STRENGTH CHARACTERISTICS OF JUTE FIBRE AND LATHE WASTE ON CEMENT CONCRETE

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ABSTRACT:

These project works assess on the study of the mechanical properties (Compression and Flexure) of cement concrete using natural fibers (jute fibre) and artificial fibre (mild steel) and compare it with that of conventional concrete. The natural jute fibre can be the effective material to reinforce concrete strength which will not only explore a way to improve the properties of concrete; it will also explore the use of jute and restrict the utilization of polymer which is environmentally detrimental. Mild steel is a type of carbon steel with a low amount of carbon – it is actually also known as "low carbon steel." In this project mild steel is in the form of lathe scrap. The Lathe scrap is the waste collected from iron and steel industries. The amount of fibres added to a concrete mix is expressed as a percentage of the total volume of the composite (concrete and fibres), termed & quot; volume fraction & quot; (V) which ranges from 0.1% to 3% by volume of the concrete specimen. Hence Concrete blocks of mix percentages of 0.2% and 0.5% of fibers are used in this project for the fiber length of 20mm. Conplast SP430 is a chloride free, super plasticizing admixture based on selected sulphonated naphthalene polymers is used. Conducted the tests for different curing periods (7days, 14 days, and 28 days). Compressive strength as well as flexural strength of concrete increased as the curing period increased. Compressive strength of conventional concrete increased by 50% in the presence of 0.2% of jute fibres and increased by 45% in the presence of 0.5% of jute fibres. Flexural strength of conventional concrete increased by 8% in the presence of 0.2% of jute fibres and decreased by 7% in the presence of 0.5% of jute fibres. Compressive strength of jute FRC for 0.2% was reduced by 3% when 0.5% of jute fibres by volume of cube were used. Flexural strength of jute FRC for 0.2% was reduced by 14% when 0.5% of jute fibres by volume of beam were used. Compressive strength of mild steel FRC for 0.2% increased by 7% when 0.5% of mild steel fibres by volume of cube were used. Flexural strength of mild steel FRC for 0.2% increased by 17% when 0.5% of mild steel fibres by volume of beam were used.

Key Words: Jute fiber, Lathe waste, Compressive strength, Flexural strength.

INTRODUCTION:

FIBER REINFORCED CONCRETE (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers each of which lend varying properties to the concrete. In addition, the character of fiber-reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation, and densities.

Fibers are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water. Some types of fibers produce greater impact, abrasion, and shatter resistance in concrete. Generally, fibers do not increase the flexural strength of concrete, and so cannot replace moment–resisting or structural steel reinforcement. Indeed, some fibers actually reduce the strength of concrete.

The amount of fibres added to a concrete mix is expressed as a percentage of the total volume of the composite (concrete and fibres), termed "volume fraction" (V). V typically ranges from 0.1% to 3% by volume of the concrete specimen. The aspect ratio (l/d) is calculated by dividing fibre length (l) by its diameter (d). Fibres with a non-circular cross section use an equivalent diameter for the calculation of aspect ratio. If the fibres modulus of elasticity is higher than the matrix (concrete or mortar binder), they help to carry the load by increasing the tensile strength of the material. By increasing the aspect ratio of the fibre, the flexural strength and toughness of the matrix increases. However, fibres that are too long tend to "ball" in the mix and create workability problems. Some recent research indicated that using fibers in concrete has limited effect on the impact resistance of the materials. This finding is very important since traditionally, people think that ductility increases when concrete is reinforced with fibers. The results also indicated that the use of micro fibers offers better impact resistance to that of longer fibers.

MATERIALS USED

Fine Aggregate: Sand is a naturally occurring granular material comprising of finely divided rock and mineral particles. It is finer than gravel and coarser than silt. Sand is the fine aggregate whose size is less than 4. 75mm.In this project, clean and dry river sand which is available locally is used.

Coarse Aggregate: Coarse aggregates are the particles greater than 4.75mm. They range between 9.5mm to 37.5mm in diameter. They can be from Primary, Secondary or Recycled sources. Gravels constitute the majority of coarse aggregate used in concrete with crushed stone making up most of the remainder. In this project, coarse aggregates of maximum 20mm size and downsize aggregates which is locally available are used.

Water: Tap water is used in experimental study, in order to avoid any mineral interference in polymerization reaction. And water is also used for the preparation of sodium hydroxide solution and small percent by weight of water is added to concrete at the time of mixing in order to get good workability.

Super Plasticizer: Conplast SP430 is a chloride free, super plasticizing admixture based on selected sulphonated naphthalene polymers. It is supplied as a brown solution which instantly disperses in water. Conplast SP430 disperses the fine particles in the concrete mix, enabling the water content of the concrete to perform more effectively. The very high levels of water reduction possible allow major increases in strength to be obtained.

Jute Fibre: Jute fibres are totally biodegradable and recyclable materials, i.e., environmentally friendly materials. Jute fibres have good insulating properties for both of thermal and of acoustic energies with moderate moisture regain. The natural jute fibre can be the effective material to reinforce concrete strength which will not only explore a way to improve the properties of concrete; it will also explore the use of jute and restrict the utilization of polymer which is environmentally detrimental.

Fig1:Cutjutefibres

Mild Steel: Mild steel is a type of carbon steel with a low amount of carbon – it is actually also known as “low carbon steel.” Although ranges vary depending on the source, the amount of carbon typically found in mild steel is 0.05% to 0.25% by weight. Less carbon means that mild steel is typically more ductile, machinable, and weldable than high carbon and other steels, however, it also means it is nearly impossible to harden and strengthen through heating and quenching. In this project mild steel is in the form of lathe scrap. The Lathe scrap is the waste collected from iron and steel industries. The huge amount of waste products from Iron and Steel industries creates a land filling and hazardous to environment.

Fig2:Lathewaste(mildsteel)

EXEPERIMENTAL WORKS

SPECIFICATIONS

Type of cement	OPC53 grade(IS269)
Specific gravity	3.16
Fineness of cement	1.13
Initial setting time of cement	85minutes

Final setting time of cement	320minutes
Size of aggregate	20mm
Specific gravity of fine aggregate	2.64
Specific gravity of coarse aggregate	2.52
Fineness modulus of fine aggregates	6.54
Fineness of modulus for 20 mm coarse aggregate	5.31
Grade designation	M20
Maximum water-cement ratio	0.45
Chemical ad mixture type	Super plasticizer (ConplastSP430)

PREPARATIONOF TESTSPECIMENS:

In this project, we are using following specimens,

- Cube dimension:(150 X 150 X 150) mm
- Beam dimension: (100 X 100 X 500) mm

To find the compressive and flexural strength. Before pouring the mixture on to the moulds, the moulds are lubricated with oil or grease on the inner surfaces to prevent sticking of concrete mixture to the surface. After oiling, the mixture is poured into the specimens and compacted by using tamping rod in three layers and kept for curing at ambient temperature. After 7 days, 14 days and 28 days of curing the specimens are tested for strength characteristics.

Fig3: Preparation of mould

Fig4: Demoulded cube Specimen

Fig5: Specimens being water cured

QUANTITY OF MATERIALS REQUIRED FOR DIFFERENT SPECIMENS:

For one day, 3 cubes and 3 beams were casted in two batches. First batch consisted of 3 beams for a single curing period and the second batch of 3 cubes for single curing period.

Specimen	**Cement(kg)**	**Fine aggregate (kg)**	**Coarse aggregate (kg)**	**Water(ml)**
Cubes	3.981	9.237	13.779	1791.45
Beams	6.195	14.370	21.432	2787.75
Specimen	Cement(kg)	Fine aggregate (kg)	Coarse aggregate (kg)	Water(ml)
Cubes	3.981	9.237	13.779	1791.45
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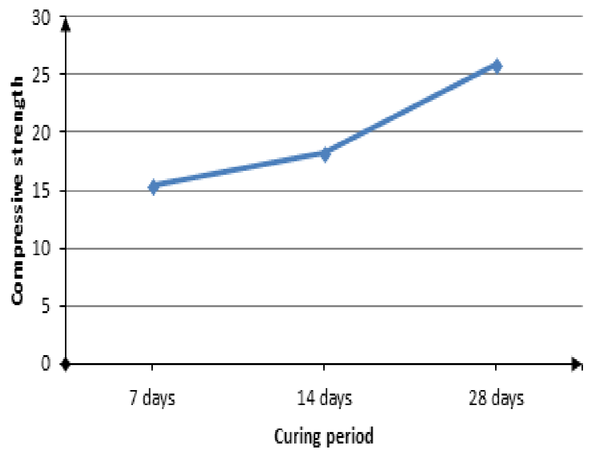
STRENGTH TEST RESULTS OF CONCRETE

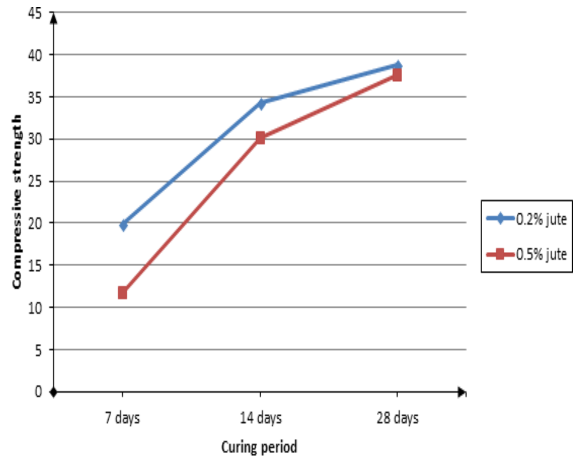
Compression test result for Conventional Concrete:

Specimen	7 days Strength (N/mm^2)	14 days Strength (N/mm^2)	28 days Strength (N/mm^2)
Cube1	14.100	17.300	24.000
Cube2	16.800	18.400	26.300
Cube3	15.200	19.200	27.400
Average	15.367	18.300	25.900



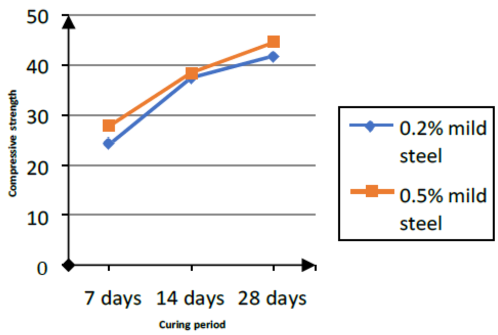
Compression test result for jute fiber reinforced:

Specimen		7 days Strength (N/mm^2)	14 days Strength (N/mm^2)	28 days Strength (N/mm^2)
0.2% jute	**Cube 1**	18.100	32.400	39.000
	Cube 2	19.500	37.400	37.200
	Cube 3	22.300	33.000	40.000
Average		19.967	34.267	38.733
0.5% jute	**Cube 1**	12.300	28.900	35.200
	Cube 2	10.800	30.600	36.500
	Cube 3	12.000	30.800	41.100
Average		11.700	30.100	37.600

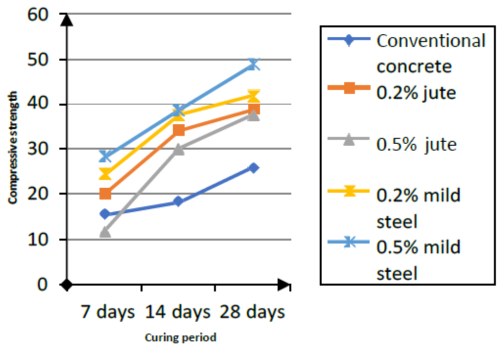


Compression test result for mild steel fiber reinforced

Specimen		7 days Strength (N/mm^2)	14 days Strength (N/mm^2)	28 days Strength (N/mm^2)
0.2% mildsteel	**Cube1**	24.100	35.600	41.000
	Cube2	25.900	37.900	42.100
	Cube3	23.900	39.000	42.500
Average		24.330	37.500	41.867
0.5% mildsteel	**Cube1**	27.200	37.600	44.000
	Cube2	28.100	39.200	43.700
	Cube3	29.000	39.000	46.300
Average		28.100	38.600	44.667

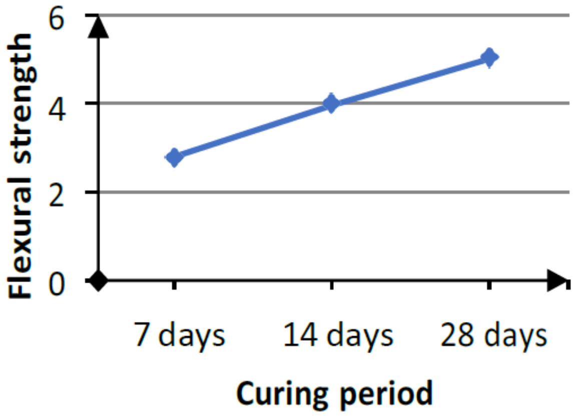


COMPRESSIVE STRENGTH COMPARISON



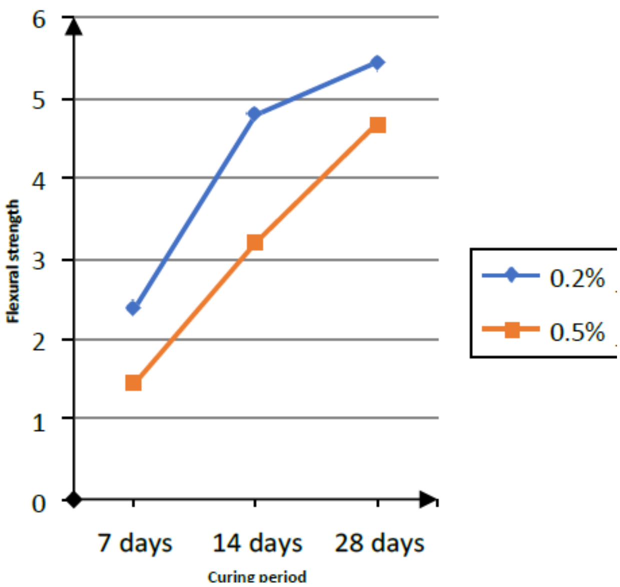
FLEXURAL TEST RESULT FOR CONVENTIONAL CONCRETE

Specimen	7 days Strength (N/mm²)	14 days Strength (N/mm²)	28 days Strength (N/mm²)
Beam1	3.000	4.100	5.200
Beam2	2.810	4.000	5.150
Beam3	2.600	3.900	4.700
Average	2.803	4.000	5.017



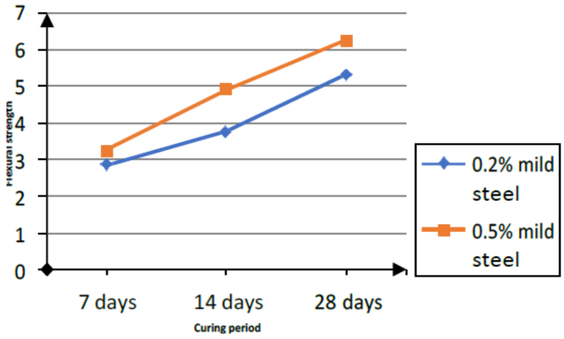
FLEXURAL TEST RESULT FOR JUTE FIBRE REINFORCED CONCRETE

Specimen		7 days Strength (N/mm²)	14 days Strength (N/mm²)	28 days Strength (N/mm²)
0.2% jute	**Beam1**	2.172	4.536	5.850
	Beam2	2.292	5.236	5.580
	Beam3	2.676	4.620	4.890
Average		2.380	4.797	5.44
0.5% jute	**Beam1**	1.476	3.750	4.650
	Beam2	1.296	2.472	4.990
	Beam3	1.560	3.388	4.380
Average		1.444	3.203	4.673

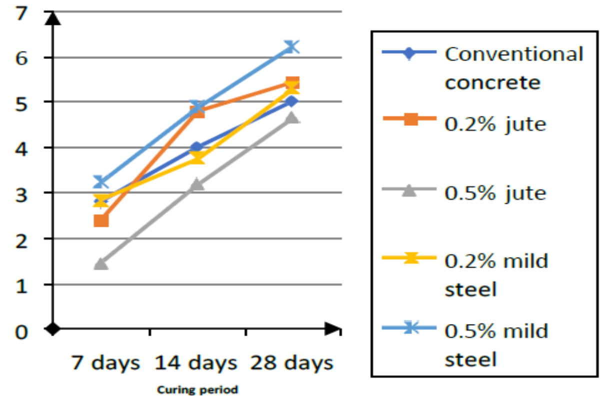


FLEXURAL TEST RESULT FOR MILD STEEL REINFORCED CONCRETE

Specimen		7 days Strength (N/mm²)	14 days Strength (N/mm²)	28 days Strength (N/mm²)
0.2% mildsteel	**Beam1**	2.700	3.400	5.300
	Beam2	2.800	3.900	5.150
	Beam3	3.000	4.000	5.470
Average		2.833	3.767	5.307
0.5% mildsteel	**Beam1**	2.800	4.700	6.000
	Beam2	3.700	4.900	6.200
	Beam3	3.200	5.100	6.500
Average		3.233	4.900	6.233



FLEXURAL STRENGTH COMPARISON



CONCLUSIONS:

1. Compressive strength as well as flexural strength of concrete increased as the curing period increased.
2. Compressive strength of conventional concrete increased by 50% in the presence of 0.2% of jute fibres by volume of cube; and increased by 45% in the presence of 0.5% of jute fibres.
3. Compressive strength of jute FRC for 0.2% was reduced by 3% when 0.5% of jute fibres by volume of cube were used.
4. Flexural strength of conventional concrete increased by 8% in the presence of 0.2% of jute fibres by volume of beam; and decreased by 7% in the presence of 0.5% of jute fibres.
5. Flexural strength of jute FRC for 0.2% was reduced by 14% when 0.5% of jute fibres by volume of beam were used.
6. Compressive strength of conventional concrete increased by 60% in the presence of 0.2% of mild steel fibres by volume of cube; and increased by 70% in the presence of 0.5% of mild steel fibres.
7. Compressive strength of mild steel FRC for 0.2% increased by 7% when 0.5% of mild steel fibres by volume of cube were used.
8. Flexural strength of conventional concrete increased by 6% in the presence of 0.2% of mild steel fibres by volume of beam; and increased by 24 % in the presence of 0.5% of mild steel fibres.
9. Flexural strength of mild steel FRC for 0.2% increased by 17% when 0.5% of mild steel fibres by volume of beam were used.
10. These fibres can be used in concrete which acts as secondary reinforcements and thus helps in preventing the formation of cracks.
11. The fibre reinforced concretes as experimented in this project can be used as replacements for conventional concrete for walls, slabs, beams, etc.

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