International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 07 | July 2021 www.irjet.net p-ISSN: 2395-0072

"Comparative Study by using Wastewater and Human Hair as FRC"

Rohit Metkari[1], Kalpit Patel[2], Tulsidas Kore[3], Kamlesh Sangale[4]

[1-4]Dept. of Civil Engineering RMD Sinhgad School of Engineering, Warje, Pune
[5]Prof. Pratibha Alandkar, HOD of Civil Engineering, RMD Sinhgad School of Engineering, Maharashtra, India

---

Abstract: *Concrete is one of the important elements in construction industries. Concrete is a man-made material which is made up of cement, sand and aggregate. It is extensively used in buildings, bridges, roads and dams. Concrete is very strong material that can withstand compressive stresses without yielding. The tensile strength of concrete is about 10% of compressive strength so as concrete is weak in tension. Fiber reinforced concrete is useful to increase the compressive strength as well as tensile strength of concrete. Human hair is strong in tension, as it is a non-biodegradable material and it creates environmental problems. Hence it can be used as a fiber reinforcement material. By adding human hair in concrete various test of strength were conducted on concrete with different percentages of hair fiber as 0%, 1%, 2% by weight of cement. Water plays a vital role in concrete as it is use for curing and mixing process. Due to lack of water in water scarcity region we can use treated wastewater for curing process instead of potable water. By doing comparative study on hair fiber concrete and by using wastewater curing in conventional concrete, we can determine different strengths of concrete. In this study we can find out whether the strength of concrete is increase by adding human hair or by using wastewater curing.*

Key Words: *Human hair, waste water, compressive strength, tensile strength, Fibre reinforced concrete.*

1.INTRODUCTION

Concrete containing cement, water, aggregate and discontinuous, uniformly dispersed or discrete fibers is called as fiber reinforced concrete. It is a composite obtained by adding different types of fibers to the conventional concrete mix so as to increase the target mean strength of concrete. Fibers can be in form of steel, glass, synthetic and natural fiber materials. In this study we are using human hair as a fiber reinforced concrete.

Human hair is a Non-Biodegradable Materials which takes long time to decay due to this it creates environmental problems. It reduces cracks in concrete due to both plastic and drying shrinkage. Concrete is weak in tension hence human fibers are added to increase its tensile strength.

In India the population increasing day by day due to this consumption of water is increases in every sector (Construction, agriculture, industrial). In construction there is no substitute of concrete it is important part of structure. Water plays important role in concrete but in summer season the scarcity of water is major concern at that time we need to study other types of water i.e. wastewater from treatment plant.

Now a days we are wasting million liter of wastewater and there is no provision to use this water rather than farming. After testing wastewater sample in lab if it gives similar result than potable water then we use wastewater in concrete.

1.1 Necessity of FRC and Wastewater:

- It increases the tensile strength of concrete.
- It reduces the air voids and water voids the inherent porosity of gel.
- It increases the durability of concrete.
- It reduces water scarcity problem in construction industry.

2. METHEODOLOGY:

Experimental work was conduct to check the effect of human hair as fiber and wastewater on concrete so as to find compressive strength of concrete. This concrete sample casted by two proportions i.e. 1% and 2% of human hair by volume of cement and curing is done by treated wastewater by conducting in 2 stages.

2.1 Materials:

Cement: It acts as a binding agent. Cement imparts strength in concrete OPC of grade conforming to IS: 8112- 1989 was used for investigation.

Fine Aggregate: The properties of sand determined by conducting test as per IS 2386. The result indicate that sand confirms to zone 2 as per as IS 383- 1970.

Coarse Aggregate: The properties of Coarse aggregate determined by conducting test as per IS 2386 part 3.

Human Hair: Collected human hair was cut into uniform length and different diameter to get a homogeneous concrete mix.

Wastewater: It collected from treatment plant for different test on laboratory.

2.2 Mix design calculation:

1) Grade Designation-M20

Type of Cement-OPC 53 grade confirming to IS- 12269-1987

Maximum Aggregate Size-20 mm

Minimum Cement Content (MORT&H 1700-3 A)-250 kg/m

Maximum Water Cement Ratio- 0.5

Workability (MORT&H 1700-4)-25 mm (Slump)

Exposure Condition – Normal

Type of Aggregate - Crushed Angular Aggregate

Maximum Cement Content (MORT&H Cl.1703.2)- 540 kg/m3.

FRC material (by volume of cement) - 1% and 2%.

2) TEST OF MATERIALS

Cement Used - King OPC 53 grade

Sp. Gravity of Cement - 3.15

Sp. Gravity of Water - 1.00

Sp. Gravity of 20 mm Aggregate - 2.884

3) Target strength:

Target Mean Strength (MORT&H 1700-5) - 30N/mm2

Characteristic Strength @ 28 days - 20N/mm2

Selection of Water Cement Ratio

Maximum Water Cement Ratio (MORT&H1700-3)

Adopted Water Cement Ratio - 0.5

4) Selection of Water Content:

Maximum Water content (10262-table-2) - 186 Lit

Estimated Water content for 25 mm Slump - 145 Lit.

Calculation of Cement Content

Water Cement Ratio - 0.5

Cement Content (145/0.5) - 290 kg/m3

5) Proportion of Volume of Coarse Aggregate & Fine Aggregate Content:

Vol. of C.A. - 2.00%

Adopted Vol. of Course Aggregate - 65.00%

Adopted Vol. of Fine Aggregate (1-0.65) - 35.00%

6) Mix Calculations:

Volume of Concrete in m3 - 1.00

Volume of Cement in m3 - 0.09(Mass of Cement) / (Sp. Gravity of Cement) x1000

Volume of Water in m3 - 0.145(Mass of Water) / (Sp. Gravity of Water) x1000

FRC material (by volume of cement) - 1% and 2%

Volume of All in Aggregate in m3-0.763

Volume of Coarse Aggregate in m3 -0.496

Volume of Fine Aggregate in m3 -0.267

7) Mix Proportions for One Cum of Concrete (SSD Condition):

Mass of Cement in kg/m3 – 290

Mass of Water in kg/m3 - 145

Mass of Fine Aggregate in kg/m3 – 696

Mass of Coarse Aggregate in kg/m3 - 1429 Mass of 20 mm in kg/m3 – 1029

Mass of hair fiber - 1% - 2.9 gm

2% - 5.8 gm

Volume of All in Aggregate in m0.763Sr. no. 1 – (Sr. no. 2+3+4)

Volume of Coarse Aggregate in kg/m3-1429

Volume of Fine Aggregate in kg/m3-696

Mix proportion of M20 – 1:1.5:3

Fig -1: Cube Specimen of size 150mm X 150mm X 150mm

2.3 Preparation of Sample (Stage 1):

1.Quantities of cement, micro Fiber (human hair), coarse aggregate, fine aggregate and water for each batch was weighed separately.

2.Firstly, cement and aggregates were mixed separately to form uniform color and then added the Fiber (human hair) in dry state and mix in mixture for minimum 5 minutes to make a uniform color.

3.Firstly, 50% to 70% of water was added to the dry mix and then mixed thoroughly for 1 to 2 minutes. Then the remaining water added in mixture and again mixes thoroughly for 1-2 minutes.

4.After properly mixing the Fiber (human hair) reinforced concrete was filled into the required moulds of cube size 150 mm X 150mm X 150mm (for compressive strength).

5.The age of sample is calculated from the time of addition of water to the dry ingredients. Three specimens are casted for testing at each selected age.

6.Testing and curing of concrete cubes on 7th and 28th days.

2.4. Stage 2:

The treated domestic waste water collected from sewage treatment plant situated near Pune. The laboratory tests were carried out as per less 3025. The primary treated waste water is collected from treatment plant and its chemical and physical properties are analyzed in a laboratory. The modern world is focusing on the conditioning, sustainability and recycling of the assets by imparting Innovative techniques and methodologies. Keeping this in view, an experimental study was conducted to evaluate the strength of concrete made with treated waste water for structural use. Experimental Program Water quality of used water has been analyzed by following.

PH test

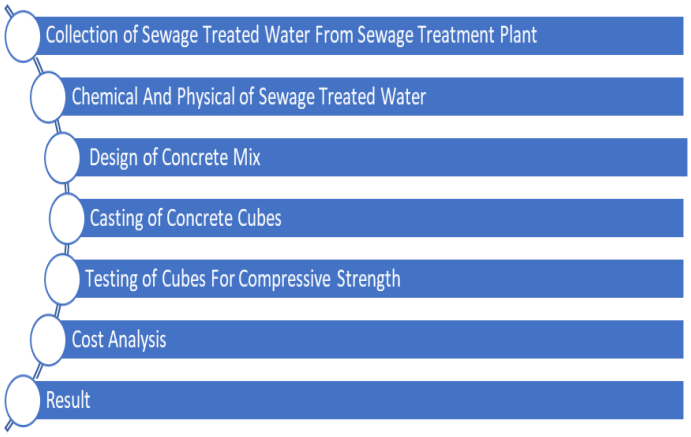
Total suspended solid

Hardness

BOD

COD

1. Flow chart of Procedure



2.5. Compressive Strength on FRC and treated Wastewater:

1.Determination of compressive strength of the micro Fiber (human hair) reinforced concrete with cubes of size 150 mm X 150 mm X 150 mm were casted for determination of compressive strength under different percentage and length of human hair.

2.Total 24 no. specimens are casted for testing at each selected age. At the test age of the specimens stored in tap water are tested immediately on removal from the water and while they are still in the wet condition.

3.In the case of cubes, the specimens are placed in the machine in such a manner that the load is applied to the opposite sides of the cubes as cast that is not to the top and bottom.

4.The load is applied without shock and increased continuously at a rate of approximately 70kN/min specified IS: 516 - 1959. Until the resistance of specimen increasing load break down and no greater load can be sustained.

5.The maximum load applied to the specimen than recorded and the appearance of the concrete and any unusual feature to the type of failure is noted.

3. Result and Discussion:(Stage 1)

3.1 COMPRESSIVE STRENGTH RESULT: -

The compressive strength test was performed on the cubes of size 15 x 15 x 15 (cm) to check the compressive strength of human hair reinforced concrete & the results obtained are shown in table give

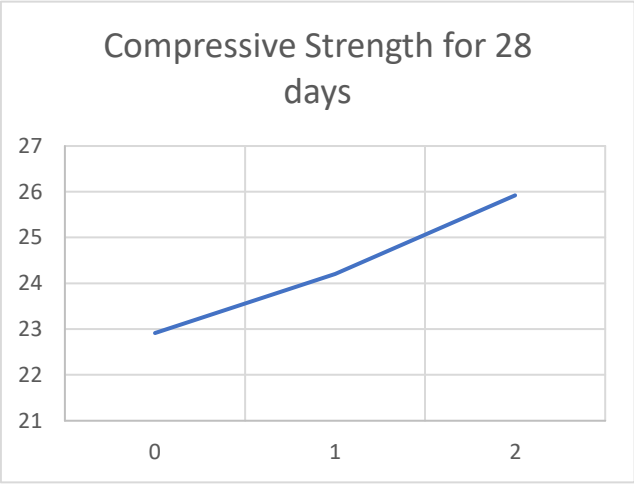
It has been observed from the above table, an increase in the percentage of hair, compressive strength also increases. 275.2 KN load recorded in Second cube of 0% hair cement concrete and 290 KN load recorded in 2nd cube of 2% hair cement concrete from table.

Table no.1 7 days Compressive Strength

Sr.no	% HAIR Mix	MAX. RECORDED (KN)		AVG. COMPRESSIVE STRENGTH(N/MM2)
		CUBE 1	CUBE 2	
1	0	276	275.2	12.29
2	1	286	285	12.69
3	2	292	290	12.90

We also observed 28 days compressive strength increases with increase in HRC 2% percentages increases in 2nd cube of 2% hair cement concrete from compressive strength calculation. **From Table no.2**

Sr.no	% HAIR Mix	MAX. LOAD RECORDED (KN)		AVG. COMPRESSIVE STRENGTH
		CUBE 1	CUBE 2	
1	0	500	531	22.91
2	1	568	521	24.20
3	2	580	586	25.92



X axis = % Human Hair

Y axis = Compressive strength

Fig .1 28 days Compressive Strength

3.2 RESULT OF STAGE 2:

CHEMICAL ANALYSIS RESULT: -

Based on the chemical analysis of treated sewage water and the testing of cubes made with that water, following results were observed.

Sr.no	Name of Test	Results (Mg/L)	Permissible Limits. Max (As Per IS 456:2000) (Mg/L)
1	Total Suspended Solids	1498	2000
2	Ph Value	6.9	>6
3	Total Solids	1686	5000
4	BOD5	281	100
5	COD	876	250

Table no.3 Results of Chemical Analysis of Treated Sewage Water

3.3. COMPRESSIVE STRENGTH RESULT:

Treated sewage water can also be used the curing water, as it is satisfying the chemical standards to be fit for the same. The treated sewage water when used in concreting or making concrete specimen cube, the compressive strength of cubes was satisfactory, in fact the cubes made with the treated sewage water attained more compressive strength.

Sr.no	% HAIR Mix	MAX. LOAD RECORDED (KN)		AVG. COMPRESSIVE STRENGTH (N/MM2)
		CUBE 1	CUBE 2	
1	0	315.45	326.25	14.26
2	1	443.25	450.9	19.52
3	2	557.1	535.5	24.28

Table no.4 Compressive Strength for 7 days

Sr.no	% HAIR Mix	MAX. LOAD RECORDED (KN)		AVG. COMPRESSIVE STRENGTH(N/MM2)
		CUBE 1	CUBE 2	
1	0	518.62	545.62	23.65
2	1	561.37	572.62	25.2
3	2	604.5	613.12	27.17

Table no.5 Compressive Strength for 28 days

When M20 concrete with 1% hair is compared with the plain cement concrete, it is found that there is an increase of 1.5% in compressive strength. When M20 concrete with 2% hair is

compared with the plain cement concrete, it is found that there is an increase of 2% in.

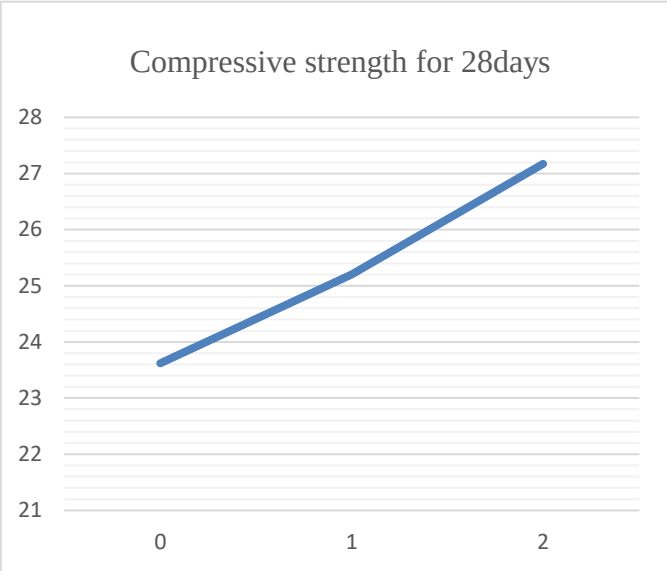
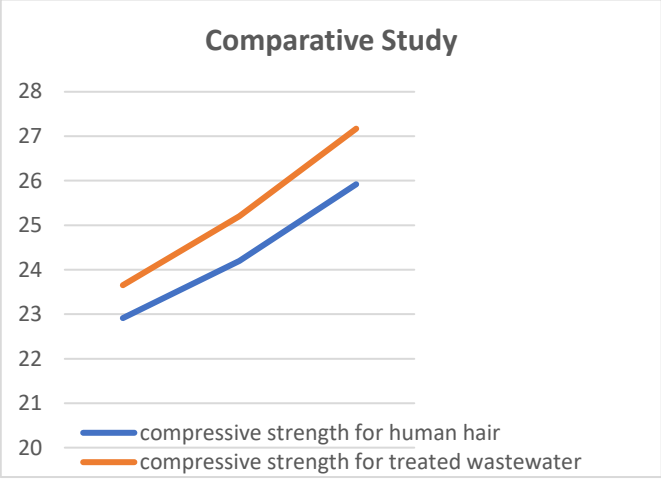


Fig 2 Compressive Strength for 28 days

4. CONCLUSION:

Strength of concrete increases with the addition of hair fiber and also increase with the curing of waste water including hair fiber. From this study we found that strength of concrete will increase by 2% by using waste water including hair fiber.



`

REFERENCES

[1] IS Code: 456-2000, "Plain and Reinforced Concrete-Code of Practice "Bureau of Indian Standards, New De

[2] Akash Sharma et al.2017, Analysis of Fiber Reinforced Concrete: Using Human Hair as A Fiber Reinforcement. Int J Recent Sci Res. 8(4), pp. 16715-16720.

[3] Ahmad, Ibrar, et al. "Compressive Strength of Cement Mortar blended with Coconut Fibers and Human Hair." Advances in Science, Technology and Engineering Systems Journal 1.4 (2016):

[4] Aloo Jain (senior quality surveyor) and Anubhav Kumar Honoria (PG student) "Use of human hairs in concrete", International Journal for Scientific Research and Development vol. 4, Issue o6(2016).

[5] Prof. A.B. More Prof. R. B. Gocke et al. Reuse of Treated Domestic Waste Water in concrete-A Sustainable Approach. Indian Journal of Applied Research- Volume 4, Issue 4, April 2014

[6] IS 3025 (part 17, 32, 18, 23, 22, 24) Methods of Sampling and Test for Water and Waste Water.