Utilization of Reclaimed Sewage Water in Concrete

Dineshkumar Govindarajan
Department of Civil Engineering
Sri Venkateswara College Of Engineering
Chennai, India

Arun Raja P
Department of Civil Engineering
Sri Venkateswara College Of Engineering
Chennai, India

Anubama S
Department of Civil Engineering
Sri Venkateswara College Of Engineering
Chennai, India

Arun G
Assistant Professor
Department of Civil Engineering
Sri Venkateswara College Of Engineering
Chennai, India

***Abstract*— This task targets giving an option in contrast to the crisp water utilized in the development by the utilization of auxiliary treated sewage water. It significantly helps in the administration of water assets in a general public winning with a colossal shortage of water assets. Various extents utilizing treated water and customary water were tried to break down the ideal extent. This investigation mirrors the quality of plain cement concrete in treated sewage water.**

***Keywords*— Crisp water; treated sewage water; colossal shortage; plain cement concrete**

INTRODUCTION:

These days the vast majority of the development ventures seem, by all accounts, to be answerable for the utilization of bountiful measure of crisp water. Without considering about different utilizations of water at the concrete industry, around 150 liters of water is required for $1m^3$ of concrete. In the accessible water just 3% is fresh water while the rest 97% is sea water which has high saltiness esteem. What's more, with the expanded urbanization the generation of sewage from the residential tenants has likewise been expanded. Very nearly 80% of the water utilized for residential reason disseminates as civil emanating water. Treated waste water is acquired from treatment plant in the wake of treating metropolitan profluent water. It is fundamentally utilized for cultivating and in some circumstance for agrarian reason. Treated waste water is hard water, it chiefly contains sulfate and chloride content. So as to diminish the utilization of customary water being developed and to utilize the assistant treated sewage water in a ground-breaking way. It hopes to save million liters of waste water which may be deliberately orchestrate in the stream.

LITERATURE SURVEY:

V. Kulkarni (2014) [1] investigated that, compressive strength of concrete by using treated domestic waste water as mixing and curing of concrete. They discussed about physical and chemical properties of treated domestic waste water of mix proportion for M20 and M40 grade concrete the number of specimens to be cast for diverse curing regimes and expand average compressive strength results of M20 grade concrete cast by utilizing Tap water as mixing and curing water for Mix M1 & treated domestic waste water as mixing and curing water for Mix M2. Additionally average compressive strength results of M40 grade concrete cast by utilizing Tap water as mixing and curing water for Mix M3 & treated domestic waste water as mixing and curing water for Mix M4.

M. Silva and T. R. Naik (2010) [2] investigated that, sustainable 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.

This paper “Use of waste water for concrete mixing in Kuwait” [5] clearly explained about the type water used for mixing do not affect to concrete slump and density. Here he mainly considered use of water in mixing concrete and studied the properties such as slump and density and he concluded that there is greater difference between these two parameters.

R.A. More and S.K. Dubey (2014) [7] investigated that, the effect of different types of water on compressive strength of concrete. They made concrete cube with mineral water, tap water, well water and waste water increased with days & not having much variation in their compressive strength. The concrete mix of M20 grade with water cement ratio of 0.5 was explored. Water samples were gathered from different sources at college campus and were used to cast 150mm concrete cubes. The cured cubes were squashed on 7^{th} day & 28^{th} day for compressive strength estimation. Likewise inferred that concrete made with various qualities of water samples, for example, ground water, packed drinking water, waste water and so on..have 7^{th} day and 28^{th} day compressive strength equal to or at least 90% of the strength of reference specimens made with clean water for M20 grade of concrete (Except waste water specimen for 7^{th}-day).

In this paper "Utilization of waste water to check strength parameters of concrete" [8] here the creator audits probability of replacing fresh water with the waste water and inferred that workability of the concrete goes on diminishes with the increase in percentage of waste water and compressive strength of the concrete is slightly increased with the increase in percentage of treated waste water in concrete.

N. Reddy (2015) [9] investigated that, the Treated domestic waste water as a mixing water in cement mortar. It has been affected on properties of cement blended with 20% fly ash such as compressive strength, setting times and soundness. Water used for mortar includes Ordinary water (PW), treated domestic wastewater (TDWW) and TDWW partially replaced with Ordinary water. The setting times and soundness of blended cement with treated domestic wastewater (TDWW) and TDWW partially replaced with Ordinary water is as good as that with Ordinary water. The compressive strength of blended cement mortar mixed with treated domestic wastewater and TDWW partially replaced with PW has been very insignificantly affected. Therefore, they were suggested that treated domestic wastewater may be considered as mixing water for blended cement mortar where Ordinary water resources are scarce. However, advised that long-term strength development and durability be studied before use. In that setting times were found to very insignificantly increase in all types of mixing water when compared with ordinary water. There were no adverse effects on resulting in compressive strength, when cement mortar specimens made with TDWW and cured in same water. As the measured values are less than 10 mm; all the samples were considered sound. The exhibited test study affirms the attainability of utilizing TDWW in concrete mortar.

SYMBOLS AND ABBREVIATIONS:

N — newton
kg — kilo gram
N/mm^2 — newton per millimeter square
MPa — megapascal

METHODOLOGY:

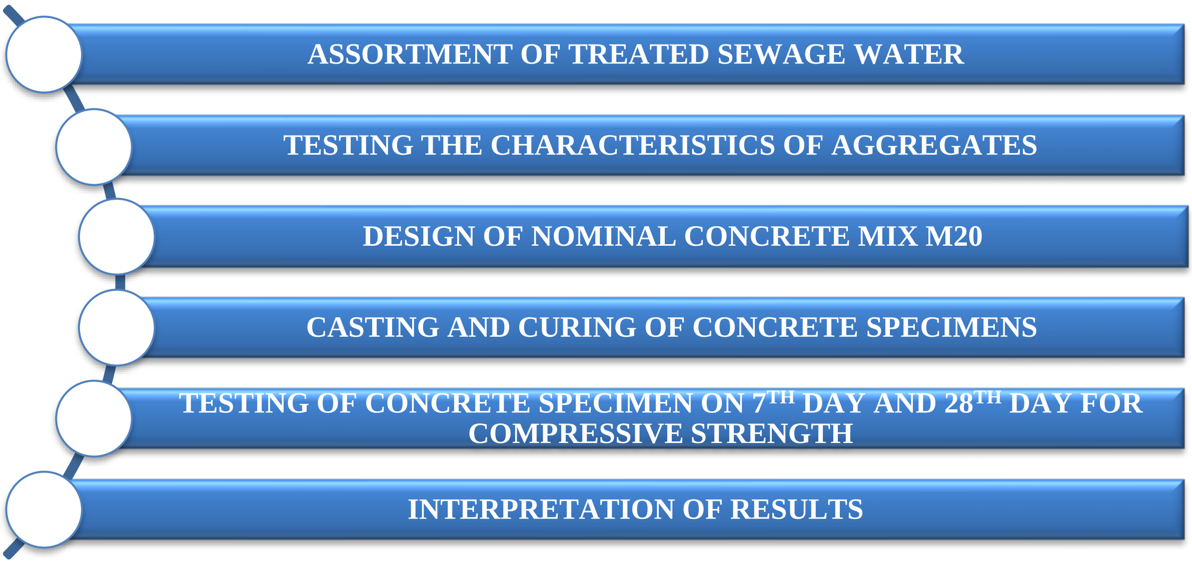

Figure 1: Flowchart of the Methodology

EXPERIMENTAL WORK:

Cement — Cement is a basic binding material used in concrete for all the construction works. In Our project we used Ordinary Portland cement of 43 grade. This sort of concrete is made to powder by blending limestone and other raw materials which comprise of argillaceous, calcareous and gypsum.

Fine aggregate — Fine aggregates are the structural filler that involves the vast majority of the volume of the concrete mix formulas. In this project, Squashed common sand was used as fine aggregate that we accumulated from locally accessible. Fine aggregate of 4.75mm down size are utilized in concrete.

Coarse aggregate — The coarse aggregate was liberated from clayey matter, silt and organic impurities. Coarse aggregate of 20mm nominal size is utilized in concrete. The coarse aggregate was also tested for specific gravity and it was 2.54.

Water — Water is basically required in concrete for complete chemical hydration of cement in concrete. Water utilized in concrete should be liberated from suspended solids, alkali, organic impurities etc., and it should met the quality guidelines for making concrete or else, it adversely affects the strength of concrete. We have prepared concrete mix with use of both ordinary water and treated waste water.

Sewage Water — The treated sewage water collected from sewage treatment plant located in our college, Sri Venkateswara College Of Engineering, Sriperumbudur.

Table 1: Concrete Mix proportion data
Ratio of mix proportion — 1:1.5:3

Mix proportion of concrete	For 1 batch of mixing
Cement (kg)	8.9
Fine aggregate (kg)	13.3
Coarse aggregate (kg)	27
Water (ml)	4005
W/C ratio	0.45

Table 2: General Test Results

S.NO.	CHARACTERISTIC	RESULT
1	Specific Gravity	2.54
2	Water absorption	2.5
3	Crushing strength	23.5%
4	Los Angeles Abrasion value	8%
5	Aggregate Impact Value	17%

CASTING:

Eighteen concrete cubes were cast according to the mix proportions. For M20 grade concrete distinctive combination of concrete mixing were carried out as given beneath.

1) Six Specimens were cast utilizing 100% ordinary water.
2) Six Specimens were cast utilizing 50% treated sewage water.
3) Six Specimens were cast utilizing 75% treated sewage water.

Figure 2: Casted Concrete specimens

CURING:

Curing is done by drenching the specimens in curing ponds of ordinary water under standard supervision. For each of these above three mixes, two curing ages were chosen i.e. 7th day & 28th day and ordinary water was utilized as curing water.

1) Six Specimens cast and cured by utilizing 100% ordinary water for testing at 7th day and 28th day.
2) Six Specimens cast by 50% treated sewage water and cured by utilizing 100% ordinary water for testing at 7th day and 28th day.
3) Six Specimens cast by 75% treated sewage water and cured by utilizing 100% ordinary water for testing at 7th day and 28th day.

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Table 3: Using 0% treated sewage water in concrete (7th Day)

S. No	Load (k N)	Compressive strength (N/mm^2)	Weight (kg)
1	686.3	30.5	8.45
2	730.5	32.46	8. 45
3	703.3	31.25	8.30

Table 4: Using 50% treated sewage water in concrete (7th Day)

S. No	Load (k N)	Compressive strength (N/mm^2)	Weight (kg)
1	579.70	25.76	8.30
2	635.70	28.25	8. 30
3	690.80	30.70	8.40

Table 5: Using 75% treated sewage water in concrete (7th Day)

S. No	Load (k N)	Compressive strength (N/mm^2)	Weight (kg)
1	544.2	24.18	8.35
2	539.8	25.76	8.40
3	669.6	29.76	8.30

Table 6: Using 0% treated sewage water in concrete (28th Day)

S. No	Load (k N)	Compressive strength (N/mm^2)	Weight (kg)
1	1011.7	44.96	8.35
2	1024.2	45.52	8.50
3	979	43.51	8.45

Table 7: Using 50% treated sewage water in concrete (28th Day)

S. No	Load (k N)	Compressive strength (N/mm^2)	Weight (kg)
1	1051.6	46.73	8.50
2	1097.2	48.76	8.40
3	1080.5	48.02	8.30

Table 8: Using 75% treated sewage water in concrete (28th Day)

S. No	Load (k N)	Compressive strength (N/mm^2)	Weight (kg)
1	1078	47.91	8.55
2	877.7	39	8.30
3	959.2	42.63	8.25


Figure 3: Concrete testing

Figure 4: Concrete testing

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COMPRESSIVE STRENGTH OF MORTAR CUBES:

Fig. 5 shows the Compressive strength of mortar cube prepared with 50% treated sewage water shows improvement in the strength when contrasted with 100% ordinary water for 28th day. The mortar cubes prepared with 75% treated sewage shows diminishing outcomes as contrasted with ordinary water. The outcome proposed that the natural substance present in treated sewage water might be going about as a scattering specialist, improving the scattering of particles.

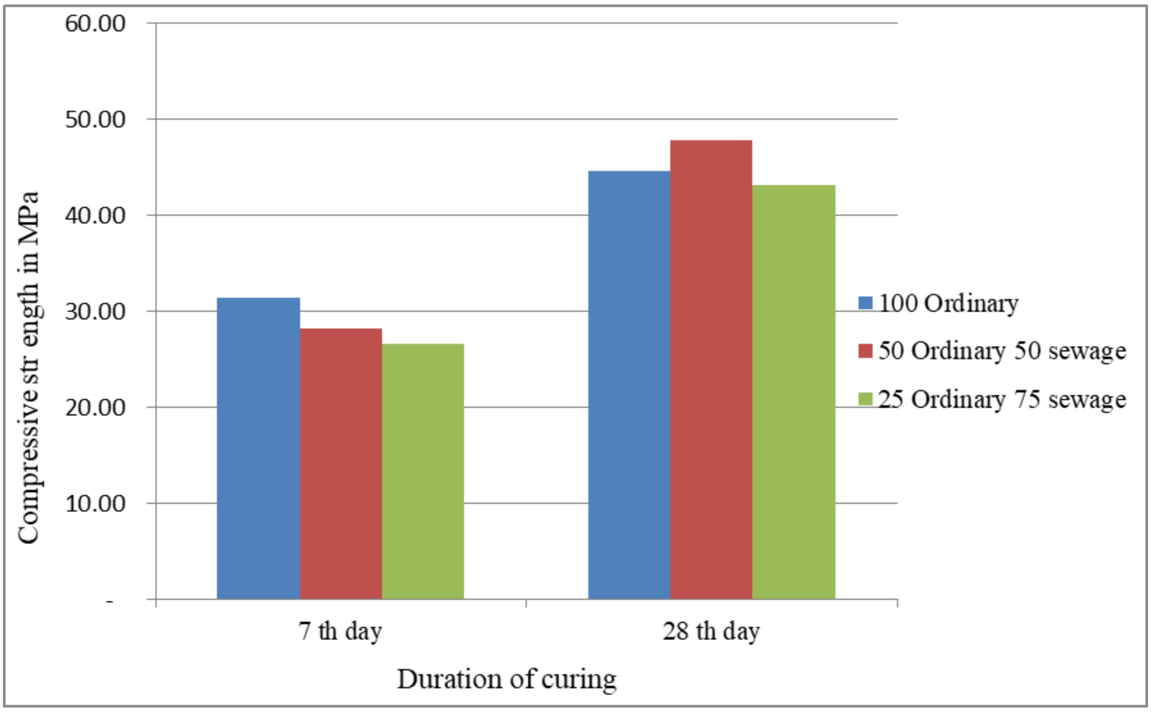

Figure 5: Compressive Strength of mortar cube

COMPRESSIVE STRENGTH OF CONCRETE:

Fig. 6 shows the effect of mixing treated sewage water in concrete on compressive strength of concrete for 7th day & 28th day. The compressive strength development was measured after 7 days and 28 days of casting. The specimens were tested in compressive testing machine. The specimen was removed from the curing tank and the surface was wiped .The specimen was placed beneath the upper bearing block of the testing machine. Total maximum load was recorded and compressive strength of the specimen was determined.

Figure 6: Specimen after failure

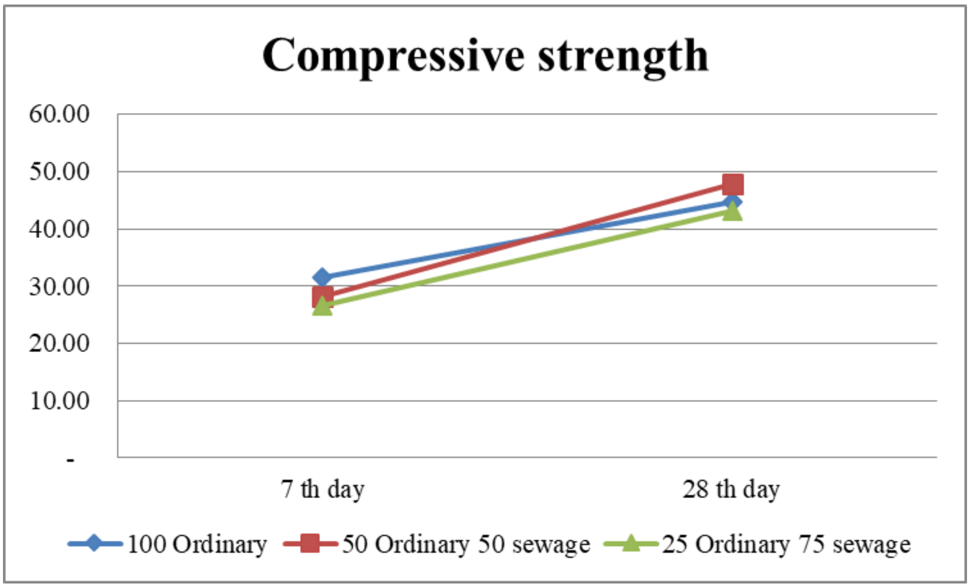

Figure 7: Compressive Strength of concrete

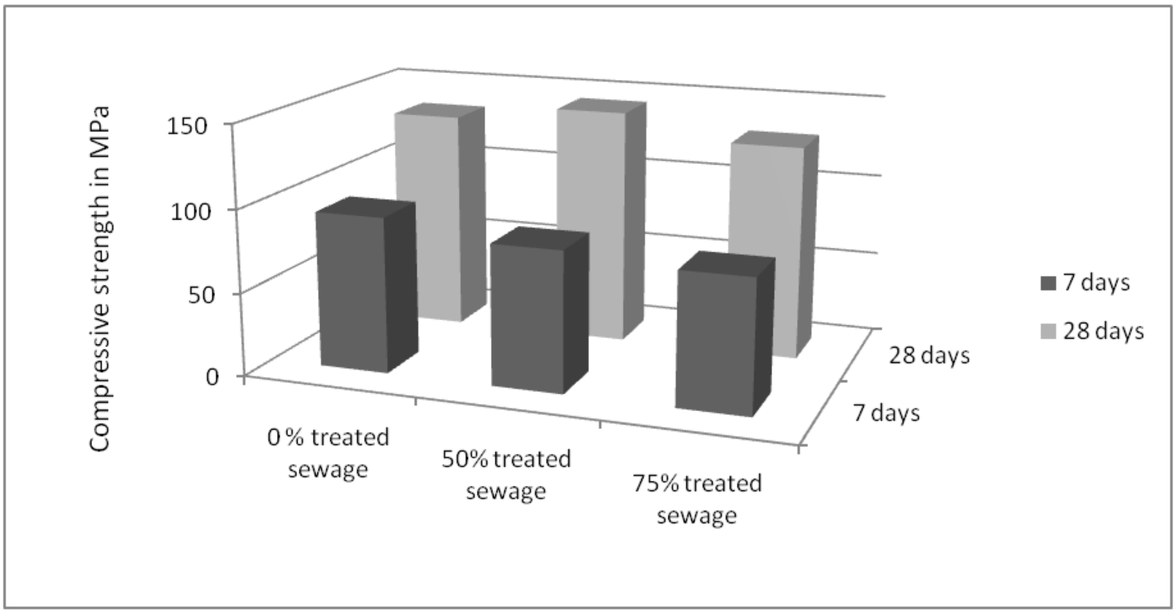

Figure 8: Pictorial representation of Compressive Strength test results

CONCLUSION:

This investigation analyzed the potential of utilizing treated sewage water as mixing water in the synthesis of concrete. From the perception, it is obvious that the concrete cubes with mixed proportions of sewage has strength is within the prescribed limits. Critical enhancements of strength were recorded in concrete mixes of w/c = 0.45. Concrete with 50% secondary treated water and 50% ordinary water has the most elevated compressive strength corresponding to the 28^{th} day testing. Minimal effort and ecological inviting concrete can be produced by using treated waste water in concrete Thus, sewage treated water is a handful substituent for ordinary water in the concrete. In the event that the sewage treated water is utilized in the development rehearses, at that point the expense of water will just incorporate the transportation cost of water on the grounds that the sewage treated water can be accessible uninhibitedly at any administration STP. The treated water is anyway released into the regular stream without being of much criticalness, as opposed to that it very well may be utilized to supply water to building locales. So if the treated water can be accessible openly or at an extremely ostensible charge then the transportation cost just stays as the expense of water.

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