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# Impact of Waste Water Properties on Concrete: A Review of the Literature

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## ABSTRACT
In manmade material most widely used materials across the globe is concrete. As we know concrete is the one of the versatile material that demands the huge quantity of fresh water. Water is one of the major social concern as the population is doubled with drastic uplift in water utilization has reduced the water quality and quantity. Indeed we are investing huge funds in managing the used water, the reclaimed water is not been used for any major purpose in the society. Construction sector which demand large quantity of fresh water for various activity has burden to existing water resources distribution. Perhaps make use of recycled household effluent is considered as one the valuable resource should not be discharged on the ground without make use of that. Most of the countries utilizing the reclaimed water as mixing water in concrete manufacture to overcome the fresh water dearth .This paper introduces the over view of various literatures of evolved concrete behaviorin its various period by reclaimed domestic water .

**Key words**: Waste water reclamation, Domestic effluent, Behavior of concrete

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## I. INTRODUCTION

Every year, around one million people are impacted by the continuous water issue known as water scarcity. In addition to having an impact on a large rural and urban population, water shortage also has an impact on agriculture and the ecosystem. With 1.3 billion people, India only possesses 4% of the freshwater resources in the globe. India has always struggled with a lack of water. In India, the current value of per capita water availability is noted to be 1,545 m3, which is less than 1,700 m3. The Water Ministry estimates that by 2025, water availability may drop to 1,341 m3, and by 2050, it may reach 1,140 m3.

Reuse is the process of turning used materials into new products that can be used again, saving energy, preventing the waste of potentially useful materials, and lowering air and water pollution by lowering the need for conventional waste disposal. One of the main tenets of contemporary waste management is reuse, which is a practical technique for reusing wastewater in both industrial and agricultural settings.

Cement (mostly Portland cement) and other cementitious materials, like fly ash and slag cement, aggregate (usually a coarse aggregate made of gravels or crushed rock, like limestone or granite, plus a fine aggregate, like sand), water, and chemical admixtures are the ingredients of concrete. After being mixed with water and placed, concrete hardens and solidifies because of a chemical process called hydration. Water and cement react, binding the other ingredients to form a substance that eventually resembles stone.

Building industry seems to be the cause of the massive freshwater use. Without taking into account other uses of water in the concrete industry, 1 m3 of concrete requires about 150 litters of water. Challenges about water quality have arisen during the development of civil engineering projects. Potable water must be used according to most criteria because its chemical makeup is well-known and controlled. Many types of water that are unsuitable for drinking can be successfully used in concrete, road construction, and other purposes when potable water is not readily apparent.

This survey provides an overview of the previous research that was done. This discusses the lack of fresh water in India, the need to reuse treated waste water in the building industry, and the impact of water quality on the durability, hardness, and fresh properties of concrete.

## II. WATER QUALITY SUITABILITY FOR MAKING CONCRETE

The research studies on water quality suitability in concrete works are projected in following section.

| Standards | Parameter | Permissible Limits Max | Remarks |
|---|---|---|---|
| IS 456-2000 | Organics | 200 mg/l | - |
| | In organics | 3000 mg/l | - |
| | Sulphate as $So_3$ | 400 mg/l | - |
| | Chlorides as $Cl^-$ | 2000/500 mg/l | Concrete not containing embedded steel /concrete containing steel |
| | Suspended matters | 2000 mg/l | - |
| | $P^H$ | >6 | - |
| ASTM | Total solids | 50000ppm | - |
| | Sulfate | 3000 ppm | - |
| | Alkali $Na_2O$ | 600ppm | - |
| | Water specific gravity | 1.03 | - |
| | Chloride | 500 mg/l | Prestressed concrete |
| | | 1000 mg/l | Reinforced |
| | Suspended solids | 50000 mg/l | - |
| | $P^H$ | >5 | - |
| | Alkalinity | 600mg/l | - |
| | | | |
| BS-EN | Suspended solids | 1% | of total aggregates |
| | | | |
| | $SO_4$ | 2000mg/l | |
| | Chlorides | 1000 mg/l | Reinforced concrete |
| | | 4500mg/l | Without reinforcement |
| | | 500mg/l | Prestressed concrete/grout |
| | Pb | 100 mg/l | - |
| | Zn | 100mg/l | - |
| | Mn | 500mg/l | - |
| | $P^H$ | >4 | - |
| | Nitrates | 500mg/l | - |
| | Alkalinity | 1500mg/l | - |
| | Phosphates | 100mg/l | - |

## III. FEATURES THAT AFFECT THE FRESH STATE AND MECHANICAL PROPERTIES OF CONCRETE OBTAINED BY TREATED WASTE WATER

Impact of water quality in concrete production is dealt in this section

K S Al-jsbri et al [2] investigates the possessions properties of concrete with treated effluent. The characteristics of waste water collected from three different car washing station shows the excess of chemical composition in chlorides, hardness, alkalinity, and sulphates though the compressive strength of concrete produced from 25 percent to 100 percent of wastewater shows no significant difference in strength properties of concrete over the conventional sample after 28 days and the study ascertains the every concrete composition that substitutes waste water shows the similar rate of water absorption hence use of car washed waste water is concrete production will be the option for replacement of fresh water.

GholamrezaAsadollahfardi et al [7] tested the fresh and harden properties of the concrete derived and cured using tap and reclaimed domestic waste water along with and without super plasticizers. The physical and chemical important qualities of waste water, Portland cement, setting time, slump in the concrete, compressive strength, tensile strength, and water absorption in the concrete were all examined using the ASTM, APHA, and BS standards. Research work found setting time is reduced by 30 minutes for concrete formed using treated domestic waste waster then split tensile strength of concrete is not much varied compared to controlled samples of tape water and compressive strength is reduced 11 percent at 21 days freezing and thawing conditions.

Bassam Z Mahasneh [4] observed how treated and untreated waste water affected the concrete tensile and compressive strengths. These work symbolize the decline of compressive and tensile strength by 23.2% and 23.1% o when concrete casted using waste water. Similarly the strength reduction is observed 7.3% and 9.7 % casted with treated waste water though it's achieving the 90 % of the strength by treated waste water casting. It is recommended to utilize treated waste water for concrete manufacture instead of untreated waste water, as per British standards and AASHTO T29-79. Cast concrete must reach 90% strength to be used as mixing water for concrete production.

Manjunath M et al [6] Research on the reuse of treated waste water in the production of concrete reveals that no chemical feature of the waste water has a significant influence on the fresh properties of the concrete produced using treated waste water, such as consistency, initial and final setting times. Neither does it have a significant impact on the workability or compressive strength. This alternate source of water might be used in the building sector due to the ongoing water scarcity in the majority of the region.

Peche et al [5] Research exhibits using grey water as a possible source of water for making concrete. Different code provision like EN, AS, ASTM and IS are taken into consideration to assess the eminence of grey water in producing concrete, evidence the presence of chloride, detergent, suspended matter, odour and $P^H$ were within the prescribed limits. The work also taken up the different grade of concrete to inspect the compressive strength after $7^{th}$ and $28^{th}$ day ,out come substantiate the almost same or little less deviation of strength in most of the grades of concrete and in some grade of concrete the strength has been increased due to higher alkalinity of the grey water.

Devendra swami et al [1] Exercised home wastewater as a mixing water when making regular concrete and observed the penetration and strength after 28 days. The treated waste water samples collected are found to be within the desired limit. Concrete sample are prepared for water cement relation of 0.4, 0.5 and 0.6 with treated effluent exhibit the better compressive strength then the tape water and it also improves the surface density and degree of hydration of concrete. They also examined the moisture penetration of concrete demonstrate the increase the in water penetration with increase in the water cement ration. Study highlight the use of treated effluent is beneficial for concrete production.

## IV. CHARACTERIZATION OF HARDEN CONCRETE

The work related material characterization of harden concrete using SEM, XRD and EDX are evidenced in this section.

Dhanraj et al [6] have used scanning electron microscopy (SEM) to perform a microscopic investigation of concrete made utilizing treated waste water. The results have emphasized the concrete's paste phase, aggregate phase, bonding, and C-S-H gel formation. Excellent cement and sand particle bonding has been noted, with a resolution of 3300x. The C-S-H gel development in the cement paste phase of the concrete, along with some small pores in the concrete, sand, cement, etringites, and calcium hydroxide, are all shown in a 1000x zooming frame. The bonding between the C-S-H gel and aggregate is also excellent..

Gholamreza et al [7] carried out a SEM examination on concrete made with treated wastewater. According to the study, concrete samples containing 300 kg/m3 of cement produce euhedral crystals more frequently than concrete created with drinking water. In addition, compared to concrete prepared with treated waste water, concrete cast using treated effluents as mixing water has produced subhedral to anhedral crystals that are denser and have fewer cavities.

## V. DURABILITY

In this segment durability of concrete which is casted using waste water is demonstrated.

Navid et al [7] studied concrete casted specimens of size of 15*15*15cm having area of 225cm$^2$ with cement content of 300,350 and 400 kg/m$^3$ having water absorption rate of 3%, 2.2 % and 2.7 % respectively. Similarly concrete which is casted with treated waste water then cured with treated waste water with cement content of 300,350 and 400 kg/m$^3$ having water absorption rate of 3%,2.4% and 2.6 % respectively. The study indicates that rate of water absorption of concrete specimens with cement content 350 kg/m$^3$ is obtained with lesser water absorption in both case. Good concrete material water absorption should not be more than 4 %.All the results generated by water absorption test are within the limit hence waste water can be used in concrete production.

Devendra swami et al [1] have taken up concrete durability tests like pull out, rebound hammer, initial surface absorption,sorptivity and ultrasonic pulse velocity of concrete casted using treated waste water for different water cement ratio of 0.4,0.50 and 0.60. Research exhibits the durability factor test conducted in this work have shown better results for water cement ratio of 0.40 and the result were almost similar to the tape water concrete production.

K S Al-jsbri et al [2] investigated surface absorption test, which was used to examine the impact of waste water on the durability of high strength concrete, shows that all concrete mixtures exhibit a similar trend of decreasing surface water absorption with time. The decline was rapid in the first half hour; subsequent absorption declines continue for up to 120 minutes. During the first ten minutes, all of the mixtures yield flow rate values within the designated ranges, which are 0.05 ml/(m2s) to 3.6 ml/(m2.s). Waste water-infused concrete in this investigation exhibits a comparable rate of water absorption to control mixtures.

## VI. CONCLUSION

In the building sector, using treated wastewater in concrete is becoming a more and more common and sustainable practice. Treated wastewater is water that has been purified to remove pollutants and impurities. It is sometimes referred to as reclaimed water or recycled water. Utilizing treated wastewater in concrete reduces the demand on freshwater resources, contributing to water conservation and sustainability.It promotes the accountable and efficient use of water, especially in regions facing water scarcity or drought conditions.

Treated wastewater is often rich in certain minerals and nutrients that can positively influence the properties of concrete. For example, it may contain small amounts of nutrients such as phosphorus and nitrogen that can enhance the growth of cementations materials.In some regions, using treated wastewater in concrete can help meet regulatory requirements for wastewater discharge and disposal, promoting compliance with environmental standards.

The quality of treated wastewater must be carefully monitored to ensure that it meets established standards for use in concrete production. A substance's excessive concentration or presence of contaminants can have a detrimental effect on the durability and performance of concrete. The long-term durability of concrete may be impacted by residual chemicals or salts found in treated wastewater, contingent upon the method of treatment employed. Accurate analysis and testing are crucial. The application of treated wastewater in concrete might be governed by regional laws and policies. In order to guarantee the concrete's performance and safety, it is crucial to follow these guidelines. Understanding the long-term effects of treated wastewater on concrete characteristics requires ongoing research and testing. This includes studies on durability, strength, and potential impacts on corrosion of reinforcement with limit of impurities in mixing water.

The use of treated wastewater in concrete can offer environmental and economic benefits, but it requires careful consideration of water quality, treatment processes, and potential impacts on concrete properties. Engaging with local water authorities, conducting thorough testing, and staying informed about regulations are essential steps for successful implementation.

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