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RESEARCH ARTICLE OPEN ACCESS

Effect of Wastewater Quality Collected from Various Sources on Concrete Properties

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ABSTRACT
This research explore the possibility of using wastewater as a mixing water in concrete. Three different wastewater including service station wastewater, textile factory wastewater and sugar factory wastewater were used as a mixing water in concrete and test result for mechanical and durability properties were compared with concrete produced with potable water. The motive of this experimental investigation is toanalyze the impact of impurities present in wastewater collected from different industry on properties of concrete. Compressive strength, Split tensile strength, flexural strength test for mechanical properties and rapid chloride penetration and water absorption test were carried out for durability properties. The results of the tests demonstrate that industry wastewater can be used for mixing in areas where potable water is scarce, as well as for tackling the problem of industrial wastewater disposal.

Keywords–Concrete, Mixingwater, Wastewater, Compressivestrength, Durability

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I. INTRODUCTION

Today most industrial and domestic wastewater is discharged to landfills .However the increased pressure from environmental agencies and rejection of the landfill near the community are creating demand for alternative disposal. In many parts of India scarcity of drinking water is the major problem, therefore it is need of era to think about alternative to potable water for mixing in concrete. After Water, the most widely used material is concrete which requires approximately one trillion gallon of water per year. Therefore is is necessary to minimize the use of potable water in construction activity. Use of wastewater as a mixing water in concrete not only saves potable water, but helps to reduce the problem of wastewater discharge into landfills and ultimately prevents pollution.

Many research on the utilization of wastewater as a mixing water in concrete can be found in literature.The use of treated industrial and domestic wastewater will boost the reserve in nations where fresh water is scarce and will have a positive impact on the environment.[1] When compared to concrete made with potable water, the utilization of textile industrial wastewater in the manufacture of concrete produced a high compressive strength.

In comparison to potable wastewater, higher compressive strength was obtained at the age of 7 days and lower compressive strength was acquired at the age of 28 days and 90 days when fertilizer factory wastewater was used for the development of concrete mix.The use of service station wastewater in concrete mixing had only a minimal impact on compressive strength.[2]-When wastewater is used, the water adsorption of concrete is unaffected. [3]Where potable water is scarce, river water could be utilized for mixing.[4]

From the literature studies it can be concluded that wastewater from various industries can be the best alternative to fresh water and also resolve the issue of wastewater discharge .Therefore this study focuseson investigating the mechanical and durability properties of concrete made with different type of industry wastewater.

II. OBJECTIVE

The major goal of this research is to look at the usage of various forms of industrial waste water in concrete manufacturing.
The impact of wastewater on concrete's pliable and hardened properties was studied.

It's crucial to examine the performance of concrete created using tap water and wastewater of various types.
This research will aid in lowering the amount of fresh water used in the manufacture of concrete.

III. EXPERIMENTAL STUDY

3.1 Material

Cement - Cement is a prominent binding agent in concrete. The ordinary Portland cement of 53 grade collected from local shop was used for the preparation of concrete. Cement was tested for physical characteristics given in table 1

Table 1
Physical properties of OPC employed in this study

Property	Value
Specific gravity	3.05
Fineness	6 %
Initial Setting time	190 min.
Final Setting time	485 min.
Compressive strength At 28 days	52.23 Mpa

Fine Aggregate- Aggregates are commonly used as a filler material in concrete to increase its strength. Natural river sand (Kanhan River) of size below 4.75 confirming to zone II of IS 383-1970 was used as fine aggregate.

Table 2
Physical properties of Fine Aggregate employed in this study

Property	Unit	Value
Specific gravity	--	2.63
Fineness Modulus	--	2.65
Water Absorption	%	2.21
Bulk Density	kN /m^3	18.12
Maximum size	mm	4.75

Coarse Aggregate - Coarse aggregate was also tested for various properties given in table 3

Table 3
Physical properties of Coarse Aggregate employed in this study

Property	Unit	Value
Specific gravity	---	2.75
Fineness Modulus	----	--
Water Absorption	%	1.90
Maximum size	mm	20

Mixing Water - Three different types of wastewater as a mixing water used in this experimental study. Wastewater collected from service station wastewater, textile factory wastewater and sugar factory wastewater were used as a mixing water in the production of concrete. All types of industrial wastewater were tested for the various parameter at Water Quality Lab, Hydrology Project Division, Jal Vidyan Bhavan ,Nagpur.Test result for various parameter are given in table 4

Table 4
Physical and Chemical properties of potable and wastewater used in this study

Parameter	Potable water	Service station	Textile factory	Sugar factory
pH	7	6	7	7.35
Dissolved solids	510	497	397	3890
Hardness (mg/l)	350	372	341	2132
Alkalinity (mg/l)	95	84	49	127
Fluoride (mg/l)	0.76	0.15	0.74	0.47
Chloride (mg/l)	38	254	68	843
Sulphate (mg/l)	7.6	119	105	216

3.2 Mixing and Casting

For concrete preparation, the M30 mix design proportion was employed, and the water cement ratio was kept constant at 0.50 for all mixes. The concrete elements were weighted according to proportion and then mixed in a concrete mixture. For the concrete mixing, a mechanical mixture was used. The whole time spent mixing was ten minutes. Water was added in two stages throughout the mixing process to ensure a homogeneous mixture. Four concrete mixes were made, one with potable water the other with each type of wastewater.Thirty-six cubes measuring 150 x 150 x 150 mm were made for compression testing, and twenty-four cylinders measuring 150 mm in diameter and 300 mm in height were made for split tensile strength testing. Twelve cubes were also castes for the rapid chloride penetration test, and twenty four specimens were castes for the water absorption test.All specimens were kept for curing in normal water for different age periods.

IV. RESULT AND DISCUSSION

4.1 Mechanical Properties

4.1.1 Compressive strength

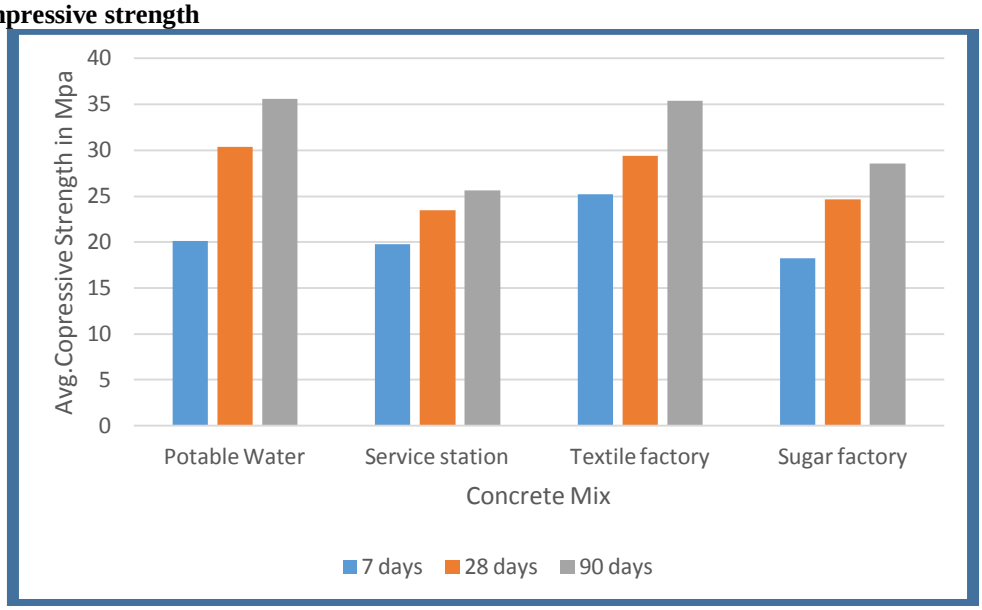

Fig.1 Compressive strength Test for 7, 14 and 90 days using compression Testing Machine.

The most important mechanical attribute of hardened concrete is its compressive strength. According to IS 516, this property was measured at 7, 28, and 90 days foreach of three concrete mixes. Graphs shows the compressive strength of concrete developed using different types of industrial wastewater.For each age group, three specimens were crushed from all of the concrete mixes, and the results obtained were compared to the compressive strength of concrete made using drinkable water.Concrete built with textile industry wastewater had the highest compressive strength, while concrete made with service station wastewater had the lowest compressive strength.

4.1.2 Spilt Tensile strength

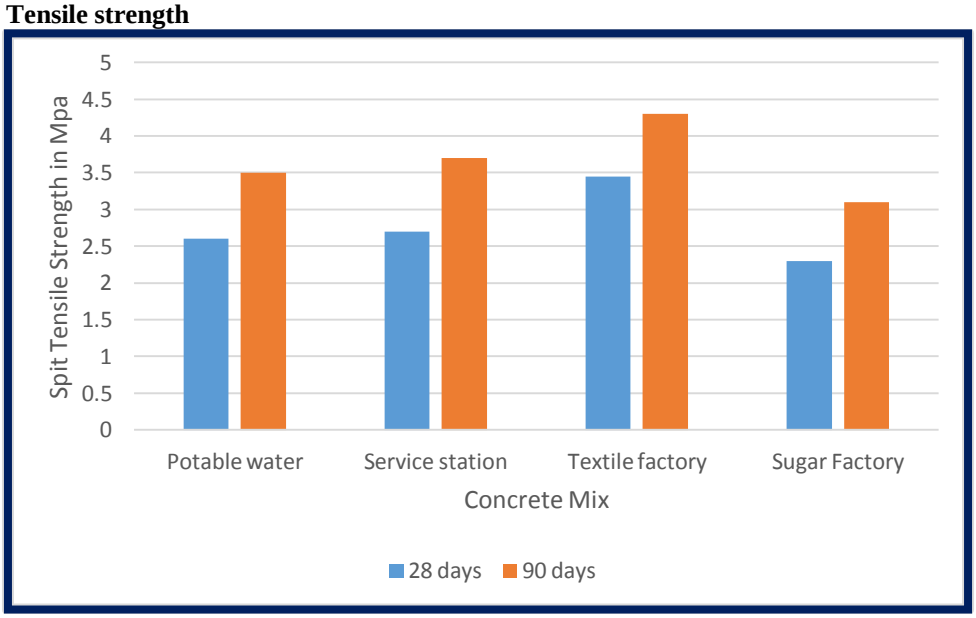

Fig.2 Split Tensile strength Test for all concrete mixes ate age of 28 and 90 days.

The graph depicts the split tensile strength of concrete made using various wastewater. The test results suggest that the textile industry wastewater mix has the highest split tensile strength, whereas the sugar factory wastewater mix has the lowest.

4.2 Durability Test

4.2.1 Rapid Chloride Penetration Test

Table 5 Rapid Chloride Penetration Test for all concrete mixes.

Wastewater Type	Charge Passed (Coulomb)	Chloride Ion Permeability
Service Station	**3815**	**Moderate**
Textile Factory	**3614**	**Moderate**
Sugar Factory	**2345**	**Moderate**

The depth to which chloride ions from the environment or mixing water permeate the concrete is referred to as chloride penetration.This can cause corrosion in RCC constructions, hence studying chloride permeability is an important factor to consider when considering concrete durability. The RCPT involves measuring the amount of electrical current that goes through a sample that is 50 mm thick and 100 mm in diameter over the course of six hours .This sample is usually sliced as a core or cylinder slice. Throughout the test, a voltage of 60V DC is maintained across the ends of the sample.The obtained results show that chloride permeability is moderate for all concrete mixes made with various wastewater.

4.2.2 Water Permeability Test

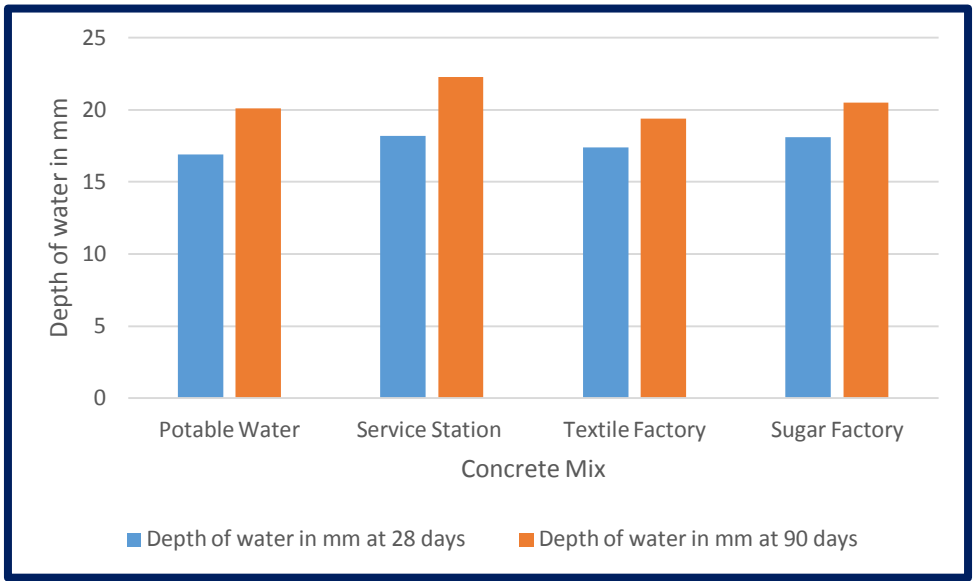

Fig. 5 Water Permeability Test for concrete mixes.

Water permeability is one of the hardened concrete's durability parameters.

High water permeability causes reinforcement to corrode and impurities to permeate the concrete through water, reacting with the ingredients and changing the properties of the concrete.Water absorption for all concrete mixes is shown in Fig.6. The comparatively high water absorption observed for all concrete mixes. Textile factory wastewater mix had lower water absorption than potable water, but service station wastewater mix had higher water absorption.

V. CONCLUSION

The goal of this study was to look at the mechanical and durability features of concrete made from a variety of wastewater sources, including textile factory wastewater, service station wastewater, and sugar factory wastewater. The impact of the wastewater on compressive strength, split tensile strength, rapid chloride penetration test, and water absorption test was investigated. From the experimental results, the following important conclusions can be drawn:

1. The findings demonstrates that concrete created from textile industry wastewater has highest compressive strength and, split tensile strength at 90 days.
2. Specimens made with sugar industry effluent have a compressive strength lower than those made with tap water.
3. It has been discovered that excessive suspended particles in waste water cause calcium silicate hydrates, which have a direct impact on concrete strength.
4.Water absorption was lower in the textile industry wastewater mix than in potable water, but higher in the service station wastewater mix.
5.The results demonstrate that the chloride permeability of all concrete mixes prepared with varied wastewater is moderate.

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