INVESTIGATION ON PROPERTIES OF CONCRETE CASTED WITH TREATED EFFLUENT

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ABSTRACT

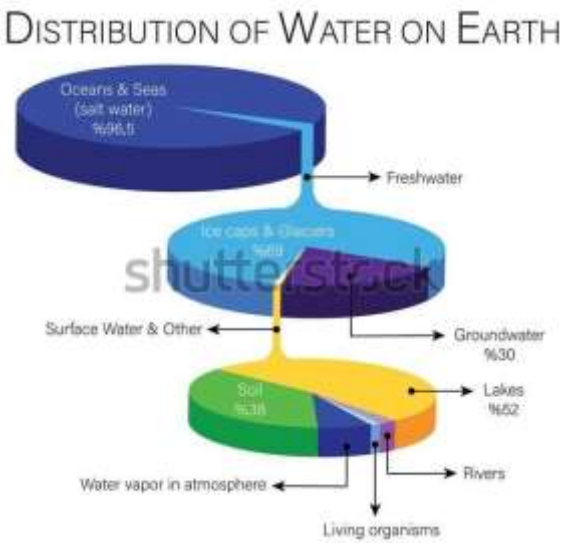
Water is a basic element in construction and construction industry required fresh water. Nowadays, we are facing problem related to availability of fresh/potable water.Considering this problem, this research deals with study of the effect of different type of treated waste water on properties of concrete such as compressive strength with respect to potable water. The domestic treated wastewater sample collected from Sewage water treatment plant (STP) in Lalkhadi and Industrial treated wastewater sample from effluent treatment plant (ETP) near Amravati city. Water samples of domestic treated waste water and industrial treated waste water tested in laboratory to calculate impurities of water such as pH, BOD & COD etc. After testing impurities of treated waste water, it is observed that all parameters of treated water are in permissible limit. Concrete cube casted with Industry treated water, domestic treated waste water and potable water for M20 & M25 grade of concrete and compared result. The result indicate that the compressive strength of industrial treated waste water and domestic treated waste water is gradually decreases but within acceptable limit as compare to the potable water the chemical analysis were performed by free chlorine by (starch iodide test) titration method.

Keywords: Potable water, Domestic treated water, Industrial treated water, Compressive strength.

INTRODUCTION

Water is one of the nature's precious gifts, which sustains life on earth. Civilizations over the world have perished depending upon the availability of this vital resource. Water has been worshiped for life nourishing properties in all the scriptures.

About 71% of earth surface is covered with water and the ocean holds about 97% of and all earths' water, remaining 3% is freshwater. This 3% freshwater is categorized as 79% is covered with icecaps and glaciers, 20% is groundwater and remains only 1% surface water. This 1% surface water is categorized as 52% water covered by lakes, river1%, 1%consume by living organism, 38% is soil moisture 8%, 6% atmospheric water vapour. The water covered by lakes and reservoirs is useful for drinking and many other purposes and may subjected to various losses also.



LITERATURE REVIEW

Ramkar A.P. *et.al* (2016) The effect of different source of treated waste water on properties of concrete i.e. compressive strength, tensile strength and flexural strength of concrete has checked. The treated waste water has been collected from waste water treatment plant situated at shirdi. They have used PTWW (primary treatment waste water) and STWW (secondary treatment waste water) process and also they have checked the chemical properties of collected treated waste water in laboratories. After determining the properties of collected sample from treatment plant they have cast the cubes using M30.

K. Nirmal kumar *et.al* (2008) investigated that, durability impact of concrete by using recycled wastewater. They used the recycled wastewater 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 conacre 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 these cubes and cylinder were casted and tested for its durability (sulphate attack, chloride attack and corrosion impact).

K.S. Al-Jabri *et.al* (2011) carried out study on treated waste water for concrete mix then they have checked which effects are developed on properties of high strength concrete. The sample was collected from three car washing stations in Muscat area. They have cast different types of samples for testing purpose i.e. first six cubes are cast in size 150 x150 x 150, second three cylinders are cast in size 300 x 150 diameter and last three prisms are cast in 100 x 100 x 500 dimension. They have determined the compressive strength, tensile strength and flexural strength at 28 days of curing. And also, compressive strength of cubes checked for 7-day curing. They have concluded that when curing period increases the compressive strength of concrete is also increases using waste water there is no significant difference. It may be also concluded that from this study that the use of waste water produced from car washing stations has negligible effect on the strength of concrete

Asif Rashid sheikh *et.al* (2016) Main aim of this study is to determine the quality of water which was used for mixing purpose for concrete. They have the waste water collect from waste water treatment plant at Kuwait. They have used M20 grade of concrete. They have concluded that comparison between potable water concrete and treated waste water concrete are giving nearly similar results. [4] P. Rama Mohan Rao carried out the study on treated waste water for preparing concrete mix are suitable or not suitable and also studied which exactly effect is developed on concrete by using treated waste water. They have also checked what exactly happen when waste water used in reinforcement concrete. They have concluded that treated waste water is suitable for construction activity without compromising strength of concrete.

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H. Vijay *et.al* (2014) mainly focused on the reuse of treated waste water effluent in place of potable water in plain concrete. They have also studied the effect of physic-chemical characteristics of this non fresh water on concrete. They were used water sample from four source which are treated domestic sewage water, service station water (garage), Dairy waste water and potable water. After sample collecting they were analyzed all sample for pH, total dissolved solids, chloride, hardness, alkalinity, and sulfates. This study concluded that use of treated

effluents auto service station (garage) water and dairy wastewater has no noticeable side effect on the strength of concrete.

Himashu Sharma *et.al* (2015) carried out study on effect of alkaline substance present in mixing and curing water on the compressive strength of concrete is assessed under the laboratory conditions. They have used two type of grade for mixing purpose i.e. M25 and M30. The concrete mix prepared with additional two concentrations of NaOH i.e. 40ml/l and 80ml/l in mixing and curing of water. Compressive strength of concrete was checked for 14, 28 and 90 days. They conclude that compressive strength of concrete decrease with 40ml/l concentration of NaOH as compared to cube cast with normal water when tested for 14, 28 and 90 days. The compressive strength of concrete increase with 80 ml/l concentration of NaOH as compared to cubes cast with normal water when cubes tested at 14 and 28 days but it is decreasing the compressive strength of concrete again when cube tested at 90 days. So, they conclude that some amount of the effected of NaOH on compressive strength of concrete.

Shrilatha *et.al* (2017) carried out study on the primary treated waste water used for concrete mix which was analyzed for chemical properties in laboratories. The waste water sample collected from MYLSANDRA waste water treatment plant. The grade of concrete which they have used is M20. The potable water was replaced with the primary treated waste water in different dilution ratios of 20%, 40% and 100%. They also conclude that the results obtained from treated effluent, compressive strength of concrete is increased by 10.68% till 28 days as compared to potable water.

S.P. Kale *et.al* (2018) This study has evaluated the use of treated waste water for concrete mixing is seen to favourable for strength development. It also seen that reduction in long term strength of concrete including it may possible to use treated waste water in mixing and curing of concrete. However, there is Risk of corrosion of steel reinforcement in concrete.

Mr. K. J. Kucche *et.al* (2015) Impurities present in water are reacting differently with different constituent of cement. These reactions mostly affect the setting time, compressive strength and may also cause straining of concrete surface. All impurities may not have adverse effects on the properties of concrete. Some impurities react such that, net result may be harmless or improve concrete properties. Hence it is difficult to draw a common conclusion for use of water for mixing and curing in concrete. The use of impure water for concrete mixing is seen to favorable for strength development at early ages.

R. A. Taha *et.al* (2010) investigated that, the feasibility of using 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 *et.al* (2010) investigated that unstainable 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.

KishanLal Jain *et.al* (2016) This paper reviews the possibility of replacing fresh water with waste water for making concrete. The strength is not affected so much by using waste water as replacement for waste water. From the literature it is seen that, the reaction between waste water and cement affect the workability, compressive strength and flexural strength. The reduced strength is within the acceptable limit. The use of impure water for concrete mixing is reduces the cost of the construction and in this way the process of construction becomes economical.

Ayoup M. Ghrair *et.al.* (2016) This study has evaluated the use of treated waste water for concrete and mortar production in bench and full scales. The water quality analysis showed that treated waste water is suitable for concrete and mortar production. This study has shown that treated waste water is a potential alternative for fresh water in the concrete industry. Therefore, the current guidelines for wastewater recuse should be revised by the governmental authorities to encourage the use of treated waste water as a substitute for fresh water in concrete production

Abdul Razak *et.al* (2015) There is a decrease in the workability of concrete using treated waste water whereas gave better workability to concrete. There is no significant difference in the compressive strength value of concrete made using treated waste water and potable water. The tensile strength of concrete made using treated waste water was found to be lesser compared to that of potable water. Considerable construction cost can be reduced by utilizing the treated water for plain cement concrete

U.S Ansari *et.al* (2016) This study deals with the effect of different type of treated waste water properties of strength of concrete. In that use of concrete mis of M30 the Potable water was fully replaced with the PTWW, STWW & Domestic waste water The consistency, initial e final setting time of cement paste by mixing STWW is within the Is limit. The compressive strength of mouton is in by mixing STWW at the end of 28 days 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 & flexure strength is improve by using STWW.

METHODOLOGY

➢ **Test on water**

- pH of water

pH determines the acidity or alkalinity of water or waste water. The pH of water is a very important measurement to know the quality of water.

- BOD of water

BOD, also called biological oxygen demand, is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period.

- COD of water

The chemical oxygen demand gives an idea of quality of water. COD test is often used to understand the water treatment plant efficiency.

Table no. 1 Test on water

Sr No	Test	Result		
		Potable Water	Domestic treated water	Industrial treated water
1	pH of water	6.05	6.69	8.4
2	BOD of water	3.66 mg/L	6 mg/L	10.2 mg/L
3	COD of water	4 mg/l	20 mg/l	34 mg/l

1.1 Test on Materials

a) Test on cement

- Fineness of cement

The cement used in this study is Ordinary Portland Cement 53 grade cement which preferred for its high compressive strength

Table no 2. Test on cement

Sr. no.	Test	Result
1.	Fineness of cement	4.67%

b) Test on Sand

- Silt sand test

The procedure involves adding sand to a salt water solution, shaking, and allowing the silt to settle for 2 hours to measure the silt volume. The silt content percentage is then calculated. If the average silt content exceeds 6% by volume, the aggregates require washing before use to improve concrete strength.

- Sieve analysis

Sieve analysis is a method used to determine the particle size distribution of a granular material, such as sand, gravel, soil, or aggregate. This analysis helps characterize the material and assess its suitability for various engineering and construction applications. sieve analysis involves passing a sample of the material through a series of standard sieves with progressively smaller openings (mesh sizes). The material is separated into fractions based on particle size, with finer particles passing through finer sieves and coarser particles retained on coarser sieves.

Table no 3 Test on Sand

Sr. no.	Test		Result
1.	Silt sand test		3.97%
2.	Sieve analysis		Well graded sand

c) Test on Aggregate

- Aggregate impact test

The aggregate impact value should be measured to check capacity of aggregate of resistance to sudden impact or shock. This characteristic is measured by impact value test.

Table no 4 Test on Aggregate

Sr. no.	Test	Result
1.	Aggregate impact test	12.89%

4.2 Cube casting

Mix design is a process used in civil engineering and construction to determine the proportions of various ingredients needed to produce a concrete mix with desired properties. These properties may include strength, workability, durability, and other performance characteristics required for a specific application. Concrete mix design is the science of choosing the types of ingredients, and the proportions to use them in, to create concrete that meets the technical specifications for a given construction project. We used M20 and M25 grade of concrete to cast our cubes by using potable water, Domestic treated waste water and Industrial treated waste water. The duration of testing and curing of cubes is 7 days, 14 days and 28 days.

➢ **M20 Grade of concrete**

M20 grade of concrete is a designation used to specify the mix proportions of materials required to produce concrete with a characteristic compressive strength of 20 megapascals (MPa) or 20 Newtons per square millimetre (N/mm^2) after 28 days of curing. In the Indian standard (IS 456:2000), the M20 grade of concrete is commonly used for various construction applications such as residential buildings, pavements, foundations, and light-duty structures. The ratio of cement, sand, aggregate of M20 grade of concrete is 1:1.5:3

➢ **M25 grade of concrete**

M25 grade of concrete is another commonly used designation in the Indian standard (IS 456:2000) to specify the mix proportions of materials required to produce concrete with a characteristic compressive strength of 25 megapascals (MPa) or 25 Newton per square millimetres (N/mm^2) after 28 days of curing. M25 grade concrete is often used for various construction applications such as residential buildings, commercial structures, bridges, and heavy-duty pavements. The ratio of cement, sand, aggregate of M25 grade of concrete is 1:1:2

➢ **Testing Procedure**

Concrete cubes are typically casted with freshly concrete and tested at specified ages usually 7 days, 14 days and 28 days to assess compliance with design requirements and specifications of M20 and M25. To test the cubes, we used UTM (Universal Testing Machine).

➢ **UTM**

A Universal Testing Machine (UTM) is a test machine used to test the mechanical properties of a sample by applying a tensile compressive or transverse load. A universal test machine is designed to meet a wide range of tests by simply switching out different grips and fixtures.

Universal Testing Machine

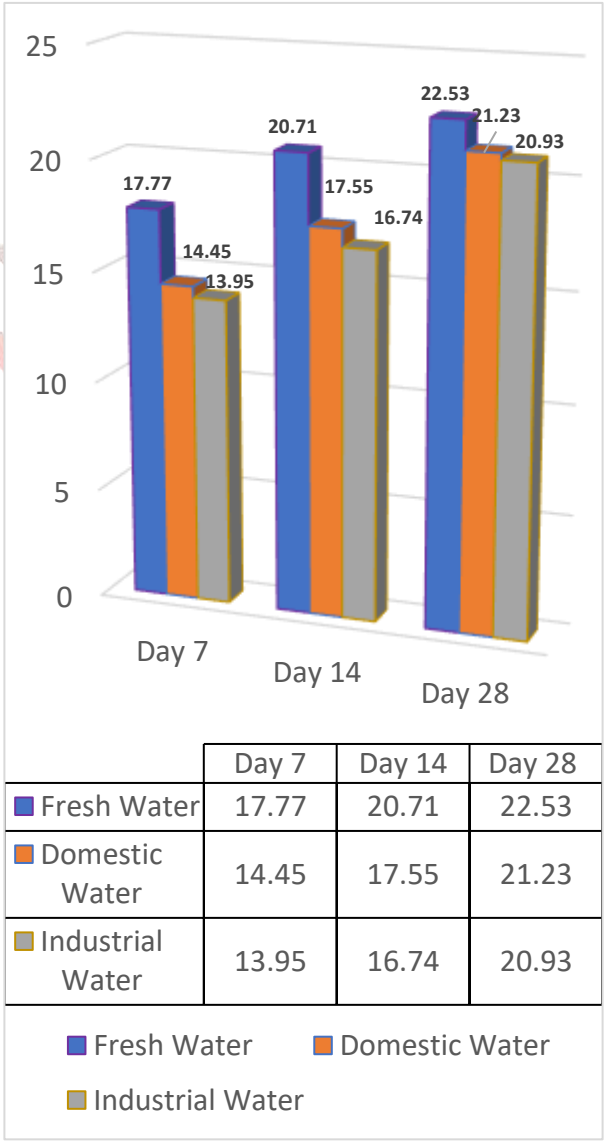
RESULTS & DISCUSSION

5.1 Overall result of M20 Grade of concrete cubes

Type of Water	Days	Compressive strength(N/mm²)
Fresh Potable Water	7 days	17.77
	14 days	20.71

	28 days	22.53
Domestic Treated Waste Water	7 days	14.45
	14 days	17.55
	28 days	21.23
Industrial Treated Water	7 days	13.95
	14 days	16.74
	28 days	20.93

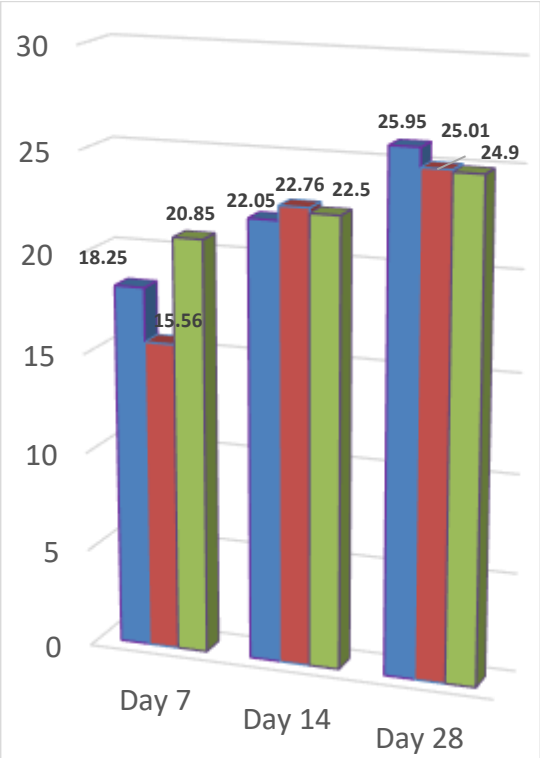
Graph of M20 Grade of concrete



5.2 Overall result of M25 grade of concrete

Type of Water	Days	Compressive strength(N/mm²)
Fresh Potable Water	7 days	18.25
	14 days	22.05
	28 days	25.95
Domestic Treated Waste Water	7 days	15.56
	14 days	22.76
	28 days	25.01
Industrial Treated Water	7 days	20.85
	14 days	22.5
	28 days	24.9

Graph of M25 Grade of concrete



	Day 7	Day 14	Day 28
Fresh Water	18.25	22.05	25.95
Domestic Water	15.56	22.76	25.01
Industrial Water	20.85	22.5	24.9

DISCUSSION

From the result and tests performed earlier, it is clear that the treated sewage waste water and industrial treated water can be used to prepare cement mortar as the impurities are under permissible limits according to the tests. It was observed that under normal conditions this water gives comparatively the same compressive strength hence it is economical to use the treated sewage waste water and industrial treated waste water for curing and preparing cement mortar. On the other hand, while testing the performance of the same water for the preparation of cement concrete. The result obtained was more than normal water. Thus, the treated sewage water and industrial treated waste water can also be used for the preparation of cement concrete. So, it is clear that the treated wastewater can be used for construction works and thus, the commercial use of treated sewage water and industrial treated waste water will encourage many more industries to install more sewage treatment plants resulting in the

reuse of water. The idea of sustainable development can be achieved by the use of treated sewage water and industrial treated waste water

CONCLUSION

From the research carried out to use of treated waste water and potable water in concrete construction, following conclusion are made:

- Impurities present in treated waste water from domestic treatment plant and industrial treated water having almost nearby same and hence, we can say that it is in within permissible range.
- The compressive strength of cement cube casted by potable water for 7-day, 14 day, 28 days of M20 grade of concrete is 17.77 N/mm², 20.77 N/mm² & 22.53 N/mm²and for M25 grade of concrete is 18.25N/mm², 22.05 N/mm² & 25.95 N/mm²
- The compressive strength of cement cube casted by domestic treated water for 7 day, 14 day, 28 days of M20 grade of concrete is 14.45 N/mm², 17.55 N/mm² & 21.23 N/mm² and for M25 grade of concrete is 15.56 N/mm². 22.76 N/mm² & 25.01 N/mm²
- The compressive strength of cement cube casted by industrial treated water for 7 day, 14 day, 28 days of M20 grade of concrete is 13.95 N/mm², 16.74 N/mm²& 20.93 N/mm² and for M25 grade of concrete is 20.85 N/mm² 22.5 N/mm² & 24.95 N/mm²
- After studying effect of treated water on concrete property it is observed that we can use treated water in plain cement concrete in nearby construction of treatment plant to achieve economy and it help for sustainable development.

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