Experiment on Reuse of Effluent in Casting and Curing of Concrete

Mayuresh S. Bajbalkar, Rushikesh Bangar, Pratik Pawar, Rahul S. Chaudhari

Abstract: ***Due to climate change and increasing population demand of water is increasing. In coming days there will be less availability of water for construction industry. On the other hand a huge quantity of water has been released to the nearby stream after treatment from Sewage Treatment Plant by the Municipal Corporations. Reuse of waste water is very less. The waste water collected is mainly from domestic. After secondary or tertiary treatment the water is released. So it is possible to reuse the effluent water for construction (mainly for Concrete casting & curing.***

As per the literature survey, new combinations are created seven different possibilities to find which the best preferable combination to reuse the water is. This will leads to saving the portable water and also the water can be used for drinking purpose which is current need of the society. This will satisfy need of industry, society & environment.

Main focus of this experimental investigation to search possibility to use effluent water for construction purpose individually or in combination mainly for Concrete casting & Curing.

Keywords: **Concrete, Curing, Reuse of Waste Water.**

I. INTRODUCTION

Concrete is the main construction material used on construction industry. According to IS 456:2000, water used for preparation of concrete shall be portable water.

But due to increase of demand of water for drink inking purpose municipal corporations Like Bengaluru, Chennai (The BUSINESS INSIDER, published on June 28, 2019, 18:11 IST, The TIMES OF INDIA, on May 21 2019, 7:42 IST) are not in position to supply required amount of portable water to construction work which mainly include casting and curing of concrete.

In this regard. If the STP treated water (Treated Waste Water) is used result in up to 68% reductions in the cost of water required for the construction of base layers. (According to Farid H. Abed, Ph.D., ASCE; Munir D. Nazzal, Ph.D.; Mousa F. Attom, Ph.D, © ASCE, 2018). When portable water is used for curing Compressive strength was observed as 18.92 Mpa at the age of 7 days and when STP Treated water is used it was 24.41MPa. (Ms.Spoorthy B C, Ms.Bhavana P V, Ms.Sanjana N N, Ms.Suchitra S S).

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Mr. Mayuresh S. Bajbalkar, Final year Civil Engineering student, Pimpri Chinchwad College of Engineering, Nigdi, Pune.

Mr. Rushikesh R. Bangar, Final year Civil Engineering student, Pimpri Chinchwad College of Engineering, Nigdi, Pune.

Mr. Pratik D. Pawar, Final year Civil Engineering student, Pimpri Chinchwad College of Engineering, Nigdi, Pune.

Mr. Rahul S. Chaudhari, Assistant Professor, Civil Engineering Department, Pimpri Chinchwad College of Engineering, Nigdi, Pune.

When treated effluent is used in concrete, of Grade M-30 & M35,it was observed that there is increase in compressive strength is 3.6 and 9% respectively(Ooi Soon Lee, Mohd Razman Salim, Mohammad Ismail, MD.Imtiaj Ali, January 2017)

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II. TESTING OF MATERIAL

A. Cement

For this study OPC (Ordinary Portland Cement) is used which is purchased from the local market and Aditya Birla make (53grade). The test like 1.Initial setting time 2.Final Setting time3.Soundness of cement was carried out on the cement. The results obtained are satisfying guidelines given by Indian Standard. IS 4031 (part 5&269), IS 5513

B. Coarse and Fine Aggregates

Test on Course and Fine aggregate was carried out. Those test include, 1.Moisture content 2.Water Absorption 3.Specific Gravity 4.Fineness Modulus. The procedure followed is according to IS 2386 (part 3), IS 2386 (part III), IS 383, IS 2386-1963.

The results obtained are within the permissible limits specified in the above IS.

C. Test on Water Samples collected.

For this experimental study, water sample was collected from two Sewage Treatment Plants (STP) where sewage from domestic area was collected and treated. It is very important to know the characteristics of the STP Treated water before using the effluent in concrete preparation.

So following tests was carried out in the laboratory to know the properties of the treated waste water.

Temperature	pH	Turbidity
Total Solids	TDS	TSS
TVS	TFS	Alkalinity
Chlorides	Hygiene Test	

After tests it was observed that all parameters are within range as per IS 456:2000

D. Mixing Water

Effluent is used for mixing and curing of concrete of M-20 proportion. For this seven various combinations are created so that best probable solution.

E. Combinations Created

As per the literature survey, following important points were observed,

1. Six different combinations were created **(H. Saricimen, M. Shameem, M. Barry, and M. Ibrahim)** by using 8% cement, Silica Fume and cement contain 8% silica fume, Portable and Treated water. After testing it was observed that about 28% increase in strength.

2. To study the Effect of Waste Water Type on Concrete Properties work was carried out **(Nabil M.A. Al-Joulani)** and found that compressive strength of mortar using tap water and Treated Waste Water was 140.30 & 137.30 Kg/cm^2.

3. Experimental investigation was carried out to study Use of Sewage Treated Water in Concrete (Sachin Mane, Shaikh Faizal, Gyan Prakash, Shamli Bhandarkar,Vikki Kumar). For M-20 grade concrete the Compressive strength was observed as 49.20(using Treated Sewage water) and 38.37 using Tap Water respectively.

So, following seven combinations are created to study the effect of effluent in casting and curing of concrete in the proposed work.

Table No: 1 Combinations Created for Testing

Sr. No.	Casting	Curing	NO. of Cubes For Compression Test	
			7 Days	28 Days
1	P	P	3	3
2	P	D1	3	3
3	P	D2	3	3
4	D1	P	3	3
5	D2	P	3	3
6	D1	D1	3	3
7	D2	D2	3	3
Total			21	21
Gross			**42**	

Where,

Pure Water = P & Domestic Effluent = D1, D2

III. EXPERIMENTAL PROGRAM

3.1. Preparation of Mix Design preparation of Combinations

Concrete mix design was prepared for calculating the individual weight of the ingredients of the concrete. For this (Table 1, IS 10262 Cl 3.2.1.2, A-3 & B-3), (Table 2, IS 10262 Cl 4.2, A-5, B-5), (Table 3, IS 10262:2009) was used.

To prepare the sample mix, first dry mixture was prepared. Then required amount of water is added. This process consume approximately 5 minute. After mixing, slump cone test was carried out and slump found in the permissible range. For filling cubes, IS procedure is adopted. Those cubes were demolded in the next day (after 24 hours) and cured at room temperature for 7 7 28 days.

The Mix proportions are as under,

Table 1: Mix proportion and water/cement (w/c) ratios for concrete mixtures. Mix proportions (kg/m^3)

Cement	FA	CA	Water	Water Cement Ratio
360.426	724.754	1223.635	178.382	0.45

To find load taken by the cubes so as to know the compressive strength, Forty two cubes of size (150mm x 150mm x 150mm) were casted. (21 cubes are required to test on 7 days and 21 at the age of 28 days). The Cubes are casted as per the guidelines given in IS: 10086-1982.

3.2. Testing Procedure

After curing, for 7 & 28 days, 2000 KN Compressive Testing Machine was used to know the load taken by individual cube. Then load was converted to compressive strength (IS: 10086-1982).

IV. TEST RESULTS FOR 7 & 28 DAYS

4.1 The cubes were casted at was tested at the age of 7 days and 28 days respectively. Total 21 Cubes were tested at the age of 7 days and again 21 cubes were tested at the age of 28 days.

Following table shows details of average compressive strength obtained.

Table 2: Average strength of concrete at 7 days of curing with various wastewater replacement.

Sr. No.	Casting	Curing	Strength Obtained in MPa
	Combinations		
1	P	P	24.10
2	P	D1	23.60
3	P	D2	25.00
4	D1	P	22.10
5	D2	P	21.60
6	D1	D1	22.90
7	D2	D2	22.90

Following graph represents the variation in strength for 7 days for various combinations.

Graph 1: Representation in variation in strength at the age of 7 Days.

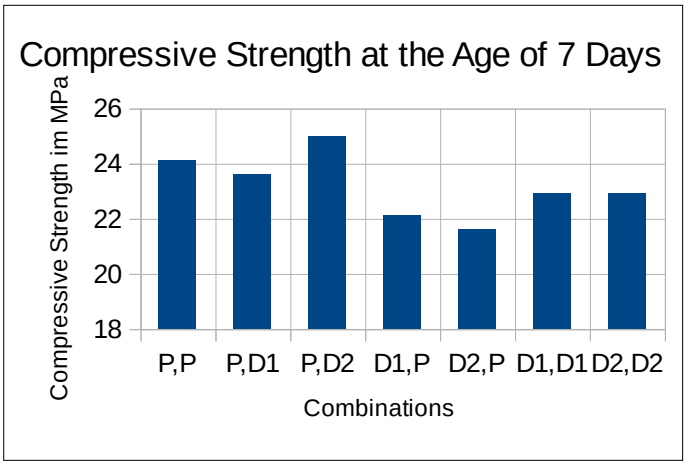
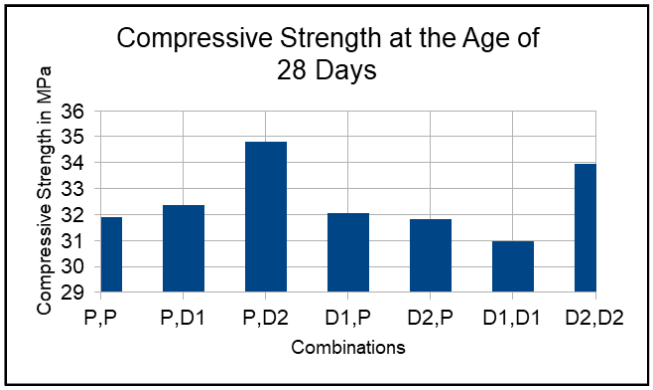


Table 3: Average strength of concrete cubes at the age of 28 days with various combinations.

Sr. No.	Casting	Curing	Strength Obtained in MPa
	Combinations		
1	P	P	31.89
2	P	D1	32.38
3	P	D2	34.79
4	D1	P	32.04
5	D2	P	31.82
6	D1	D1	30.96
7	D2	D2	33.94

Following graph represents the variation in strength for 28 days for various combinations.

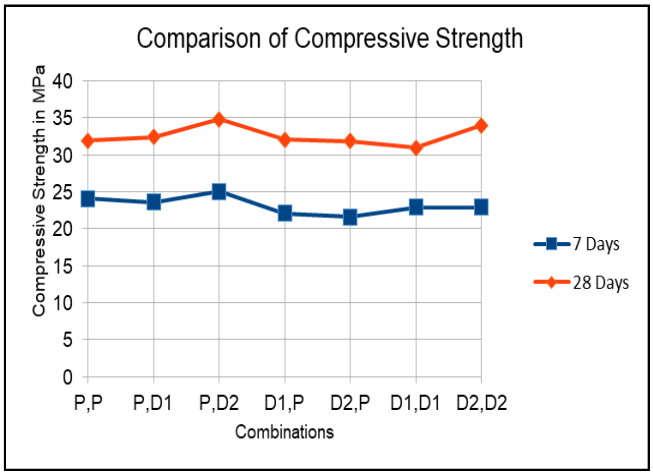
Graph 2: Representation in variation in strength at the age of 28 Days.



4.2 Comparison of the results obtained

As per the discussion above, the Average compressive strength was calculated for individual combination. Following Graph represents the comparison between both the results obtained.

Graph 3: Representation in variation in Compressive strength at the age of 7 & 28 days.



V. CONCLUSION

After this study, following points were concluded,

1. The water samples from both the STP were satisfying the criteria mentioned in IS Code as the values obtained for the 11 tests were in the limit.
2. It was observed that nearly 24 %, 27%, and 28% in increase in the strength for PP, PD1 & PD2 combinations respectively as compared to 7 days strength.
3. Again 31%, 32%, 26%, 32% of increase in compressive strength was observed for D1P, D2P, D1D1, D2D2 combination respectively as compared to 7 days strength.
4. Maximum variation was observed for D2D2 combination as casting and curing was done with the second sample.

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AUTHORS PROFILE

Mr. Mayuresh S. Bajbalkar, Final year Civil Engineering student, Pimpri Chinchwad College of Engineering, Nigdi, Pune.

Mr. Rushikesh R. Bangar, Final year Civil Engineering student, Pimpri Chinchwad College of Engineering, Nigdi, Pune.

Mr. Pratik D. Pawar, Final year Civil Engineering student, Pimpri Chinchwad College of Engineering, Nigdi, Pune.

Mr. Rahul S. Chaudhari, Assistant Professor, Civil Engineering Department, Pimpri Chinchwad College of Engineering, Nigdi, Pune. Area of Interest: Construction Management. Memberships: ISTE, IWWA, IEI, QCFI Achievements: University Topper in Construction Management