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AN EXPERIMENTAL STUDY OF REPLACEMENT OF POTABLE WATER BY TREATED WASTE WATER IN CONCRETE MIXING

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Abstract: This paper focus on the use of treated waste water in construction industry which helps to reduces the load on nature. The current water problem in India, there is a need to look for alternative sources of water. India discharges Treated Waste Water (TWW) in natural water bodies, which can be used in construction industry. Water samples used were Primary Treated Waste Water (PTWW), Secondary Treated Waste Water (STWW), and Tap Water (TW).Parameters of water were tested which was found well as per IS 456-2000 limits. Using TWW tests were conducted on cement, fresh and harden concrete. For compressive strength, concrete cubes for 7, 14 and 28 days. For tensile strength cylinders and for flexural strength beams were casted for 28 days. Hence results for PTWW, STWW and TW suggested STWW is appropriate for using in construction industry.

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INTRODUCTION

In construction industry concrete being most widely construction material used, uses most of water. About 5 billion cubic yards of concrete are used each year, annual production is about two tons per person on the plane. As per provision of IS10262-2009, 186 liters water is required for $1m^3$ of concrete. On an average 150 liters water is required for $1m^3$ of concrete. The construction of 100,000 sq. ft. multistorey structure can require about 10 million liters water for production, curing and site development activity. A double lane flyover can consume 70 million liters water on the same scale. Also in construction industry water is used for mixing, aggregate washing, curing of concrete and for washing concrete related mechanical machines. The mixing of water which is fit for drinking purpose is fit for concreting, But about 97 percent of water is held in the oceans, while only 3 percent is fresh water of the freshwater, only 1 % is easily accessible as ground or surface water, the remains are stored in glaciers and icecaps. Moreover, freshwater is not evenly distributed across land surfaces, and there are a number of heavily populated countries located in arid lands where fresh water is scarce.

Hence, the ultimate and last option will be treating the waste water and using it. But the humans have not accepted or will never accept the treated waste water for drinking purpose. So we can use this treated waste water in the construction industry where the large amount of share of water is used and save the freshwater.

The impurities present in the waste water can affect the properties of the concrete when used for mixing in concrete. Also the impurities may not affect all properties of concrete but some. The water samples PTWW and STWW were collected from Bhandewadi sewage treatment plant, Nagpur, India.

So if we can use the treated waste water for above purposes in construction industry, we can save a lot of freshwater and try to spread awareness and importance of water.

MATERIALS AND METHODOLOGY

An experimental investigation was carried out to evaluate the feasibility of treated waste water in concrete. We had performed various experiments on cement, fresh concrete and harden concrete.

Cement, fine aggregate, coarse aggregate, PTWW, STWW and TW were used under guideline of IS standards.

Treatment and characteristics of waste water

Primary treated water is the sewage water from which removal of constituents like as racks, sticks, floatable grit and grease. Secondary treated waste water is the primary treated waste water from which removal of suspended solid, organic matter and biodegradable organic waste.

MATERIAL USED

CEMENT

Ordinary Portland Cement (Ultra tech 43Grade) is used Cement is a fine, grey powder. It is mixed with water and materials such as sand & aggregate to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens. The ordinary Portland cement contains two basic ingredients namely argillaceous and calcareous. In argillaceous materials clay predominates and in calcareous materials calcium carbonate predominates.

FINE AGGREGATES

The sand used for the experimental program of sieve analysis. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust. The sand conforming to zone I as per IS 383-1970 was used for making reference concrete.

COURSE AGGREGATE

All types of aggregates are suitable. The normal maximum size is generally 10-20 mm. Consistency of grading is of vital importance. Coarse aggregate, conforming to IS 383-1970, Regarding the characteristics of different types of aggregate, crushed aggregates tend to improve the strength because of the interlocking of the angular particles, whilst rounded aggregates improve the flow because of lower internal friction.

WATER

Generally, water that is suitable for drinking is satisfactory for use in concrete. Water from lakes and streams that contain marine life also usually is suitable. The water used for the study is obtained from Bhandewadi sewage treatment plant. We have used three types of water in this project i.e. primary treated waste water (PTWW), secondary treated waste water (STWW) and tap water (TW) for casting of specimen. We have found the pH of all these water and the results are satisfactory for the use in concrete.

Table pH value of different water sample

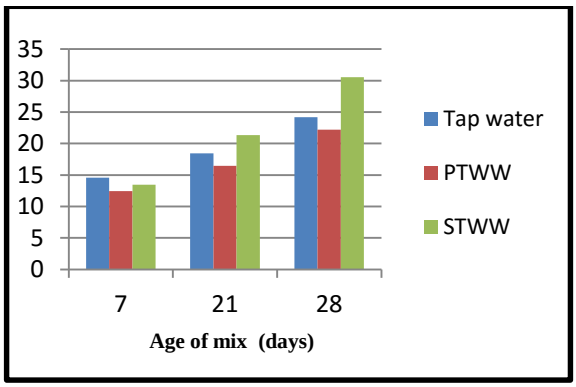
SR. NO.	TYPE OF WATER	pH
1	Tap Water(TW)	6.80
2	Primary Treated Waste Water(PTWW)	6.11
3	Secondary Treated Waste Water(STWW)	6.42

Experimental work:

Compressive strength of concrete

The M20 grade of concrete has been designed for preparing the concrete cubes as per IS. The mix proportion of concrete cube was 1:1/2:3 (cement: fine aggregate: coarse aggregate) and the water cement ratio was 0.45. The cubes were casted by each type of water. The dimensions of cubes were 150 x 150 x 150mm. The concrete cubes were tested after 7 days, 14 days and 28 days of curing. The test was performed according to IS 516 -1959 under compressive testing machine.

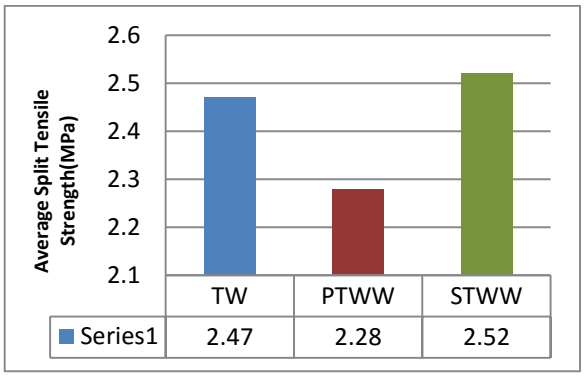
Mix	Curing Period	Types of Water	Average Compressive Strength(MPa)
M20	7 Days	TW	14.58
		PTWW	18.46
		STWW	24.17
	21 Days	TW	12.45
		PTWW	16.46
		STWW	22.19
	28 Days	TW	13.47
		PTWW	21.34
		STWW	30.54



Tensile strength of concrete

Cylinders were casted for 28 days by M20 grade of concrete. The cylinders were 150 dia. x 300mm.The cylinders were casted by mixing each types of water and tested under compressive testing machine according to IS standard.

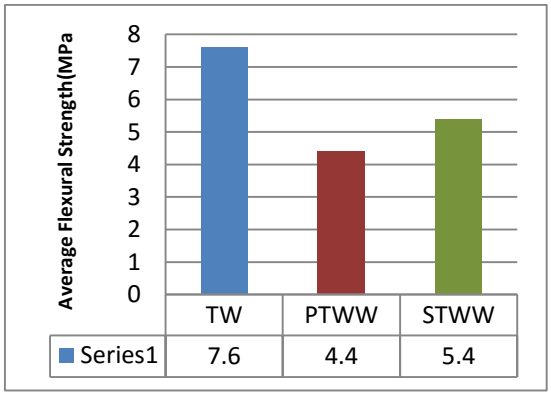
Mix	Curing Period	Types of Water	Average Split Tensile Strength (MPa)
M20	28 Days	TW	2.47
		PTWW	2.28
		STWW	2.52



Flexural strength of concrete

The beams were casted for 28 days of curing to check the flexural strength of concrete. The dimensions of beams were 100*100*700mm. beams were casted by using PTWW, STWW and TW. The beam were tested under universal testing machine as per guideline of IS: 516-1959; (Method of test for strength of concrete) and IS: 9399-1979(Specification for flexure testing of concrete).

Mix	Curing Period	Types of Water	Average Flexural Strength(MPa)
M20	28 Days	TW	7.6
		PTWW	4.4
		STWW	5.4



DISCUSSION OF RESULTS AND CONCLUSION

- It is found that the 7 days compressive strength of STWW is more than 0.31% PTWW & 0.66 % of TW.
- It is found that the 14 days compressive strength of STWW is more than 0.35% PTWW & 0.79 % of TW.
- It is found that the 21 days compressive strength of STWW is more than 0.44% PTWW & 1.27 % of TW.
- It is found that the 28 days tensile strength of cylinder of PTWW & STWW is nearly same.
- It is found that the 28 days flexural strength of beam of TW is more than 0.43% STWW & 0.73 % of PTWW.

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