Exotic Anatomical Investigation Study on Effective Usage of Recycled Wastewater in Construction

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Abstract*— Water is one of the world's most valuable resources, yet it is under constant threat due to climate change and resulting drought, explosive population growth, and waste. One of the most promising efforts to stem the global water crisis is industrial and municipal water reclamation and reuse. The Waste Reuse Association defines reused, recycled, or reclaimed water as "water that is used more than one time before it passes back into the natural water cycle. "Thus, water recycling is the reuse of treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, or replenishing a groundwater basin (referred to as groundwater recharge). Water reuse allows communities to become less dependent on groundwater and surface water sources and can decrease the diversion of water from sensitive ecosystems. Additionally, water reuse may reduce the nutrient loads from wastewater discharges into waterways, thereby reducing and preventing pollution. This 'new' water source may also be used to replenish overdrawn water sources and rejuvenate or reestablish those previously destroyed.

I. INTRODUCTION

Water is one of the most important elements in human life and construction. India has more than 17 percent of the world's population but has only 4% of the world's renewable water resources. Constructional activities play a major role in infrastructural development. Water has an undisputedly important place in civil construction and so far, no alternative to water is available. In the construction industry concrete, being the most widely used construction material, uses most of water. About 5 billion cubic yards of concrete are used yearly; annual production is about two tons per person on the plane. As per IS10262-2009, 186 liters of water are required for 1m3 of concrete. On average 150 liters of water is required for 1m3 of concrete—the construction of a 100,000 sq. ft.Multi-storey structure can require about 10 million liters of water for production, curing, and site development activity.

A double-lane flyover can consume 70 million liters of water on the same scale. Also, in the construction industry water is used for mixing, aggregate washing, curing of concrete, and for washing concrete-related mechanical machines. 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 ice caps. Moreover, freshwater is not evenly distributed across land surfaces, and there are several heavily populated countries located in arid lands where freshwater is scarce.

The construction industry is among the most water-consuming industries. But there is one relief it does not essentially need fresh or potable water. Chemical limits for water for construction, suggested by different codes indicate that many types of non-potable water can be used for construction. Reuse of non-potable water like grey water for construction can reduce the burden on freshwater resources and the environment. Almost all results of the parametric study suggest the feasibility of using treated domestic wastewater as mixing or curing water. Household wastewater is mainly divided into black water and grey water. Black water consists of the discharges from toilets. Black water contains nitrogen and phosphorous in high concentrations and most of the pathogens, germs, and pharmaceutical residues. Commonly, grey water should consist of discharges from showers, baths, and washing and it can be used for construction purposes.

II. RELATED WORK

R.T PECHE, DR.S.S. JAMKAR, DR.P.S. SADGIR, Grey water- a potential source of water for constructionist Journal of Mechanical and Civil Engineering (IOSR-JMCE)

Grey water is potentially less contaminated than wastewater. Taking scarcity of water into consideration various global agencies are suggesting reuse of grey water for different purposes. Water is one of the major ingredients of concrete and the most used material in construction practices. The grey water available from domestic sources is being used for gardening purposes. As the discharge of grey water within the urban area is huge and as good as 60% of the per capita domestic water supply, the possibility of its reuse for construction is investigated. Samples of grey water are collected from various domestic sources and their chemical analysis is carried out. The quality of grey water is compared with the requirements of water for construction suggested by various codes. It is observed that the requirements like oil fats, color, detergent, suspended matter, odor, and pH were within prescribed limits. The presence of chemicals like chlorides, sulfates, alkalis, and other harmful contaminations was also within permissible limits. The investigation is further done to study grey water's influence on the strength of concrete. Concrete cubes of grades M-20, M-25, M-30, M-35, and M-40 were cast using potable and grey water and tested for compressive strength on the 7th and 28th days. The results of the compressive strength of concrete with grey water are found to be almost the same or little less than the concrete with potable water.

III. METHODOLOGY

The methodology is as follows, initially grey water samples will be collected, and it will be tested to determine its physical, chemical and biological properties. Then after cube specimens will be cast using grey water.

IV. MATERIAL TESTING

A. Cement:

Si. No	Test Performed	Fresh Water	Grey Water
1	Fineness	96.60%	93.20%
2	Initial setting time	33.24 min	33 min
3	Final setting time	520 min	570 min
4	consistency	33%	34%
5	Specific Gravity	3.15	3

B. Coarse Aggregate:

Si. No	Test Performed	Result
1	Specific Gravity (20mm)	2.77
2	water Absorption (20mm)	0.35%
3	Aggregate Impact Test	17.46%
4	Flakiness Index	24%
5	Elongation Index	17%

C. Fine Aggregate:

Si. No	Test Performed	M Sand	River Sand
1	Specific Gravity	2.65	2.62
2	water Absorption	2.50%	1.25%
3	Fineness Modulus	2.88	2.4

D. Lab Analysis of chemical properties of fresh water & grey water:

Si. No	Properties	Fresh water	Grey water
1	pH value	7.2	6.5
2	Turbidity	80 NTU	132 NTU
3	Chloride	946.96 mg/l	356.35 mg/l
4	Total Hardness	360 mg/l	400 mg/l
5	Sulphate	7.61 mg/l	17.4 mg/l

V. EXPERIMENTAL INVESTIGATION

The experiment consists of the process of design the concrete mix M40 grade as per the Indian Standards (IS: 10262-2009). After designing and calculating the mix proportions, the materials for the concrete, that is, cement, fine aggregate, coarse aggregate were mixed at the dry state before adding water. Then the calculated amount of water (recycled water) was added to it and thoroughly mixed to have a homogenous mix. The slump factor test was conducted as per the Indian Standards for the concrete mixes to know the workability of the concrete mix. Then, to find the strength characteristics, the specimen was cast. For the compressive strength test, the specimens were cast to the size of 150x150x150mm of typical size cubes. For the split tensile test, the

specimens were cast in the size of cylinders of 150mm in diameter and 300mm in height. For Flexural strength test beams of 150x150x700 mm size are cast. For the rapid ion penetration test, Concrete disc of size 100 mm diameters and 50 mm thickness is to be casted and allowed to cure for 28 days. After 28 days of curing, the concrete specimens were subjected to RCPT test by impressing a voltage of 60 V. The cast cubes are cured for 7, 14 and 28 days and strength tests are conducted.

VI. EXPERIMENTAL RESULT

The test results show that more strength of the concrete can also be achieved by using the recycled wastewater, and the obtained results are also greater than normal concrete's strengths.

A. Test on Fresh Concrete

Slump Test:

S.NO	SAMPLE	GRADE OF CONCRETE	SLUMP VALUE IN (mm)
1	Fresh water in M sand	M40	110
2	Fresh water in R sand	M40	120
3	Grey water in M sand	M40	115
4	Grey water in R sand	M40	120

Initial and final setting time of concrete by penetrometer test:

Si. No	Test Performed	Result
1	Initial Setting Time	3.6 hrs
2	Final Setting Time	7 hrs

B. Test on Hardened Concrete:

Compressive strength of concrete:

S.No	Sample	Strength (KN)		
		7 Days	14 Days	28 Days
1	Fresh Water in M sand	30.02	39.88	47.36
2	Fresh Water in R Sand	29.87	40.37	49.26
3	Grey Water in M sand	28.12	39.44	47.56
4	Grey Water in R sand	27.45	40	49.34

In the compressive strength tests performed, the observation was that with the use of the recycled/treated wastewater and the concrete had gained more strength for 14 and 28 days when compared with the no

Split Tensile strength of concrete:

S.No	Sample	Strength (KN)		
		7 Days	14 Days	28 Days
1	Fresh Water in M sand	3.69	3.94	4.15
2	Fresh Water in R Sand	3.72	3.98	4.21
3	Grey Water in M sand	3.9	4.02	4.93
4	Grey Water in R sand	3.95	4.1	5.06

In the split tensile strength tests performed, the observation was that with the use of the recycled/treated wastewater and the concrete had gained more strength and there is an increase in strength for 7, 14 and 28 days when compared with the normal concrete.

Flexural strength of concrete:

S.No	Sample	Strength (KN)		
		7 Days	14 Days	28 Days
1	Fresh Water in M sand	3.75	4.09	4.32
2	Fresh Water in R Sand	3.82	4.22	4.56
3	Grey Water in M sand	3.84	4.21	4.44
4	Grey Water in R sand	3.88	4.34	4.61

In the flexural strength tests performed, the observation was that with the use of the recycled/treated wastewater and the concrete had gained more strength and there is an increase in

strength for 7, 14 and 28 days when compared with the normal concrete.

CONCLUSION

Based on the compression, split and flexural strength test we can conclude that, The strength test results obtained for 7, 14 and 28, there is an increase in strength for 14 and 28 days when compared with the strength of normal concrete.

Considering huge and perennial availability, grey water has a potential to fight against scarcity of water. The types of grey water used met the standards of mixing water as mentioned in various codes. Grey water should be disinfected before use to avoid health risks to people at work. Using recycled wastewater for construction purposes is cheaper and economical when compared with the usage of normal or portable water. Recycled wastewater is one of the alternative sources for mixing and curing of concrete.

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