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EFFECT OF TREATED WASTE WATER ON STRENGTH OF CONCRETE

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ABSTRACT

In construction industry , concrete is most widely used construction material . 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 IS 10262-2009 , 186 liters water is required for $1m^3$ of concrete. On an average 150 liters water is required for $1m^3$ of concrete. Also in construction industry water is used for mixing, aggregate washing, curing of concrete and for washing concrete related mechanical machines. The mixing ,water which is fit for drinking purpose is use, but about 97 percent of water is held in the oceans, while only 3 percent is fresh water. 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. 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 this treated waste water can be in the construction industry where the large amount of water is used and the freshwater is used. This works aims to explain how treated waste water can be used in construction industry and reduces the load on nature.

Keywords: Compressive Strength, Flexural Strength, PTWW, Splitting Tensile Strength, STWW.

I. INTRODUCTION

Water is the basic need of all living beings rather than air, food and shelter. Without water man cannot survive. In early days, water was primarily used for domestic needs like drinking, washing, bathing and cooking etc. But due to modernization, water is also required for industrial, construction purpose, ornamental and sewerage purposes along with domestic needs. 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 percent 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. 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 this treated waste water can be in the construction industry where the large amount of water is used and the freshwater is used. This works aims to explain how treated waste water can be used in construction industry and reduces the load on nature.

II. LITERATURE REVIEW

K. Nirmalk umar and V. Sivk umar (2008) [1] investigated that, durability impact of concrete by using recycled waste water. They used the recycled waste water from the tannery industry for the construction purpose, so that the shortage in water can be greatly reduced by making some primary treatment. Then the specimens were also casted by adding the concare admixture with dosages of 0.5%, 1.0%, 1.5%, 2.0% and 2.5%. The specimens were tested for durability properties for 28 days, 90 days and 365 days .By using this cubes and cylinders were casted and tested for its durability (sulphate attack, chloride attack and corrosion impact).

R. A. Taha (2010) [2] investigated that, the feasibility of us ing Ground (brackish) water and Production (oily) water in construction Compared with Tap water. Non fresh water samples were obtained from four P DO (Petroleum Development O man) asset areas. Nine water samples, including controlled potable (tap) water, were analyzed for pH, total dissolved solids (TDS), chloride, hardness, alkalinity, and sulphates. In addition, cement pastes and mortars and plain concrete mixtures were prepared using 100% substitution of potable water. N ine mixtures were prepared and cured for up to one and a half years. Mixtures were tested for initial setting times, compressive strength and flexural strength.

M. Silva and T. R. Naik (2010) [3] investigated that , ustainable use of resources, such as use of reclaimed water, especially partially processed sewage treatment plant water in concrete. An initial laboratory investigation was conducted samples were collected from the Milwaukee Metropolitan Sewerage District (MMS D) and analyzed the Characteristics of reclaimed wastewater. According to their investigation the compressive strength, mortar cubes with sewage treatment plant water has shown improvement in strength during 3 to 28 days and increased by the duration of 91 days.

K. S. al jabri et al (2011) [4] Investigated that, the effect of waste water on properties of high strength concrete. In that wastewater samples were collected from three car washing station in Muscat area. The collected wastewater samples were mixed together and chemical analysis was carried out. Four water samples, including controlled potable (tap) water were analyzed for pH, total dissolved solids (TDS), chloride, hardness, alkalinity, and sulfates. Their chemical analysis results showed that although the chemical compositions of wastewater were much higher than those parameters found in tap water, the water composition was within the ASTM standard limits for all substance indicating that the wastewater produced can be used satisfactorily in concrete mixtures. High strength concrete mixtures were prepared using different proportions of wastewater and water-to-cement ratio of 0.35. The percentage of wastewater replaced ranged between 25-100% of tapwater used in concrete. For each concrete mixture, six 150mmx150mmx150mm cubes, three 300mmx150mm dia. cylinders and three 100mmx100mmx500mm prisms were cast. Slump, compressive, tensile, flexural strengths and initial surface absorption test were determined at 28-day and 7-day of curing in order to assess the durability of concrete.

B. Madhusudana Reddy and I. V. Ramana Reddy(2011) [5] investigated that, the effect of lead (Pb) present in mixing water on compressive strength, setting times, soundness and magnesium sulfate attack on high strength cement mortar was experimentally evaluated. Based on the results of this investigation, they were concluded that Lead spiked deionized water affected setting times. For the concentration of 3000 mg/L and above, setting times were significantly increased. The presence of lead in high concentrations (≥ 3000 mg/L) in

deionized water considerably decreased the compressive strengths. For a concentration of 2000 mg/L, at early ages of 3 and 7 days, compressive strength development was slow but for 28 days and onwards, compressive strength development was slightly higher than that of reference specimens. The presence of lead in cement matrix up to 2000 mg/L p ositively influences engineering properties of mortar. The compressive strength loss in reference and test specimens was almost the same when they were immersed in magnesium sulfate solutions. The strength loss exhibited was due to dissociation of calcium hydroxide and decalcification of C-S-H.

V. Kulkarni (2014) [6] investigated that, compressive strength of concrete by using treated domestic waste water as mixing and curing of concrete. By using of treated domestic waste water utilized in concrete preparat ion where there was a scarcity of fresh water. They discussed physical properties of Materials and chemical properties of treated domestic waste water of mix proportion for M20 and M40 grade concrete the number of specimens to be cast for different curing regimes and elaborate average compressive strength results of M20 grade concrete cast by using Tap water as mixing and curing water for Mix M1 & treated domestic waste water as mixing and curing water for Mix M2 S imilarly average compressive strength results of M40 grade concrete cast by using Tap water as mixing and curing water for Mix M3 & treated domestic waste water as mixing and curing water for Mix M4.

R.A. More and S.K. Dubey (2014) [7] investigated that, the effect of different types of water on compressive strength of concrete. They made concrete cube with mineral water, tap water, well water and waste water increased with days & not having much variation in their compressive strength. The concrete mix of M20 grade with water cement ratio of 0.5 was investigated. Water samples were collected from various sources at college campus and were used to cast 150mm concrete cubes. The cured cubes were crushed on 7 & 28 days for compressive strength estimation. Also concluded that concrete made with different qualities of water samples such as ground water, packed drinking water, waste water etc. have 7 and 28-day compressive strength equal to or at least 90% of the strength of reference specimens made with clean water for M20 grade of concrete (Except waste water specimen for 7 -day).

F. Adeye mietal (2014) [8] investigated that, the effect of sea water on the compressive strength of concrete. They have been taken cement concrete cubes of 150mm x 150mm x 150mm were cast using fresh water and sea water with mix ratio 1:2:4. All the mixes were prepared using constant water cement ratio (w/c) of 0.6 by weight. A total of 140 concrete cubes were made in two batches; half of the cubes were made using fresh water and the other half using sea water. They were cured in fresh and sea water respectively. The curing was done for 7, 14, 21, 28 and 90days, then crushed using the Compressive Strength Test Apparatus at prescribed ages. Their study shows an increase in the compressive strength of concrete for concrete specimens mixed and cured with sea water. Compressive strength of the concrete were also affected when the concrete was cast with fresh water and cured with salt water and vice-versa. In case of reinforced or prestressed members, corrosion of embedded steel could be prevented by painting or coating the steel with cement slurry made with fresh water. In addition, higher concrete cover can be provided when designing the member.

N. Reddy (2015) [9] investigated that, the Treated domestic waste water as a mixing water in cement mortar. It has been affected on properties of cement blended with 20% fly ash such as compressive strength, setting times and soundness. Water used for mortar includes Potable water (PW), treated do mestic wastewater (TDWW) and treated domestic wastewater (TDWW) partially replaced with Potable water. The setting times and soundness of blended cement with treated domestic wastewater (TDWW) and treated domestic wastewater (TDWW) partially

replaced with Potable water is as good as that with Potable water. The compressive strength of blended cement mortar mixed with treated domestic wastewater and treated domestic wastewater partially replaced with Potable water has been very insignificantly affected. Therefore, they were suggested that treated domestic wastewater may be considered as mixing water for blended cement mortar where Potable water resources are scarce. However, advised that long-term strength development and durability be studied before use. In that setting times were found to very insignificantly increase in all types of mixing water when compared with potable water. There were no adverse effects on resulting in compressive strength, when cement mortar specimens made with TDWW and cured in same water. As the measured values are less than 10 mm; all the samples were considered sound. The presented experimental study confirms the feasibility of using TDWW in cement mortar.

E.W. Gadzama (2015) [10] Studied on the effect of using sugar factory waste water as a mixing water on the properties of normal strength concrete. In that the setting time of wastewater increases with an increase with percentage replacement, sugar wastewater from the factory was found to be acidic and the strength increases with an increase in curing duration. However, there were appearances of hair- like cracks all over the cubes casted with an appreciable volume change in the dimension of the cubes. The utilized wastewater from Savannah Sugar factory as a total replacement for mixing water in concrete, as well as curing water. Tests were carried out include, setting time of cement mixed with wastewater, composition analysis of wastewater as compared with Potable water and compressive strength of concrete. Due to this there was substantial delay in the setting time of the cement mix using wastewater, the delay increase with an increase in the percentage of mixing wastewater. Concentrations of metallic elements as measured from the wastewater and compared with that of Potable water revealed that Zinc, Lead and Sodium were within the range of WHO standard and the wastewater had a pH that was acidic, outside the quoted standard. Positive volume change as much as 3.03% was observed and measured using a digital meter. Target strength at 28 days was not met, but it ranged from 83% - 91%, however, when the curing duration was extended to 90 days, the concrete cubes produced strength that S urpassed the target strength.

III. OBJECTIVE

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 water of Treatment plant as PTWW, S TWW directly mix into the concrete. The following are specific tasks:

- Study of various issues in concrete technology and environment factor.
- Study of how to use waste material in the concern of environment.
- Chemical treatment of waste water that will be used for concrete mix easily.
- Preparation and testing of concrete.
- Evaluate the result and compare. Study of how to use waste material in the concern of environment.
- Effect on strength of concrete by using different type of treated water (PTWW, S TWW and Domestic waste water) with Potable water.
- Preparation and testing of concrete.
- Evaluate the result and compare.
- Identify of civil work where these water can be used without compromising structural strength parameters.

IV. METHODOLOGY

Step No.1- Collection Of Material Which Is Used For Preparation Of Concrete.

Step No.2-Testing Of That Materials

Step No.3- Prepared The Mix Design Of Concrete For M30 Grade

Step No.4- Treated Waste Water Were Collected From Waste Water Treatment Plant(Ptww & Stww)& Domestic Waste Water From Shirdi City

Step No.5- Determine The Chemical Characteristic Of The Waste Water(Ph, Tss, Hardness, Bod, Cod)

Step No.6- Testing Of That Casted Specimen To Obtain Compressive Strength , Tensile Strength & Flexural Sterngth

Step No.7- Compared These Obtained Results Of Treated Waste Water Of Each Specimen With Result Of Fresh Water Concrete

V. EXPERIMENTAL INVESTIGATIONS

Material used for investigation:-

- Cement
- Sand
- Coarse aggregate
- Water

Table no 1.1. Laboratory tests on waste water

No.	Parameters	Units	BIS	WHO	GOI	PTWW	STWW	Domestic Waste
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

Table No 1.2. Test Results of Materials

Sr. No.	Test Description	Values
1	Specific Gravity of Cement	3.15
2	Specific Gravity of Fine Aggregate	2.71
3	Specific Gravity of Coarse Aggregate (20mm)	2.61
4	Water Absorption of Fine Aggregate	0.3%
5	Water Absorption of Coarse Aggregate (20mm)	0.3%
6	Moisture Content of Coarse Aggregate	1.7%
7	Moisture content of fine aggregate	1.78%
8	Grading Zone of Coarse Aggregate	Zone II

9	Grading Zone of Fine Aggregate	Zone I
10	Water Cement Ratio	0.43
11	Fineness Modulus of Fine Aggregate	5.5
12	Fineness Modulus of Coarse Aggregate	4.592
13	Bulk Density of Coarse Aggregate	1.548
14	Bulk Density of Fine Aggregate	1.873
15	Flakiness Index of Coarse Aggregate	11.35 %

Table No.1.3 Conctete Mix Design Values For M 30 Grade

proportion	water	cement	sand	Coarse aggregates
By weight (kg)	180	400.00	744.92	1076.16
By volume (m^3)	0.45	1	1.78	2.70

Table No 1.4 Casting Of Specimens

Specification	Size	Tap Water	PTWW	STWW	Domestic Water
Mortar Cube	70x 70x70	6	6	6	6
Cube	150x150x150	6	6	6	6
Cylinders	150x300	6	6	6	6
Beams	150x150x700	6	6	6	6

VI. RESULTS AND DISCUSSIONS

In this investigations the casted specimens are tested for three type of tests:

- Compressive strength test
- Split tensile strength test
- Flexural strength test

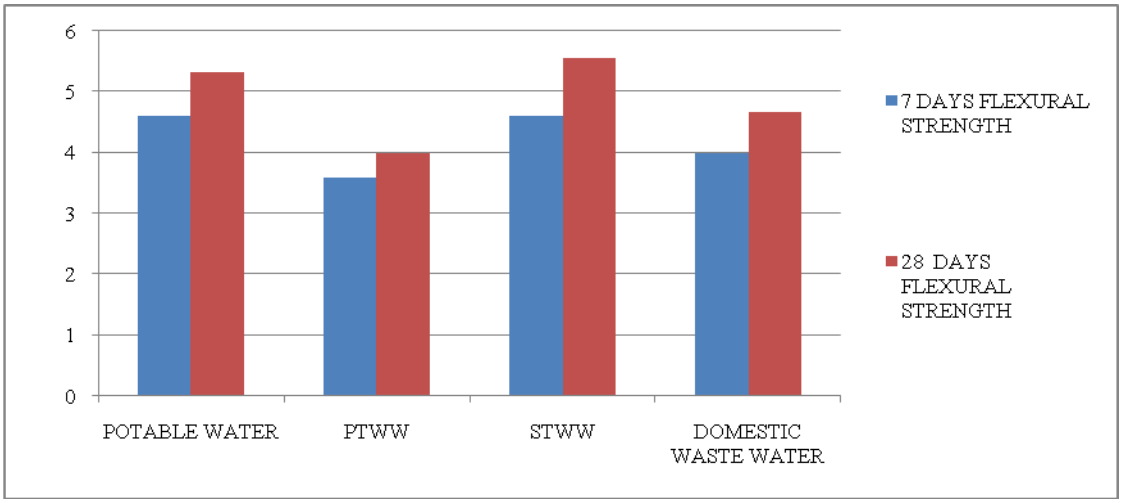

Figure no 1. Compressive strength test results for mortar

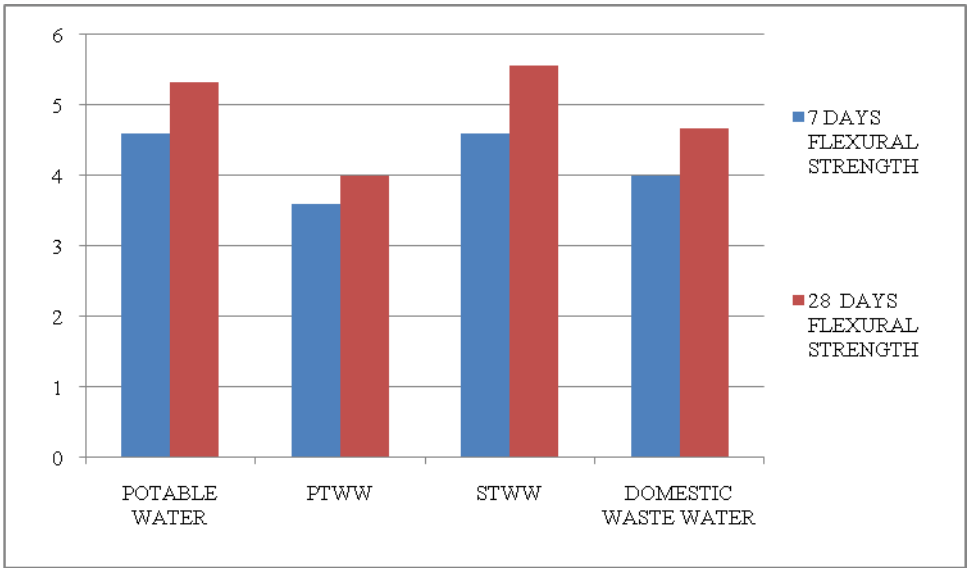

Figure no 2. Compressive strength test results

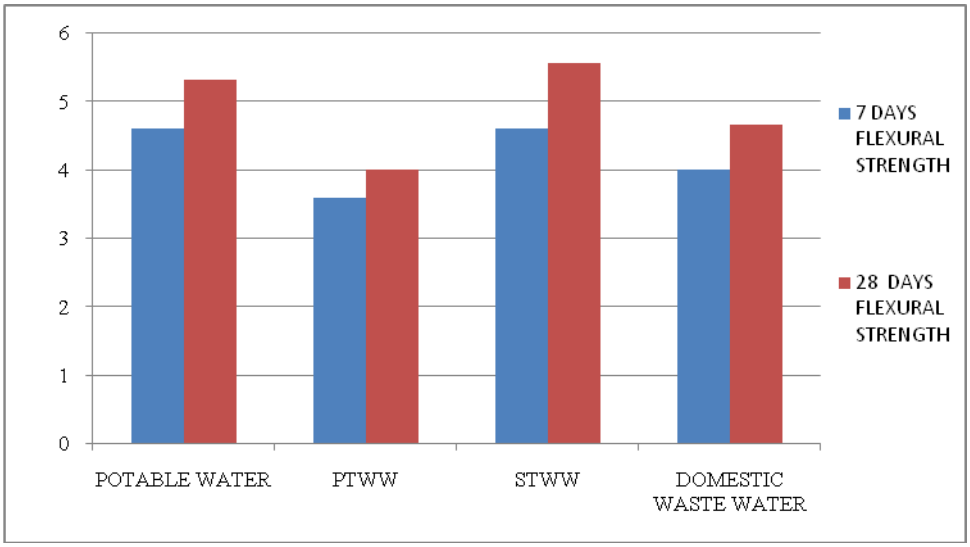

Figure no 3. Split tensile strength results

Figure no 4. Flexural strength test results

VII. CONCLUSION

- From this experiment we conclude 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
- Compressive strength of concrete is prepared with STWW gives same strength of concrete of potable water at 28 days.
- There is no any significant difference in tensile strength and flexural strength is improved by using STWW.

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