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Effect of Treated Waste Water on Strength of Concrete

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Abstract: *This study deals with the effect of different type of treated waste water on properties of strength of concrete such as compressive strength, tensile strength and flexural strength with respect to Potable water. The waste water sample collected from waste water treatment plant near Shirdi. Water samples were used as Primary Treated Waste Water (PTWW), Secondary Treated Waste Water (STWW) which was analyzed for its chemical properties in laboratory. In that use of concrete mix of M30 the Potable water was fully replaced with the PTWW, STWW and Domestic Waste Water. The tests conducted are initial and final setting time on cement, Compressive strength, tensile strength and flexural strength on concrete which is compared with the mix of M30 of potable water. The results indicate that the initial and final setting time of cement was same as that of Potable water and STWW but decreased for PTWW, for compressive strength it was increased in STWW and domestic waste water at longer duration, for tensile and flexural strength tests was same results so, there was no any improvement in tensile and flexural strength by using STWW.*

Keywords: *Domestic water, Potable water, Primary Treated Waste Water, Secondary Treated Waste Water concrete.*

I. Introduction

The construction industry appears to be responsible for the consumption of huge amount of fresh water. Approximately 150 liters water is required for $1m^3$ of concrete without considering other applications of water at the concrete industry. 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. In that the freshwater, only 1 percent is easily available as ground or surface water, the remains are stored in icecaps. Water is used for domestic and industrial purpose from surface water bodies and underground water surface. The concrete industry has serious impact on the environment with regard to consumption of water. Therefore need to find the alternative source of fresh water in concrete industry. The ultimate and last option will be treating the waste water and this treated waste water is used for drinking purpose. So use of this treated waste water in the construction industry and save the freshwater. The impurities present in the waste water may not affect all properties of concrete but some. The water samples PTWW, STWW were collected from waste water Treatment plant, Shirdi and Potable water was collected from Yeola city. The waste water was tested in the laboratory to find the chemical properties of water such as pH, TSS, hardness, BOD, COD. 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.

II. Materials

Ordinary Portland cement 53 grade is used which having specific gravity 3.15, Natural sand is used as fine aggregate in concrete mix design, Coarse aggregate which is Maximum size of aggregate selected for this mix design is 20 mm. specific gravity of aggregate is 2.61 and water absorption 0.3%, The Municipal waste water is collected from sewage treatment plant located at Shirdi district Ahemadnagar and 40 km from Yeola citiy. The main object of PTWW is to remove large size of floating matter e.g. Papers, Dead animals etc. The Secondary treated waste water is to remove fine particles which is not removed from PTWW e.g. silt, sand, clay. The domestic waste water is collected from a row house which located in Yeola city.

Objective of Study

In our country various sources of water are avilable in different region.The main objective of this is to obtained result on the use of treated waste water of treatment plant as PTWW, STWW directly mix into the concrete. The primary aim of this work is to study the effect of waste water during concrete mix for M30 grade of concrete.

Experimental Program

Water quality of used water has been analyzed for PH, TSS, hardness, BOD and COD and comparison has been done with standards as specified in table 1.0

Table 1.0 Tests on chemical properties water

Sr. No	Parameters	Units	BIS	WHO	GOI	PTWW	STWW	Domestic water
1.	pH	-	6.5-8.5	7-8.5	7-8.5	6.28	6.41	6.18
2.	TSS	mg/L	100			350	<10	280
3.	Hardness	mg/L	300	100	200	52	35	12
4.	BOD	mg/L	20	-	-	50	<10	35
5.	COD	mg/L	250	-	-	150	<100	133

2.1 Consistency of cement

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

2.2 Compressive strength of cement

Compressive strength of cement was obtained at 7 days and 28 days curing by preparing the mortar cube. The proportion of material for mortar mixture was one part of ordinary Portland cement to the three parts of standard sand. The water cement ratio was 0.45. The dimensions of mortar cubes were 70 X70 X 70 mm. The waste water used for casting was PTWW, STWW, Domestic waste water.

2.3 Compressive strength of concrete

For compressive strength of concrete the M30 grade of concrete has been designed for preparing the concrete cubes as per IS 10262:2009 revised. The mix proportion of concrete cube was 1:1.62:2.53 (cement: fine aggregate: coarse aggregate) and the water cement ratio was 0.45. The cubes were casted by using each type of water at same w/c ratio. The dimensions of cubes were 150X 150 X 150mm. The concrete cubes were tested after 3 days, 7 days, 28 days and 60 days of curing. The test was performed under compressive testing machine.

Fig 1: Compressive strength test

2.4 Tensile strength of concrete

Cylinders of M30 grade of concrete were casted for 28 days curing. The cylinders were 150 dia. X 300mm.The cylinders were casted by mixing each types of water of same w/c ratio and tested under compressive testing machine according to IS standard.

Fig 2: Tensile strength test

2.5 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 150 X 150 X 700mm beams were casted by using PTWW, STWW, and Domestic water. The beam were tested under universal testing machine as per guideline of IS: 516-1959 and IS: 9399-1979.

Fig 3: Flexural strength test

III. Result And Discussion

3.1 Treated waste water

An experimental Investigation shows that there was significant difference in analysed parameters i.e. pH, Alkalinity, Hardness, TSS etc. The pH of PTWW, STWW, Domestic water and Potable water is above 6.00 and the TSS of PTWW, STWW, Domestic water is less than IS limits. BOD and COD of PTWW, STWW, and Domestic waste water are within the desirable limit.

3.2 Consistency of cement paste:

The consistency of cement paste using STWW increases by 1.69% as compared to potable water. The consistency of cement paste using PTWW and Domestic waste water is more than STWW. As per IS guidelines consistency of cement is 24–30 % of cement. So the results obtained are within permissible limits. As the quality of mixing water impurities, it affects consistency of cement.

3.3 Initial and Final setting time of cement:

The initial setting time of cement paste is increased by 5.88% for STWW as compared to potable water. The initial setting time of cement paste for PTWW and Domestic waste water is more than STWW. As per recommendation of IS standards the initial setting time should not be less than ±30 min and final setting time should be less than 600 min given in IS 456 : 2000. The initial and final setting time of cement paste is as per guidelines recommended by IS456:2000

3.4 Compressive strength of mortar cubes:

The Compressive strength of mortar cube by mixing STWW for 7 days is near about same as Potable water. Compressive strength of mortar cube prepared with STWW shows improvement in the strength by 7 % as compared to Potable water for 28 days. The mortar cubes prepared with PTWW and Domestic waste water shows decreasing results as compared with potable water. The result suggested that the organic content present in STWW may be acting as a dispersing agent, improving the dispersion of particles.

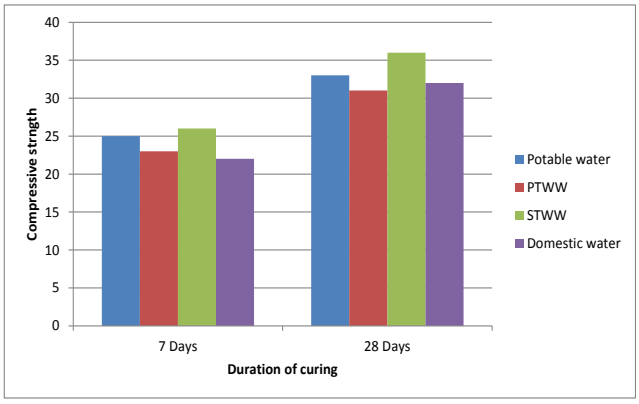

Fig 4: Compression Strength of mortar cube

3.5 Workability of concrete:
For PTWW, STWW, Potable water and Domestic waste water the slump value varied between 90 – 100 mm. Slump of concrete is not affected by adding PTWW, STWW, Domestic water compared to Potable water.

3.6 Compressive strength of concrete:
The Fig. 5 shows the effect of mixing waste water in concrete on compressive strength of concrete for 3 days, 7 days, 28 days and 60 days. The compressive strength of concrete is increased by 2 % for STWW at end of 60 days as compared to Potable water. The strength gained is slower but at the end of 60 days it is more than potable water. PTWW contains more algae content and thus reduce the strength of concrete.

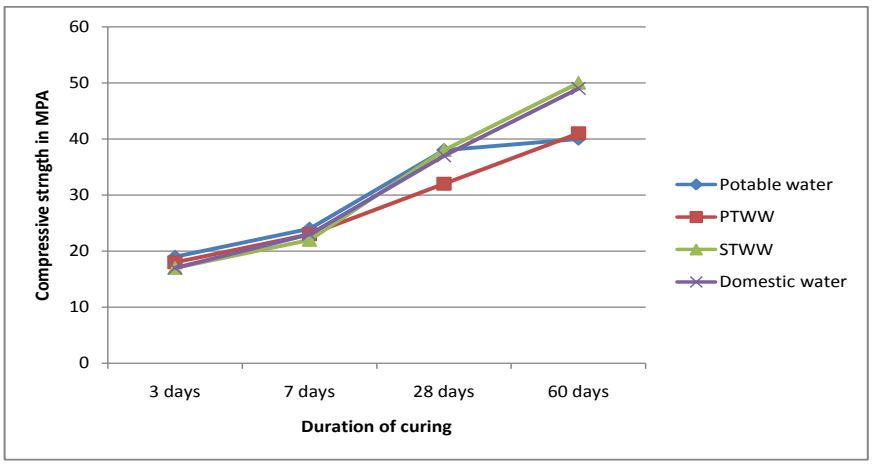

Fig 5: Compression Strength of concrete

3.7 Tensile strength and flexural strength of concrete:
The tensile strength of concrete by mixing PTWW, STWW and Domestic water was not affected. The flexural strength of concrete is increased by 4.4 % by mixing STWW as compared to potable water.

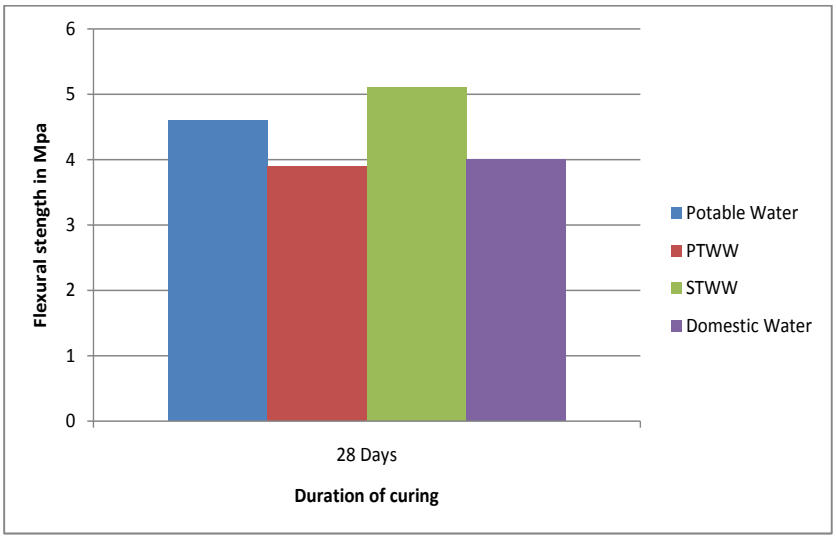

Fig 6: Flexural Strength of concrete

IV. Conclusion

From this experiment is concluded that STWW contains less impurities and is fit as per IS provision. The consistency, initial and final setting time of cement paste by mixing STWW is within the IS limit. The compressive strength of mortar is increased by mixing STWW at the end of 28 day. The compressive strength of concrete is increased by mixing STWW at the end of 60 days. There is no any significant difference in tensile strength and flexural strength is improved by using STWW.

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