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Effect of Domestic Waste Water on the Strength of Concrete

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Abstract:* Efficient water use is one of the most important requirements of cleaner production and the use of wastewater in concrete production important means to this end. However, there are no studies on the quality of concrete using wastewater and the activities in which wastewater can be used. The quality of concrete using wastewater and to propose guidelines for its treatment for non- potable applications. The type of water used for the mixing did not affect the concrete slump and density. Tests were conducted by 100% replacing the tap water with domestic wastewater in the concrete mixture. Domestic wastewater sample were collected from nalha near Sonegaon lake. The collected domestic wastewater and tap water were tastes and chemical analysis was carried out. The water samples, including a controlled portable (tap) water were analyzed for pH, total dissolve solids (TDS), chloride, hardness, alkalinity, and sulfates. 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 M25grade of concrete mixtures. For M25 grade concrete mix the total 18nos of 150mmx150mmx150mm cubes were cast. Cube compressive strength was also determined at 7 -days, 14 -days, and 28 -days of curing. Results indicated that the strength of concrete of the mixtures prepared using wastewater was comparable with the strength of the control mixture.
Keywords: Domestic waste water, aggregate size, w/c ratio, compressive strength, M25 grade.

I. INTRODUCTION

In today world every technology is growing very swiftly. In his era of research, many types of research are going on to improve the strength of concrete mix and to get maximum output using minimum resources. We should also think of protecting our environment as well as to protect our natural resources Water is a very important God gifted natural resource to the planet earth which should also be kept carefully for our next generation. Generally, potable water is used for the production of concrete as this is free from minerals, pH variations, impurities and other water quality damaging substances. Sewage treatment plants are operated for cleaning sewage through various processes into reusable water in the various stage of purification in STP water get purified up to a different degree. Many scholars are researching and doing great work in the direction of using Wastewater after purification and getting hopeful results also. Like G. Asadollahfardi, M. Delnavaz, V. Rashnoiee and N. Ghonabadi in 2016 researched on topic "Use of treated domestic wastewater before chlorination to produce and cure concrete" and found the satisfactory compressive strength of concrete produced. Further research in this direction is also going on. Day by day due to less availability of clean and safe drinking water today nearly about I billion people don't have access to it, yet we take it for granted, we waste it and even we are paying too much for getting pure drinking water from little plates bottles. Water is the main foundation for life till today so money countries are struggling for searching a fresh water, Concrete is the second industry to consume more water for preparing concrete, for hydration purpose and for curing, etc., to overcome these water scarcity problems and as a sustainability approach to the world regarding scarcity of water in our paper we used treated waste water in concrete instead of portable water, Treated waste water is water obtained from treatment plant after treating municipal waste water. Treated waste water is mainly used for gardening and in some situation for agricultural purpose.

Treated waste water is hard water it mainly contains sulphate and chloride content. Day by day the production of bacteria is more in treated waste water so while handling treated waste water proper care must be taken. Water in the concrete controls many fresh and hardened properties such as workability, compressive strength, permeability, durability, drying shrinkage and bonding properties. So, for these reasons fresh and safe drinking quality water is required for concrete. For one cubic meter of concrete about 140-160 liters of water is required for the complete chemical hydration process.

A. Objective

1) To improve the properties of concrete and determine compressive strength.
2) To reduce the environmental impact of concrete production.
3) Perform chemical characterization of the wastewater.

II. SUMMARY OF LITERATURE REVIEW

After carried out a literature from various researcher it is found that sustainable technology has a huge scope in construction industry and hence proper technology is need to developed/study. Water is a main material in concrete and as far as potable water is concern. Sources of potable water is lower nowadays and hence research in terms of reuse of water is initiated in this research paper. Research papers mentioned in the reference list are reviewed and referred in this paper.

III. MATERIALS

1) Cement-Grade 53 -Ordinary Portland Cement is used in concrete is used in concrete mixes. Different physical test on cement were carried out and below are the results. The Evaluation OPC provides a structure with high quality and sturdiness due to its ideal particle size distribution and superior crystallized structure. As a high-strength concrete, it offers numerous advantages wherever unique high-strength applications are required. For instance, this is evident in the construction of skyscrapers, bridges, flyovers - even chimneys or runways for that matter; not forgetting robust concrete roads designed specifically for heavy load-bearing structures.

Table 1: cement properties analysis report

Sr.no.	Physical Properties	Result
1.	Fineness of cement (M^2/Kg)	320
2.	Standard Consistency in%	35%
3.	Initial setting time in min	90 MIN
4.	Final setting time in min	265 MIN
5.	Specific gravity of cement	3.15
6.	Grade of Cement (OPC)	53 Grade

2) Fine Aggregate (Sand) - Size of aggregate passing through 4.75mm sieve is known as fine aggregate. Used fine aggregate in this investigation is crushed sand.

Table 2: Fine aggregate test results

Sr.no.	Physical Properties	Result
1.	Grain size analysis	2.6
2.	Specific Gravity	2.7
3.	Bulk Density(kg/m^3)	1425

3) Coarse Aggregate - Size of aggregate is more than 4.75mm is known as Coarse aggregate. Less than 25mm size of aggregate are used.

Table 3: Coarse aggregate test results

Sr.no.	Physical Properties	Result
1.	Specific Gravity	2.78
2.	Water absorption in %	0.6
3.	Impact Test	37%

4) Water - There are mainly two types of water were used for concrete production one is portable (tap) water and second is domestic wastewater. Wastewater sample were collected from nalha near sonegaon lake. These samples were analysed for certain impurities that could affect concrete mixes.

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Measurements included: total alkalinity, sulphate content (as SO4), chloride content (as NaCl), total dissolved solids (TDS), and water hardness. Other parameters such as pH and conductivity were also measured.

Table 4: Wastewater analysis report

Sr. No	Parameters	Units	Analysis Result	Method Reference
1	pH	----	7.4	APHA 23 Edition
2	Electrical Conductivity at 25° C	µS/cm	800	APHA 23 Edition
3	Total Dissolved Solids	mg/L	488	APHA 23 Edition
4	Suspended Solids	mg/L	26	APHA 23 Edition
5	Dissolved Oxygen	mg/L	3.6	APHA 23 Edition
6	BOD	mg/L	28	APHA 23 Edition
7	COD	mg/L	68	APHA 23 Edition
8	Turbidity	N. T. U	17.1	APHA 23 Edition
9	Total Hardness (as CaCo2)	mg/L	280	APHA 23 Edition
10	Total Alkalinity (as Caco3)	mg/L	272	APHA 23 Edition
11	Chloride (as Cl)	mg/L	35.0	APHA 23 Edition
12	Sulphate (as SO4)	mg/L	12.4	APHA 23 Edition
13	Fluoride (as F)	mg/L	1.10	APHA 23 Edition
14	Nitrate (as NO3)	mg/L	8.42	APHA 23 Edition
15	Iron (as Fe)	mg/L	0.35	APHA 23 Edition
16	Carbonate (as CaCO3)	mg/L	0	APHA 23 Edition
17	Bicarbonate (as caCO3)	mg/L	272	APHA 23 Edition

IV. LABORATORY TESTING PROGRAM

1) Mix Design Considerations: - The mix design process follows established guidelines for M25 grade concrete, taking into account various factors such as cement type, aggregate size, and desired workability. Design stipulations include parameters like the maximum water-cement ratio, cement content, and slump requirements. The objective is to achieve a concrete mix that meets strength while optimizing the use of wastewater as mixing water. Mix proportions for 18nos of 150mmx150mmx150mm concrete cubes.

Table 5: Mix proportions and water-to-cement (w/c) ratios for concrete mixtures.

Mix proportions (Kg/m³)				w/c ratio (l/m³)
Cement	Fine aggregate (Sand)	20mm Aggregate	Water	
33.68	27.3	45.6	16.84	0.50

2) Casting and Curing of Concrete Specimens: - Concrete specimens are cast in the form of 150×150×150mm cubes and subjected to standard curing regimes. The curing period spans 7, 14, and 28 days to promote hydration and strength development. Proper curing conditions ate maintained to ensure the integrity and quality of the specimens, allowing for accurate assessment of concrete performance in subsequent tests.
3) Testing Procedures (Workability, Compression Tests): - The concrete specimens undergo comprehensive testing to evaluate their workability and compression strength. Workability tests, such as slump tests, are conducted to assess the ease of placing and compacting the concrete mix. Compression tests are performed at designated curing intervals to measure the concrete's strength under applied load. These tests provide valuable insights into the performance of concrete mixes with the domestic wastewater as a mixing water.

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V. TEST RESULTS AND DISCUSSION

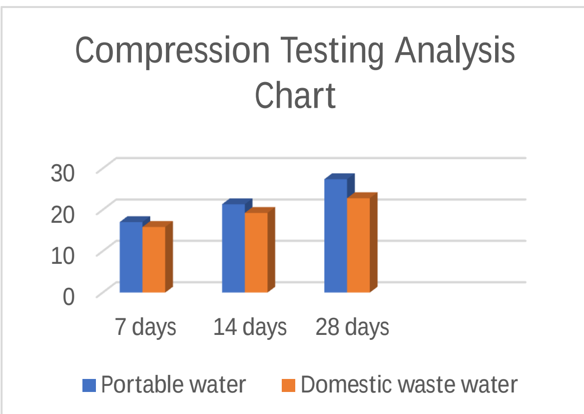
A. Effect of Wastewater Replacement on the Strength of Concrete

The compression strength tests demonstrated that concrete mixes with using domestic wastewater shows comparable strength compared to standard concrete mixes. Results of strength tests for M25 of the concrete mixtures are presented in Table 6. The 7, 14 and 28-days average cube compressive strengths of concrete specimens are presented in Fig. 1. The compressive strength of concrete cubes is determined using by compression testing machine [1000KN capacity]. The test was conducted as per IS 456: 2000 standards.

Table 6: Average strength of concrete at 7, 14 and 28 days of curing with domestic wastewater replacement.

Type Of Water	Compressive Strength (N/mm²)		
	7 days	14 days	28 days
Potable Water	17.04	21.34	27.40
Domestic Wastewater	15.85	19.25	22.81

Fig. 1. The 7, 14 and 28-days average cube compressive strengths of concrete specimens are presented.



VI. CONCLUSION

From the study and experiment it is concluded that the concrete mixed with the domestic wastewater show that following conclusions are found regarding the effect of waste water usage on the strength of concrete:

- The chemical composition of the wastewater is generally higher than tap water, but within the standard limits specified in ASTM. The high concentrations of some substances could raise concerns about the potential for corrosion and sulphate attack in reinforced concrete structures.
- There was no significant difference in the cube compressive strength of concrete mixes using domestic wastewater after 28 days of curing.
- Concrete specimen of domestic wastewater shows lower strength than portable water, but not less than 90% which is acceptable as per Indian Standard.
- This research study shows that domestic wastewater can be used as mixing water in concrete as a replacement of portable water in case of scarcity of water.
- Using waste water as mixing water in concrete saves portable water which is need of era.

VII. ACKNOWLEDGMENTS

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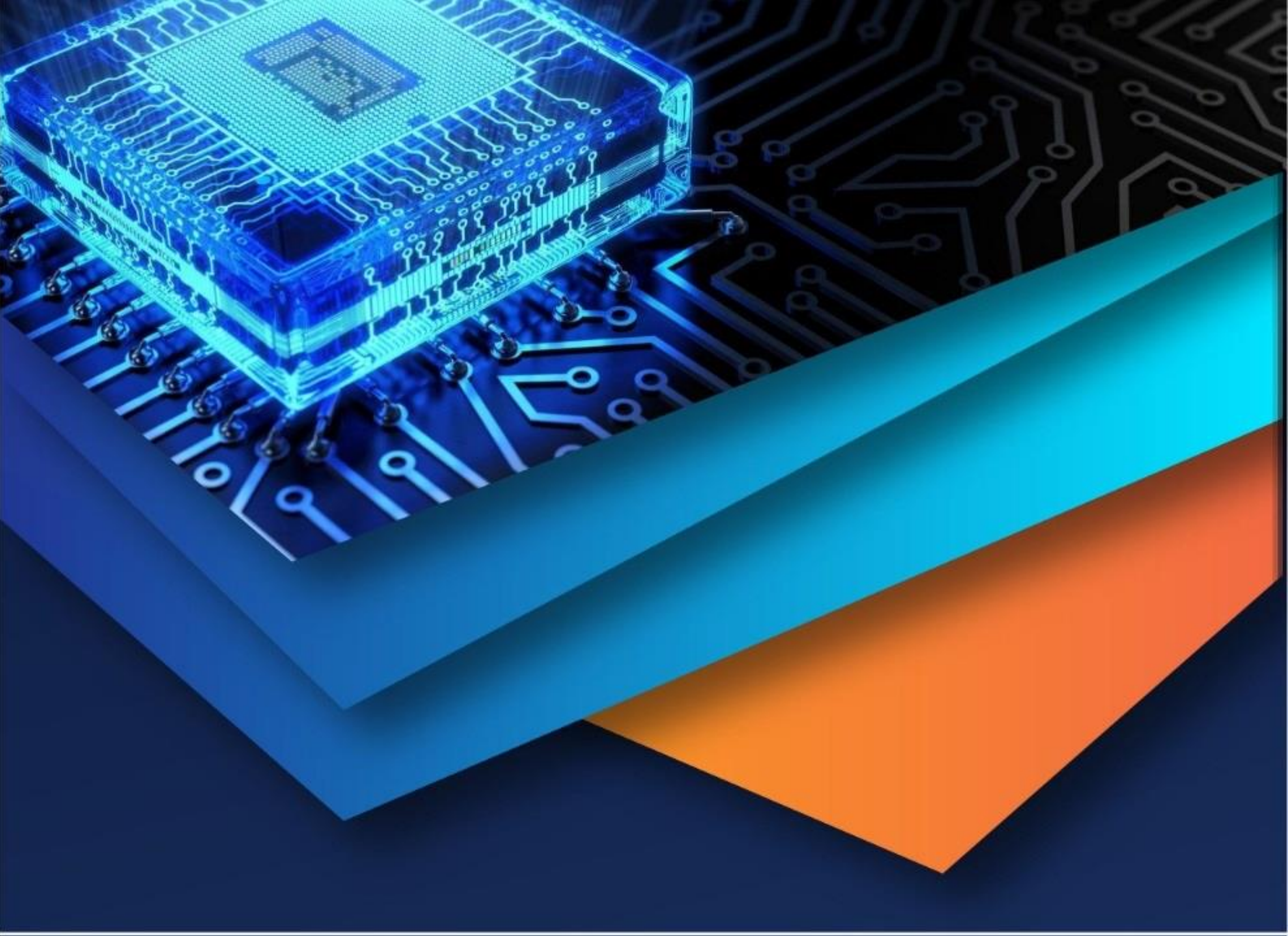

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