 Cement

We used Ordinary Portland cement is of grade 53 Prior to 1987, there was only one grade of OPC, which was governed by IS 269-1976. After 1987 higher grade cements were introduced in India. The oxide composition of the ordinary Portland cement is-

Type of Oxide	Percentage
CaO	60-67
SiO_2	17-25
Al_2O_3	3-8
Fe_2O_3	0.5-6
MgO	2.5
SO_3	1

Particulars	Test results	Requirements
Setting time		
A. Initial	180	Not < 30 mins
B. Final	200	Not > 600 mins
Soundness test Le-Chatelier	1.0	Not< 10 mm
Compressive strength		
A. 3 Days	33	Not < 27 MPa
B. 7 Days	43	Not < 37 MPa
C. 28 Days	54	Not < 57 MPa

3.2 Aggregate

The aggregate is the matrix or principal structure consisting of relatively inert, fine and course material. The aggregate for concrete varies in sizes, but in any mix the particles of different sizes are used. The particle size distribution is called the grading of aggregate. While producing good quality concrete the aggregate is used at least from two size groups.

- **Fine aggregate:** IS -383-1963 destines the fine aggregate as the aggregate which will pass through the 4.75 mm IS sieve. The find aggregate is often termed as sand size aggregate. The preliminary tests were conducted and the results are as follows.

Properties	Value Obtained
Type of aggregate	Crushed sand
Condition of sample	Moist
Moisture content	1.20%
Specific gravity	2.84
Water absorption	3.52 %

- **Coarse aggregate:** Coarse aggregate shall consist of crushed or broken stones and be hard, dense, durable, clean or proper gradation and free from skin and coating likely to prevent proper adhesion of mortar. The aggregate shall generally be cubical in shape as far as possible flaky , elongated pieces shall be avoided. Unless special stone of special quarries are mentioned in the special provisions, aggregate shall be broken from the best trap/granite/quartzite/genes stones in that order in the region and approved by the engine.

Properties	Value Obtained
Geometry	Angular
Specific gravity	2.93
Water absorption	1.00 %

3.3 Lathe waste

The fibre strength, stiffness and the ability of the fibres to bond with the concrete are important fibre reinforcement properties. The fibres are usually used in concrete to control cracking due to both plastic shrinkage and drying shrinkage. They also reduce the permeability of concrete. Hence generally fibres are added to increase the durability of concrete.

Lathe scrap, which exhibits the property of steel fibres largely can be used as an alternative for steel fibers in fibre reinforced concrete. We collected the lathe machine waste from the nearby lathe industry. The lathe waste resembles springs while some were straight. We did a random distribution of steel fibres while casting fibre reinforced concrete. We collected lathe scraps from workshops and other steel industries at very minimum cost. They were similar to the steel fiber but they don't have any regular shape and size. The dimension varies with nature of source that is depends upon the type of industries. Scraps considered in this work are 0.5mm thickness approximately.

4. MIX PROPORTIONS

The mix proportions are designed as per IS 10262-2009.

Cement	Fine aggregate	Coarse aggregate	Water
426 kgs	821 kgs	1124 kgs	192 kgs
1	1.92	2.63	0.45

5. CASTING OF SPECIMENS

5.1. Cube

After 24hrs of casting the moulds were removed and the specimens were cured in water for 28days. The size of the cube mould is 150 x 150 x 150 mm.

5.2 Cylinder

After 24hrs of casting the moulds were removed and the specimens were cured in water for 28days. The size of the cylinder mould is 150 x 300 mm.

6. TESTING

6.1 Slump cone test

Concrete slump test or slump cone test is to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction. The parameter used as the indicator of consistency of concrete is the slump height which is only related for the specific material being tested.

Generally concrete slump value is used to find the workability, which indicates water-cement ratio, but there are various factors including properties of materials, mixing methods, dosage, admixtures etc. also affect the concrete slump value.

% of lathe waste added	Slump values
0%	**82**
0.4%	**77**
0.8%	**74**
1.2%	**70**

6.2 Compressive Strength Test

Compressive strength of a concrete is a measure of its ability to resist static load, which tends to crush it. Most common test on hardened concrete is the compressive strength test. It is because the test is easy to perform. Furthermore, many desirable characteristics of concrete are qualitatively related to its strength and the importance of the compressive strength of concrete in structural design. The compressive strength gives a good and clear indication that how the strength is affected with the increase of fibre volume dosage rate in the test specimens.

Cubes of size 150*150*150 mm are cast and cured. These are tested in compression at the end of 28 days till failure occurs. The compressive strength of concrete can be calculated using the formula:

$$f'c = P \times 1000/A$$

Where,
$f'c$ = Compressive strength of concrete (MPa)
P = Maximum load applied to specimen in KN
A = Cross sectional area of specimen (mm2)

Results Of 28 days Compressive Strength for grade M30

% of lathe waste added	Sr. no	Load at failure (KN)	Strength at 28 days (N/mm^2)	Average strength (N/mm^2)
0%	1	764	33.95	**33.27**
	2	722	32.0	
	3	762	33.86	
0.4%	1	989	43.95	**42.79**
	2	940	41.77	
	3	960	42.66	
0.8%	1	1033	45.91	**44.88**
	2	983	43.68	
	3	1010	44.88	
1.2%	1	1054	46.84	**47.73**
	2	1074	47.73	
	3	1094	48.62	

6.3 Tensile Strength Test

Tensile strength is a measurement of the force required to pull something such as rope, wire, or a structural beam to the point where it breaks. Tensile strength of an can be measured by testing it with an Universal Testing Machine (or UTM). Unlike steel, the concrete is sufficient in strength only in one direction. The tensile strength of concrete is approximately one-tenth of the compressive strength and it is not generally used in the design of concrete structure. Nevertheless, it is an important property in many applications. Addition of fibre is one of the primary reasons to increase the tensile strength.

Concrete specimens for indirect tensile test were 150mm diameter and 300mm height. The specimen is first clamped in the upper chuck, and then the lower chuck to move to the appropriate clamping position, the final clamping the lower end of the specimen. The indirect tensile strength of concrete is calculated using the following formula:

$$f'ct = 2P \times 1000/\pi \times L \times D$$

Where,
f' ct = Tensile strength of concrete (MPa)
P = Maximum load applied to specimen in KN
L = Length of specimen in mm
D = Diameter of specimen in mm

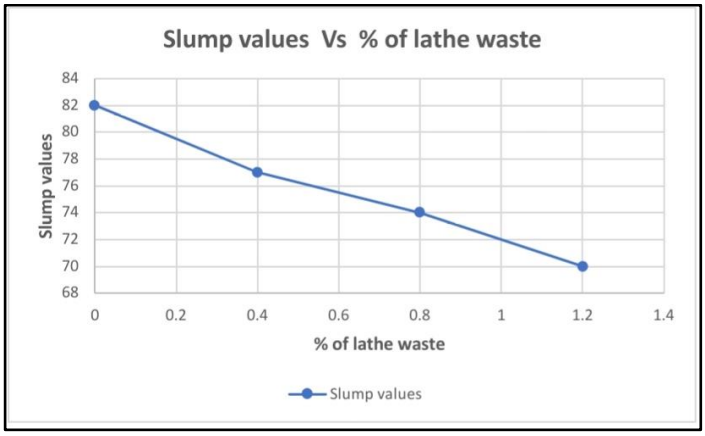
Results Of 28 days Tensile strength for grade M30

% of lathe waste added	Sr. no	Load at failure (KN)	Strength at 28 days (N/mm^2)	Average strength (N/mm^2)
0%	1	534	7.55	**7.45**
	2	525	7.43	
	3	522	7.38	
0.4%	1	638	9.03	**8.64**
	2	582	8.23	
	3	612	8.66	
0.8%	1	446	6.31	**5.99**
	2	406	5.74	
	3	420	5.94	
1.2%	1	485	6.86	**6.20**
	2	350	4.95	
	3	481	6.80	

7. RESULT AND DISCUSSION

7.1 Slump cone values

From fig. It is observed that the slump value of the concrete is in decreasing order as the dosage of lathe waste is increased. It indicates that there is a reduction in workability of concrete as the dosage is increased. Variation is shown in the fig.



7.2 Compressive strength

From fig. It is observed that the compressive strength of the concrete is in increasing order as the dosage of lathe waste is increased. Also, the compressive strength of concrete with lathe waste is greater than that of convention concrete. Variation is shown in below fig.

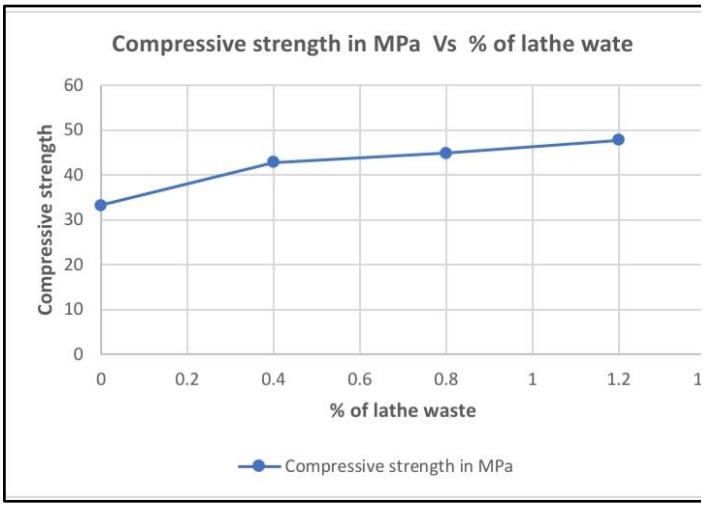


Fig. 7.1 Average Compressive strength in MPa Vs % of lathe wate

7.3 Tensile strength

From fig. It is observed that the tensile strength of the concrete increases for 0.4% of lathe waste dosage. Then there is a decrease in tensile strength for 0.8%. And then it again increases for 1.2% of dosage. Also, it is observed that the tensile strength for 0.4% of dosage is optimum as it is greater than that of convention concrete. Variation is shown in below fig.

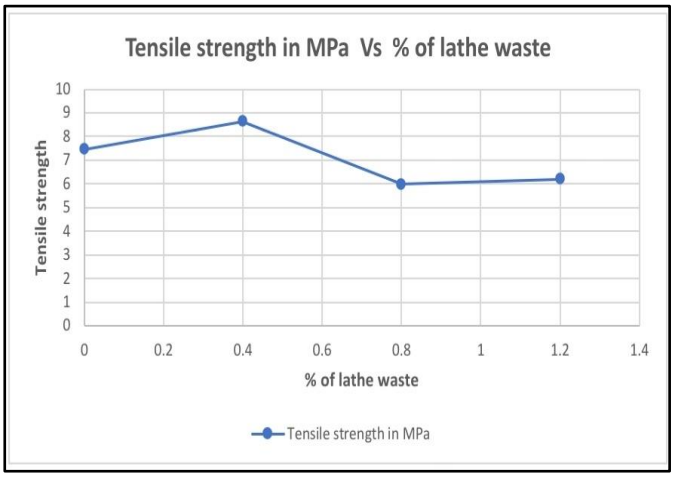


Fig. 7.2 Average Tensile strength in MPa Vs % of lathe waste

8. CONCLUSION

Slump cone test shows that the increase in lathe waste dosage in concrete decreases the slump values. It showed a decrease of 6.09% for 0.4% dosage, 9.75% for 0.8% dosage and 14.63% for 1.2% dosage.

Compressive strength test shows that the different dosage of the lathe waste affects the ultimate strength of the concrete in compression. It shows that 1.2% of lathe waste dosage was the optimum dosage applied to the concrete. It showed an increase of 28.61% for 0.4% dosage, 34.9% for 0.8% dosage and 43.46% for 1.2% dosage.

Also, tensile strength test shows that the different dosage of the lathe waste affects the ultimate strength of concrete in tension. It shows that 0.4% of lathe waste dosage was the optimum dosage applied to the concrete. It showed an increase of 15.97% for 0.4% dosage.

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