EFFECT OF TREATED WASTE WATER (TWW) ON MECHANICAL PROPERTIES OF CONCRETE

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ABSTRACT

Concrete is the most widely used construction material in the world, making it one of the largest water consuming industries. Approximately 150 litres of water is required per cum of concrete mixture without considering other applications of water at the concrete industry. But water is a critical environmental issue and water supplies and water quality are becoming more limited worldwide. The waste water sample is collected from ,"Waste Water Treatment plant, shirdi", water sample is Tertiary Treated Waste Water. Properties of cement mortar were investigated with Fresh Water (FW) and Treated Waste Water (TWW). In M20 concrete mix the Fresh Water (FW) was replaced with the Treated Waste Water (TWW) and its fresh as well as hardened properties were compared. From the test result it is observed that compressive strength of mortar is decreased by replacing FW by TWW. Workability of concrete is slightly increased by replacing FW by TWW. Compressive strength , Splitting tensile strength and Flexural strength of concrete is decreased by replacing FW by TWW.

Keyword : - *Compressive strength , Fresh water, Treated waste water(TWW), Concrete, Tertiary treated waste water.*

1. INTRODUCTION

Water is the life blood of the environment, without water no living being survive. Water plays unique role in development of all sectors in any economy of every country. Water is used for agricultural, domestic, industrial, power generation and other various purposes. There are various sources of non-fresh water including sea and alkali water , mine and mineral water, water containing sewage and industrial wastes, wastewater produced from ready-mixed concrete plants and solutions of common salt were studied for use in concrete mixtures. It is difficult to draw a common conclusion regarding the use of these water in concrete mixtures since impurities that exist in each water type are different. However, the general consensus is that there is a reduction in the ultimate strength of concrete when impure water is used. But with proper mix design (such as use of cementitious materials and admixtures) and by using some acceptable tolerance limits,it is possible to use impure water in concrete mixing and curing.
The ultimate and last option will be treating the waste water and using it. But the humans have not accepted or will accept the treated waste water for drinking purpose. So this treated waste water can be in the contruction industry where the large amount of water is used and the fresh water is used. This work aims to explain how treated waste water can be used in construction industry and reduces the load on nature.

1.1 Objectives of project

- To conserve and preserve fresh water.
- To study the effectiveness of treated waste water as substitute for potable water in mortar and concrete.

- To study various cement properties like fineness of cement, standard consistency of cement, initial and final setting time of cement.
- To study the effect of treated waste water on properties of mortar like compressive strength.
- To study the effect of trreated waste water on properties of fresh concrete like workability.
- to study the effect of treated waste water on properties of hardened concrete like compressive strength, split tensile strength and flexural strength.
- To provide necessary information regarding use of treated waste water for mortar and concrete and to correlate past and existing studies about mortar and concrete using treated waste water.

2 RAW MATERIALS

- **Cemen**t

Ambuja Portland Pozzolana Cement confirming to IS 1489 was used in producing concrete mixies. The specific gravity of cement was 3.15.

- **Fine Aggregate**

Natural river sand confirming zone II as per IS 383-1970 was used as fine aggregate. The specific gravity and water absorption of fine aggregate were 2.65 and 1.02 respectively.

- **Coarse Aggregate**

20 mm crushed stone were used in coarse aggregate. The specific gravity and water absorption were 2.74 and 0.96 respectively.

- **Water**

Fresh or potable water and Treated waste water was used to hydrate the cement in the mixture.

3. CONCRETE MIX DESIGN

The concrete mixes were designed as per IS 10262-2009 and IS 456-2000. The mix design of concrete aimed to achieve targrt mean strength of 26.60 Mpa at 28 days with slump value of 75 mm. The water cement ratio were of 0.55 for the mixes.

Table -1: Mix proportion of concrete

Mixture ID	WC	Cement (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	Water (kg/m^3)
FW	0.55	383.16	685.75	1157.55	209.87
TWW	0.55	383.16	685.75	1157.55	209.87

4. EXPERIMENTAL PROGRAMME

Test has been carried out for Treated waste water and Fresh water such as pH , TSS, hardness, BOD and COD and comparison has been done with standards specified in Table 2.0.

Table -2: Chemical properties of water

Sr.No	Properties of water	Unit	Permissible limit by BIS	Result
1.	pH of Fresh	-	6.5-8.5	7.2

	water			
2.	Ph of Treated waste water	-	6.5-8.5	6.9
3.	Total suspended solid	mg/L	100	7
4.	Hardness	mg/L	300	28
5.	BOD	mg/L	20	10
6.	COD	mg/L	250	88

4.1. Consistency of cement

Consistency of cement past was found out by vicat apparatus .The procedure used to perform this experiment is followed by IS 4031 (part 4) 1988 and found out the consistency of cement .After this initial and final setting time of cement was found out .

4.2. Compressive strength of cement

Compressive strength of cement was obtained at 7 days and 28 days curing by preparing the mortor cubes . the properation of material for mortor mixture was 1:3 . The dimension of mortor cubes were 70 X 70 X 70 mm. The water used for casting was fresh or potable water and treated waste water .

4.3. Compressive strength of concrete

For compressive strength of concret the M 20 graade of concrete has been designed for preparing the concret cubes as per IS 10262-2009 .The mix proportion of concrete cubes was 1:1.789:3.02 (cement:fine aggregate :coarse aggregate) and the water cement ratio was 0.55 .The cubes were casted by using fresh or potable water and treated waste water at same w/c ratio .The dimensions of cubes were 150 X 150 X 150 mm .The concret cubes were tasted after 7 days and 28 days of curing .The taste was performed under compressive testing machine.

4.4. Tensile strength of concrete.

Cylinders of M20 grade of concrete were casted for 7 days and 28 days .The dimensions of cylinders were 150 dia X 300 mm .The cylinders were casted by mixing fresh or potable water and treated waste water at same w/c ratio and tasted under compressive testing machine according to IS standards .

4.5. Flexural strength of concrete.

The beams were casted for 28 days of curing to check the flexural strength of concrete .The dimensions of beam were 150 X 150 X 700 mm and were casted by using fresh or potable water and treated waste water.The beam were tasted under universal testing machine as per guideline of IS 516-1959 and IS 9399-1979 .

5. RESULT AND DISCUSSION

5.1. Treated waste water

The pH of fresh or potable water and treated waste water is above 6.5. The TSS of treated waste water is less than BIS limit. BOD, COD and hardness of treated waste water are within the desirable limit.

5.2. Consistancy of cement

The consistency of cement paste using TWW decreased by 6.67 % as compared to fresh or potable water. As per IS guidelines consistency of cement is 24-30 %. So the results obtained are in permissible limits. As impurities are present in mixing water, it affects the consistency of cement.

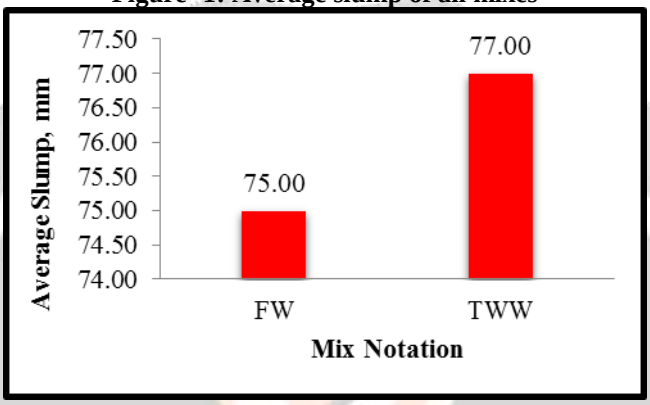
5.3. Initial and Final setting time of cement

The initial setting time of cement paste is increased by 10.42 % by mixing TWW as compared to fresh or potable water. The final setting time of cement is increased by 4.81 % by mixing TWW as compared to fresh or potable water.As per recommendation of IS standards the initial setting time should not be less than 30 min and final setting time should not be more than 600 min given in IS 456-2000. The initial and final setting time of cement paste is as per guidelines recomended by IS 456-2000.

5.4. Workability of concrete

The workability of concrete is slightly increased by 2.66 % by mixing TWW as compared to fresh or potable water. Slump of concrete is not affected by adding TWW as compared to FW.

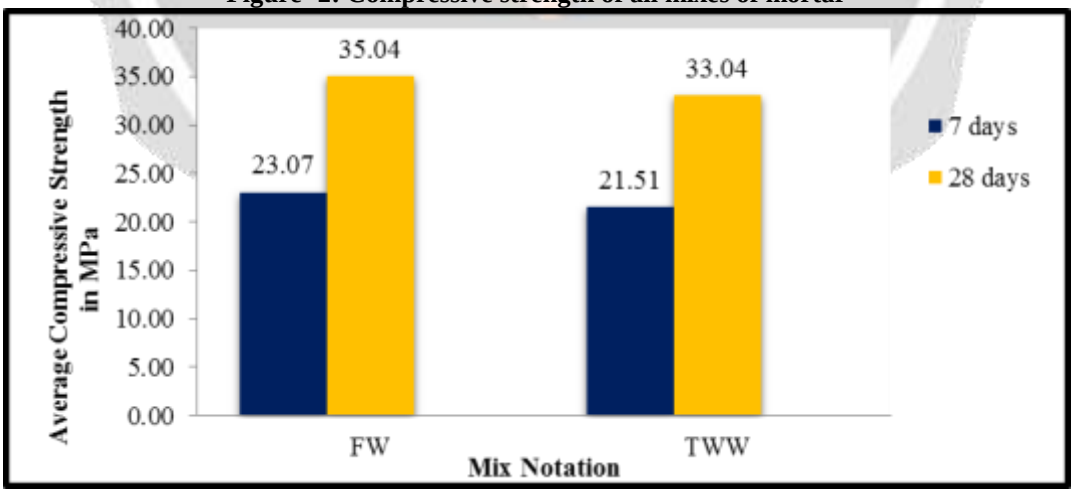
Figure -1: Average slump of all mixes



5.5. Compressive strength of mortar cube

The compressive strength of mortar cube is decreased by 5.70 % by mixing TWW as compared to fresh or potable water at the end of 28 days.

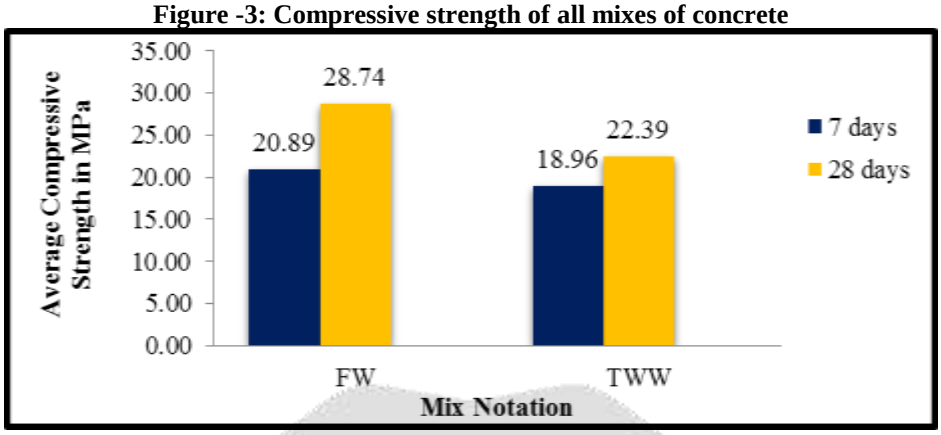
Figure -2: Compressive strength of all mixes of mortar



5.6. Compressive strength of concrete

The Fig.- 3 shows the effect of mixing fresh or potable water and TWW in concrete on compressive strength og concrete for 7 days and 28 days. The compressive strength of concrete is decreased by 22.09 % by mixing TWW as compared to fresh or potable water at the end of 28 days.

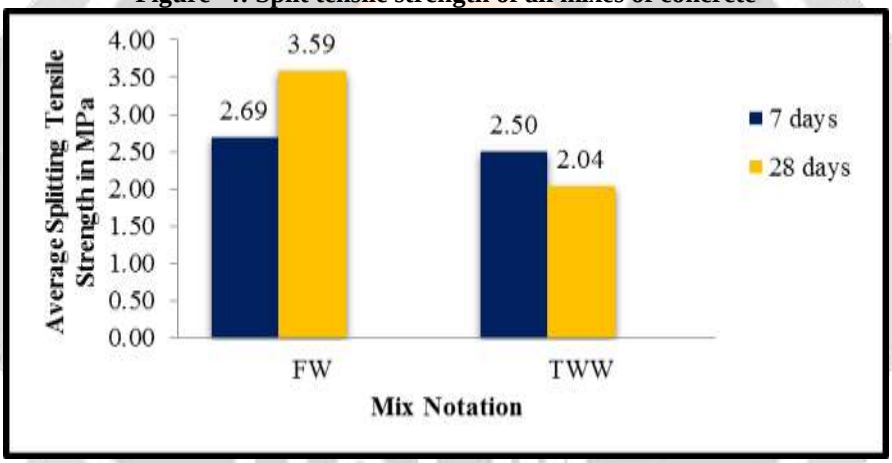
Figure -3: Compressive strength of all mixes of concrete



5.7. Split tensile strength of concrete

The split tensile strength of concrete is decreased by 43.17 % by mixing TWW as compared to fresh or potable water at the end of 28 days.

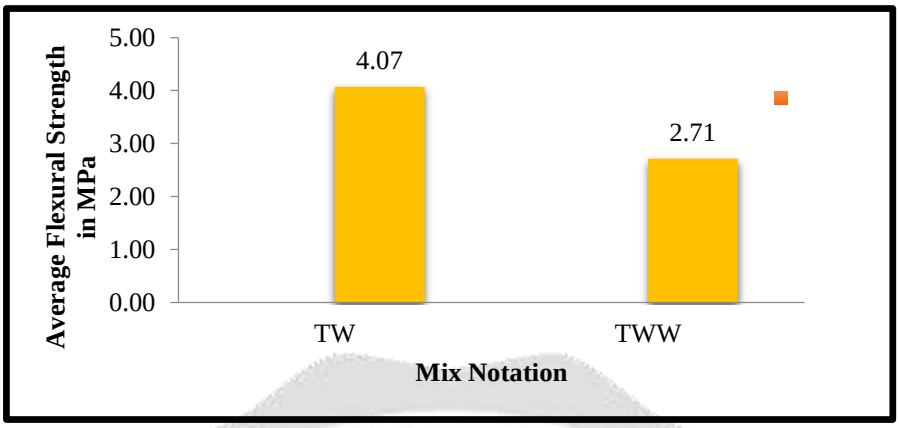
Figure -4: Split tensile strength of all mixes of concrete



5.8. Flexural strength of concrete

The flexural strength of concrete is decreased by 33.41 % by mixing TWW as compared to fresh or potable water at the end of 28 days.

Figure -5: Flexural strength of all mixes of concrete



6. CONCLUSIONS

- Standard consistency of cement is decreased by 6.67 % by mixing TWW as compared to potable or Fresh Water (FW).
- Initial setting time of cement is increased by 10.42 % by mixing TWW as compared to potable or Fresh Water (FW).
- Final setting time of cement is increased by 4.81 % by mixing TWW as compared to potable or Fresh Water (FW).
- Workability of concrete is slightly increased by 2.66 % by mixing TWW as compared to potable or Fresh Water (FW).
- Compressive strength of mortar is decreased by 5.70 % by mixing TWW compared to potable or Fresh Water (FW).
- Compressive strength of concrete is decreased by 22.09 % by mixing TWW as compared to potable or Fresh Water (FW).
- Splitting tensile strength of concrete is decreased by 43.17 % by mixing TWW as compared to potable or Fresh Water (FW).
- Flexural strength of concrete is decreased by 33.41% by mixing TWW as compared to potable or Fresh Water (FW).

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