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Strength and Flexural Bahaviour of Cellulose Fiber Concrete

Satyam Awasthi[1], Prabhat Tiwari[2]

[1]Post Graduate Student, Department of Civil Engineering, LNCT Bhopal, M.P. INDIA
[2]Professor, Department of Civil Engineering, LNCT Bhopal, M.P. INDIA

ABSTRACT

Cellulose Fibres are used for the production of Cellulose fibres Concrete in this study. So far, a very limited quantity of research work has been done on the application of cellulose fibres in structural concrete. At present, research studies are made on various percentage of cellulose fibre such as 0.5%, 1%, 1.5% and 2% respectively with volume of concrete. It is observed that studies showed Cellulose Fibre Concrete mixes provide improvement of good performance and high strength concretes. It was observed that compressive strength of concrete increase upto 1% used of cellulose fibres in concrete after that increase from 1% cellulose fiber then decreasing compressive strength as well as tensile strength respectively.

Keywords: - Cellulose Fiber, Design Mix, Workability Test, Compressive Strength, Tensile Strength, Flexural Strength.

1. INTRODUCTION

Concrete is still one of the widely used materials in the construction industry. Traditional concrete has a drawback; it tends to crack when subjected to tensile stresses. There are numerous strategies for reducing concrete cracking, including providing sufficient steel reinforcement or fiber reinforcement. The modern world is witnessing the creation of extremely demanding and challenging civil engineering structures. Concrete, as the most essential and commonly used material, is frequently required to have extremely high strength and workability attributes. In the field of concrete technology, efforts are being undertaken to generate such concretes with unique properties. Researchers from all over the world are working to build high-performance concretes by incorporating fibers and other admixtures into concrete in small amounts.

2. LITERATURE REVIEWS

Ganeshan et al. (2008) investigated the impact of steel fibers on the strength and behavior of fiber-reinforced SCC structural elements under flexure. Aspect ratio (15, 25, and 35) and percentage of volume fraction (0, 0.25, 0.5, and 0.75) of fibress were the factors in this investigation. Because of the addition of fibress, the first crack load and post cracking behavior were found to have improved. There was a slight improvement in ultimate strength. The addition of fibress considerably improved the ductility. The ideal fibress volume fraction was discovered to be 0.5 percent. (Sicakova, 2018)) carried out on experimental work providing the testing of cement mixture containing two types of cellulosic FIBRES, namely FIBRES from bleached wood pulp and recycled waste paper FIBRES, is given. FIBRES are described by selected characteristics such as length, density, and pH. They were applied as additive to the cement composite/plaster while they were dosed in different amounts: 0.2 %, 0.3 % and 0.5 % of the weight of both the filler and binder. Mixtures without FIBRES were prepared as reference samples. Density, water absorption, thermal conductivity, flexural and compressive strength were studied following by analyses of differences between resulting values. The observed differences in the physical, mechanical and thermal properties were found to be influenced by the properties (such as type, amount and other characteristics) of cellulosic FIBRES. **Savaliya et al. (2021)** carried out on building materials, natural cellulose fibres have been used to improve the strength of concrete materials. Because conventional concrete has a low tensile strength, steel bars are commonly used to resist tensile pressures in structural applications. The use of natural fibers to boost the tensile, compressive, and flexural strength of concrete. The prepared samples were subjected to flexural, compressive, and tensile strength tests using appropriate testing equipment in accordance with standard standards. The current project investigates the strength qualities of concrete with the addition of natural cellulose fibers.

3. MATERIALS AND METHODOLOGY

3.1 Cement

Throughout the experiment, ordinary Portland cement (OPC) from a single lot was used. Table 3.1 lists the physical parameters of the cement as determined by various tests 30 that comply to Indian Standard IS: 1489-1991(Part-1) and were carried out according to IS: 4031-1988 recommendations. Cement was properly preserved to avoid its characteristics from deteriorating due to moisture interaction.

3.2 Fine aggregate

As a fine aggregate, river sand was employed. 2.57 and 2.90 were the specific gravity and fineness modulus, respectively.

3.3 Course Aggregate

As coarse aggregate, crushed angular granite metal from a nearby source was employed. The specific gravity was 2.69, flakiness was 4.60 percent, and elongation was 3.89 percent.

3.4 Cellulose fiber

Cellulose FIBRES are FIBRES manufactured from cellulose ethers or esters, which can be found in plant bark, wood, or leaves, as well as other plant-based materials. In addition to cellulose, the fibers may contain hemicellulose and lignin, with various percentages of these components affecting the fibers' mechanical qualities. Due to their similar qualities to designed FIBRES, cellulose fibers are used primarily in the textile sector, as chemical filters, and as fiber-reinforcement composites. They are also another alternative for biocomposites and polymer composites. Cellulose fiber has a specific gravity of 0.72, a diameter of 3-4 mm, and a length of 6-7 mm when utilized in concrete.

4. RESULT AND DISCUSSIONS

4.1 Workability test

Slump testing was used to determine the workability of concrete mixes, as described in Chapter 3. For all of the concrete mixes, the w/b ratio was kept constant at 0.4. To keep the desired slump, SP 430 super plasticizer was utilized. Depending on the type of mix, the super-plasticizer dosage ranged from 1.0 percent to 1.2 percent by weight of binder. Table 4.1 shows the workability results of several concrete mixes.

Table 4.1 Workability values for different concrete mixes

Mix no.	Description	Super plasticizer (%) by weight of binder	Slump (mm)
1	90%OPC+10%SF+0%CF	1.00	107
2	90%OPC+10%SF+0.5%CF	1.00	105
3	90%OPC+10%SF+1%CF	1.00	100
4	90%OPC+10%SF+1.5%CF	1.00	95
5	90%OPC+10%SF+2%CF	1.20	91

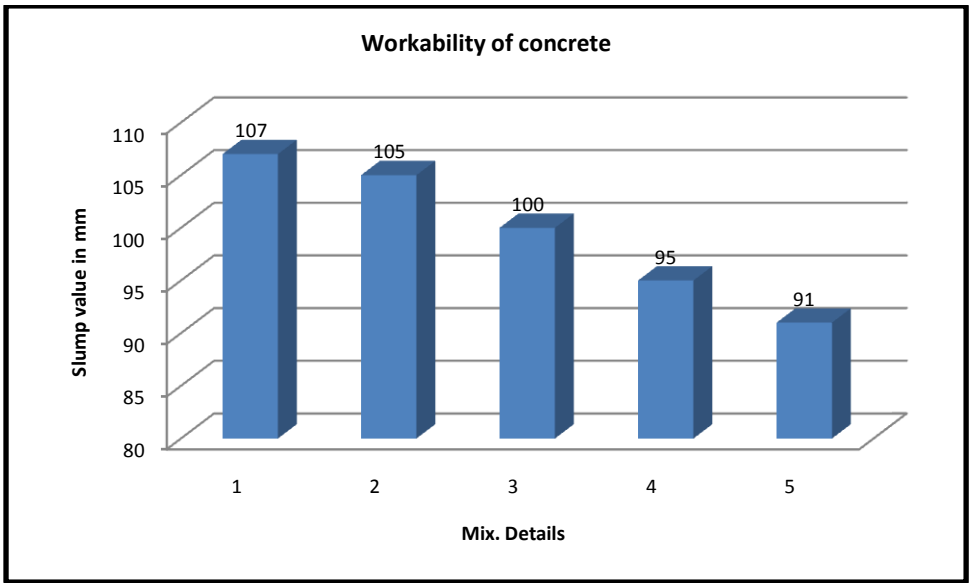

Fig. 4.1 Variation of slump of concrete

Table 4.1 shows that as the addition of cellulose fibres to concrete mix increases, the workability of concrete mix was found to decrease as compared to control mix. The addition of cellulose fibres into concrete mix further decreases the workability.

4.2 Compressive strength

The results of the compressive strength tests conducted on concrete specimens of different mixes cured at different ages are presented and discussed in this section. The compressive strength test was conducted at curing ages of 7, 14, 28days.

Table 4.2 Compressive strength (MPa) results of all mixes at different curing ages.

Mix no.	Description	7 days	14 days	28 days
1	90%OPC+10%SF+0%CF	29.10	32.50	35.10
2	90%OPC+10%SF+0.5%CF	34.20	36.00	38.70
3	90%OPC+10%SF+1%CF	35.40	35.80	39.10
4	90%OPC+10%SF+1.5%CF	32.30	33.70	37.60
5	90%OPC+10%SF+2%CF	29.20	31.20	33.00

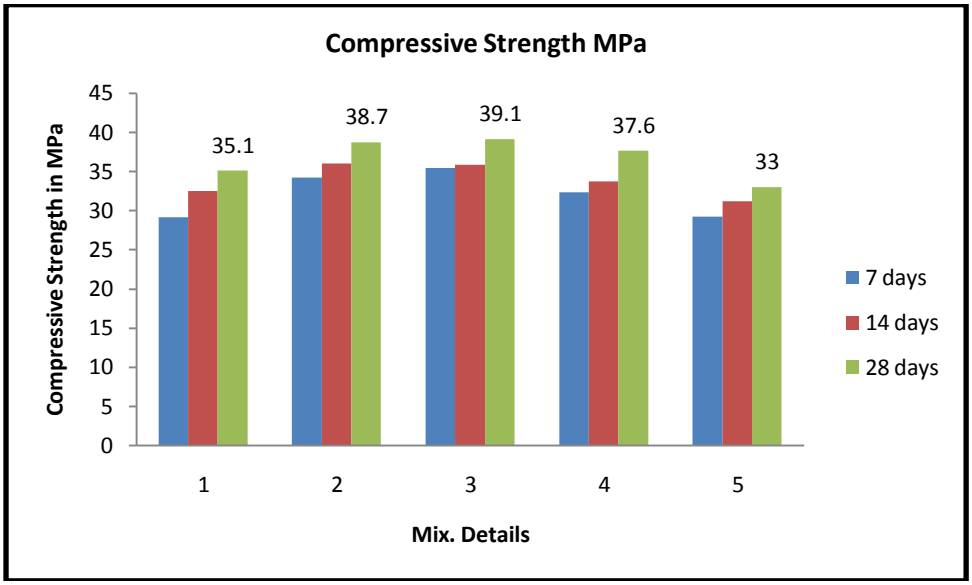

Fig. 4.1 Variation of compressive strength of concrete with age

Table 4.2 shows that addition of cellulose fibres in concrete mix increase. Compressive strength of concrete increase upto 1% use of cellulose fibre by the volume of concrete after that increase from 1% CF then decrease compressive strength of cellulose fibre concrete respectively.

4.3 Tensile strength

The results of the splitting tensile strength tests conducted on concrete specimens of different mixes cured at different ages are presented and discussed in this section. The splitting tensile strength test was conducted at curing ages of 7, 14, 28 days.

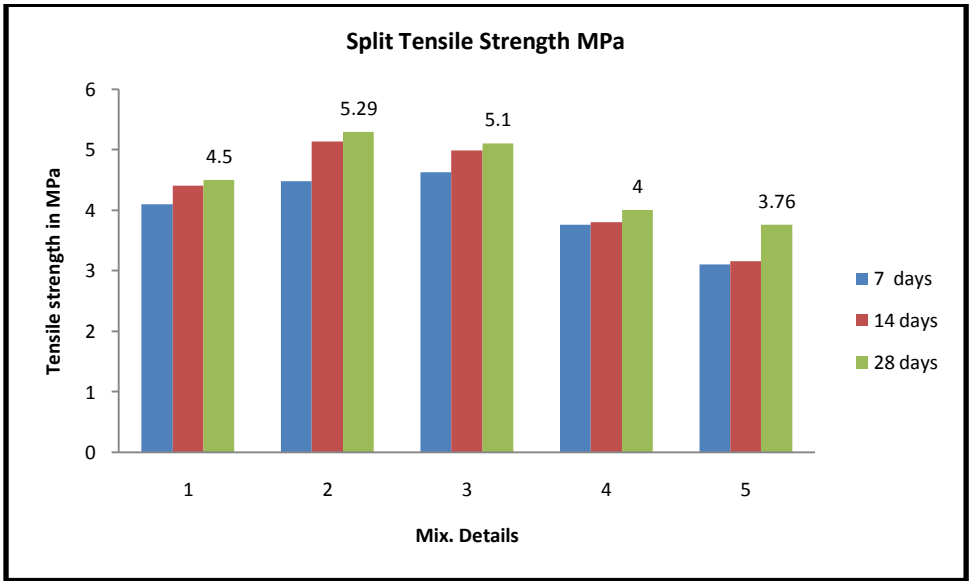

Fig. 4.2 Variation of split tensile strength of concrete with age

Fig.4.2 shows that the splitting tensile strength test results of cellulose fibres reinforced concrete shows that in general there is increases in splitting tensile strength ranging from15% to 20%. Cellulose fibres in the concrete increases splitting tensile strength and low weight fraction of cellulose fibres gives maximum increase in the strength.

4.4 Flexural strength

To investigate the flexural strength of the beam specimens, two point transverse load test were performed on UTM (2000 kN capacity). The results obtained after 28 days.

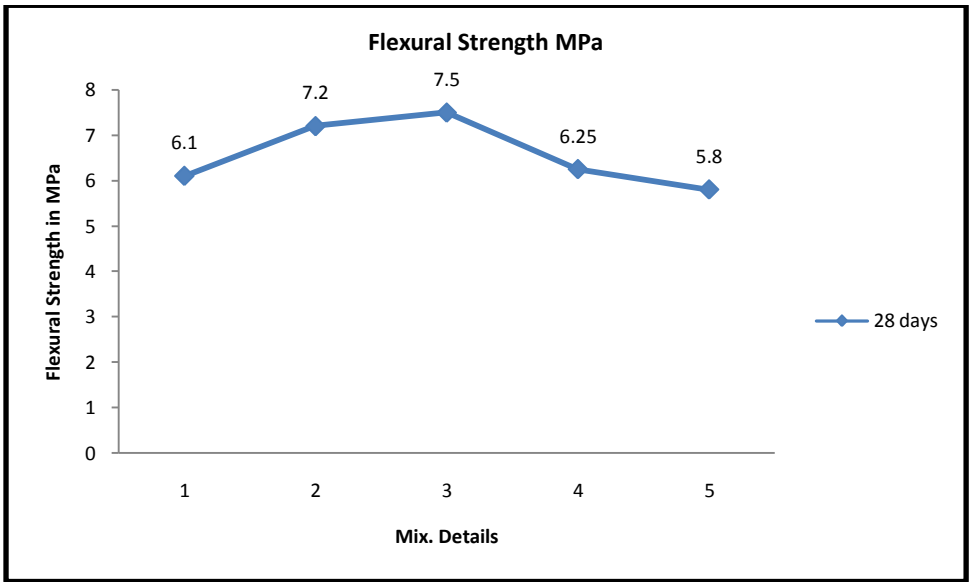

Fig. 4.2 Variation of flexural strength of concrete with age

5. CONCLUSIONS

- It was observed that workability of concrete decrease with increase of cellulose fibres in concrete. It also found that concrete bleeding reduction to using of fibres in concrete.
- It is observed that optimum dosage of cellulose fibres the increase in compressive strength of cellulose fibres concrete mixes compared with control mix of concrete at 28 days compressive strength.
- Tensile strength of concrete also increases with use of cellulose fibres in beyond limit. Maximum tensile strength obtained 5.29MPa at 28 day from mix M1.
- The flexural strength of concrete increase compare with normal mix when use of cellulose fibres upto 1% after increase from one percentage of cellulose fibres in concrete then decrease flexural strength of cellulose fibres concrete respectively.
- In further use of cellulose fibres in concrete in certain limit we get more strength compare with normal mix concrete.

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