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DESIGN OF CONCRETE MIX BY USING TREATED MAGNETISED WASTE WATER

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Abstract - *The civil engineering structures should be such that they sustain for a longer duration with lesser environmental impact at a reasonable cost. For any construction activity, we need water for mixing in concrete and as per our IS, the water used should be potable. Many studies have been made on the strength and durability properties of concrete made with water which is on par with the standards prescribed. But today, potable water is becoming scarce with rapid increase in the population, deforestation and urbanisation. So, we should think of an alternate source of water like treated waste water to use as mixing water in concrete.*

This thesis investigates and presents the effect of "magnetisation" on the compressive strength of concrete mixed with different treated waste water. In this technology, by passing water through a magnetic field, some of its physical properties change and as a result of such changes, the number of molecules in the water cluster decrease from 13 to 5 or 6, which causes a decrease in the water surface tension. The nanostructure of water molecule changes due to Magnetisation which helps in the increase of strength of concrete. In this work, concrete cubes were casted using three different water – Primary treated waste water (P-I), Secondary treated wastewater (S-I) and Tertiary treated waste water (T-I) obtained from a local waste water treatment plant. Also the cubes were casted using three more different types of water which can be quoted as the counterparts of the above mentioned water. They are – Magnetised Primary treated waste water (P-II), Magnetised Secondary treated waste water (S-II) and Magnetised Tertiary treated waste water (T-II).

Key Words: **Magnetised Water, Fine Aggregate, Coarse Aggregate, Cement, Magnets, Compressive Strength**

1. INTRODUCTION

Water is one of the basic necessities of human lives. Water covers 71% of the Earth's surface. It is vital for all known forms of life. On Earth, 96.5% of the planet's water is found in seas and oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapor, clouds (formed of solid and liquid water particles suspended in air) and precipitation. Only 2.5% of the Earth's water is fresh water and 98.8% of that water is in ice and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount of the Earth's freshwater (0.003%) is contained within biological bodies and manufactured products. Safe drinking water is essential to humans and other life forms even though it provides no calories or organic nutrients. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate sanitation. There is a clear correlation between access to safe water and gross domestic product per capita. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. A report, issued in November 2009, suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%. Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation. Approximately 70% of the fresh water used by humans goes to agriculture.

1.1 Objective

A definite increase in strength was observed due to magnetisation and hence this method can be used in case of different waste water when we are in the crisis for normal potable water. We can say that one can replace normal potable water with treated magnetic waste water as mixing water in concrete in the field by which the problem of water scarcity can be overcome to some extent and eco-friendly constructions can be made in future decades to come.

2. MATERIALS

The following materials are used in the present investigation. A brief description is given below regarding the materials used.

1. Cement
2. Magnets
3. Fine aggregate
4. Coarse aggregate
5. Magnetised water
6. Water

2.1 Pre-Experimental Investigations

CEMENT

Table 1: Physical properties of ordinary Portland cement

S.NO	PROPERTIES	TEST RESULT
1.	Normal consistency	30%
2.	Specific gravity	3.02
3.	Initial setting time (minutes)	55 min
4.	Final setting time (minutes)	560 min
5.	Fineness	3%
6.	Soundness (Lechatlier method)	2 mm
7.	Compressive strength (28 days)	54.7 N/mm^2

FINE AGGREGATE

Sieve analysis results for fine aggregate
Weight of sample taken = 1kg.

Table 2: Fineness modulus

S.NO	IS SIEVE SIZE	WEIGHT RETAINED IN gms	% WEIGHT RETAINED	CUMMILATIVE % WEIGHT RETAINED	% PASSING
1	40 mm	0	0	0	100
2	20 mm	0	0	0	100
3	10 mm	0	0	0	100
4	4.75 mm	30	3	3	97
5	2.36 mm	50	5	8	92
6	1.18 mm	190	19	27	73
7	600 µm	330	33	60	40
8	300 µm	300	30	90	10
9	150 µm	100	10	100	0

Fine aggregate conform to Zone-II in accordance with IS: 383-1970.

Table 3: Physical properties of fine aggregate

S.NO	PROPERTIES	RESULT
1	Fineness modulus	2.88
2	Specific gravity	2.6
3	Bulk density in loose state	1550 kg/m^3

Sieve analysis results for coarse aggregate of size 20mm
Weight of sample taken = 5kgs.

Table 4: Fineness modulus

S.NO	IS SIEVE SIZE	WEIGHT RETAINED IN gms	% WEIGHT RETAINED	CUMMILATIVE % WEIGHT RETAINED	% PASSING
1	40 mm	0	0	0	100
2	20 mm	1140	22.8	22.8	77.2
3	10 mm	3860	77.2	100	0.28
4	4.75 mm	0	0	100	0
5	2.36 mm	0	0	100	0
6	1.18 mm	0	0	100	0
7	600 µm	0	0	100	0
8	300 µm	0	0	100	0
9	150 µm	0	0	100	0

Fineness modulus of coarse aggregate of size 20mm is 7.228

Table 5: Physical properties of coarse aggregate of size 20mm

S.NO	PROPERTIES	RESULT
1	Fineness modulus	7.228
2	Specific gravity	2.60
3	Bulk density in loose state	1361 kg/m^3

Sieve analysis results for coarse aggregate of size 12mm
Weight of sample taken = 5kgs.

Table 6: Fineness modulus

S.NO	IS SIEVE SIZE	WEIGHT RETAINED IN gms	% WEIGHT RETAINED	CUMMILATIVE % WEIGHT RETAINED	% PASSING
1	40 mm	0	0	0	100
2	20 mm	0	0	0	100
3	10 mm	200	4	4	96
4	4.75 mm	1170	23.4	27.4	72.6
5	2.36 mm	3630	72.6	100	0
6	1.18 mm	0	0	100	0
7	600 µm	0	0	100	0
8	300 µm	0	0	100	0
9	150 µm	0	0	100	0

Fineness modulus of coarse aggregate of size 12mm is = 5.314

Table 7: Physical properties of coarse aggregate of size 12mm

S.NO	PROPERTIES	RESULT
1	Fineness modulus	5.314
2	Specific gravity	2.58
3	Bulk density in loose state	1332 kg/m³

2.2 Mix Design

Table 8: M20 Grade Concrete proportion quantities per one cubic meter

S.NO	MATERIAL	Kg/m³
1	Cement	310
2	Sand	718
3	20mm aggregate	700
4	12mm aggregate	467
5	Water	170.5

2.3 Preparation of Test Specimen

The following procedure is adopted to prepare the test specimens.

1. Preparation of magnetic water
2. Mixing
3. Casting
4. Normal Curing

3. EXPERIMENTAL INVESTIGATION

1. At first Individual tests have been done on Cement, Fine Aggregates, & Coarse Aggregates
2. In this study water is magnetized by using magnets and is tested for Different grades of Concrete
3. For M20 M25 M30 & M35 grade Mix Design is done for the above mentioned magnetized water
4. M20, M25, M30 & M35 Concrete cubes have been prepared as per the mix design.
5. Workability tests have been done for Fresh Concrete
6. Cubes have casted to measure compressive strength on 7, 14, 21, & 28 days
7. Compressive strength test have been done for all the mix proportions of the above grades concrete on 7, 14, 21, & 28 days
8. Equipment used for this tests are Sieves, Workability test apparatus, CTM, Cube Moulds, Pycnometer bottles, Specific gravity bottles.

4. RESULTS AND DISCUSSION

4.1 Effect Of Magnetic Water On Workability Of Concrete Mixes

Workability test is conducted for different concrete mixes with Normal water and Magnetic water and the slump values are listed in Table 9.

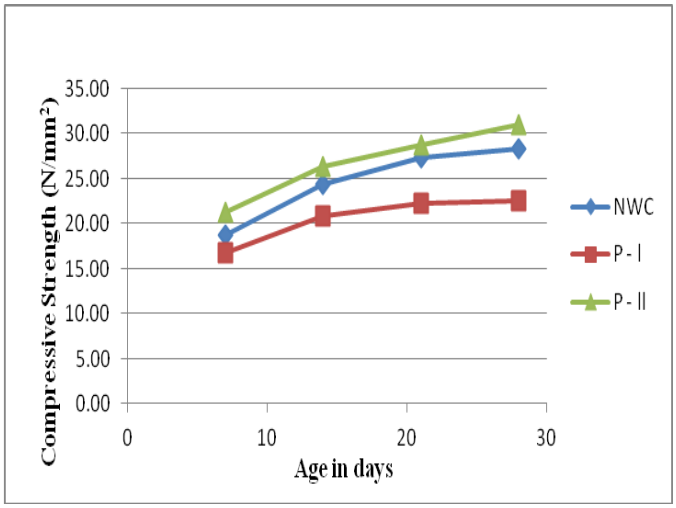
Table 9: List of Slump test in various concrete mix cases in mm

S.NO.	DESCRIPTION	NORMAL	MAGNETIC
1	Normal Water	50	55
2	Primary Treated water	50	55
3	Secondary Treated Water	50	55
4	Tertiary Treated Water	50	55

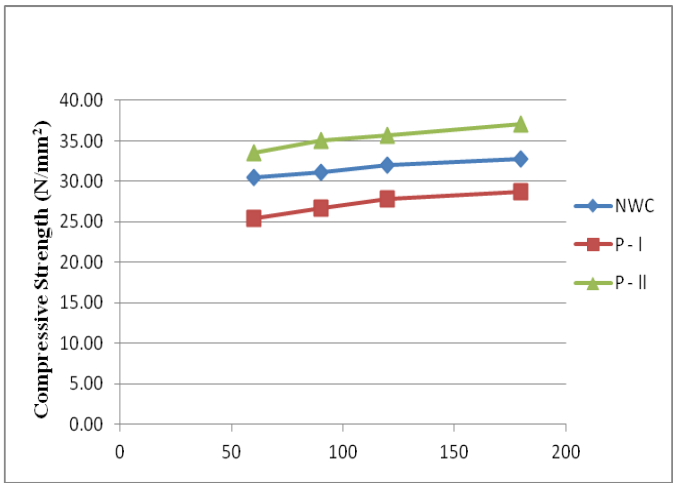
From Table 9, it is clear that there is very less change in consistency of concrete for all the concrete mixes but how ever magnetized water is showing more workability compared to normal water.

4.2 Primary Treated Waste Water

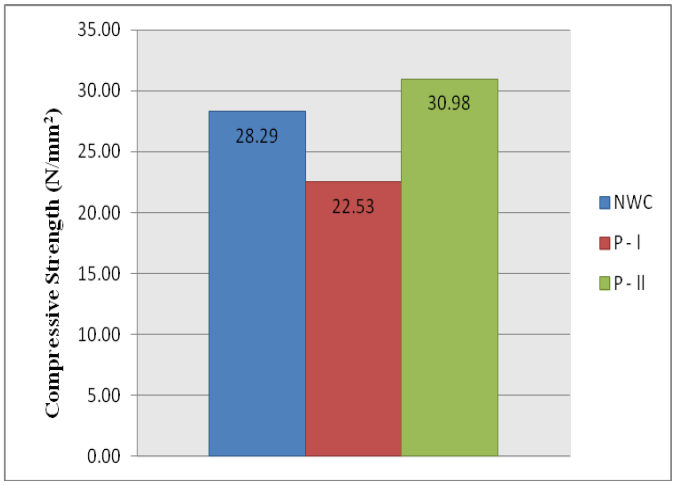
Fig 1,2 & 3 : Compressive Strength Test Results in N/mm²



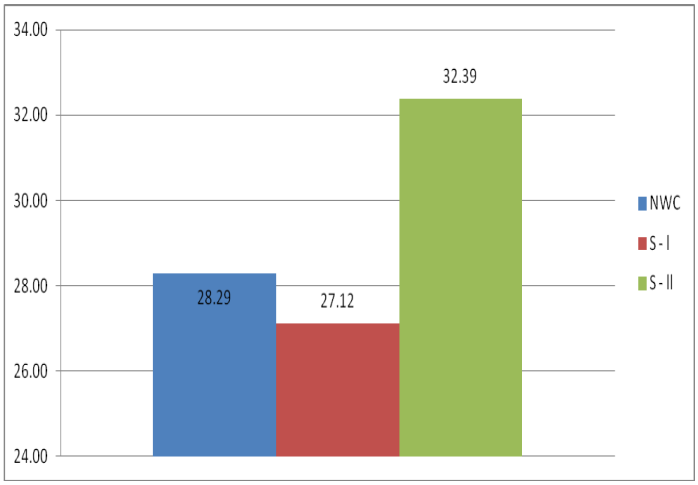
Comparison of compressive strengths of NWC, P-I concrete and P-II concrete Upto 28 days



Comparison of compressive strengths of NWC, P-I concrete and P-II concrete from 60 - 180 days



Compressive strengths of NWC, P-I concrete and P-II concrete at 28 days

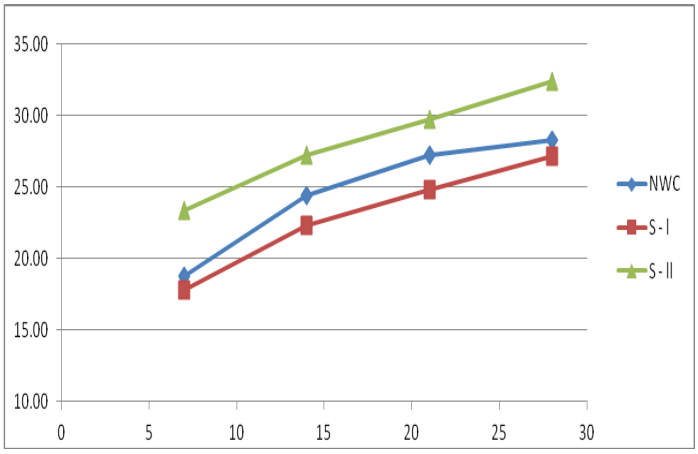


Compressive strengths of NWC, S-I concrete and S-II concrete at 28 days

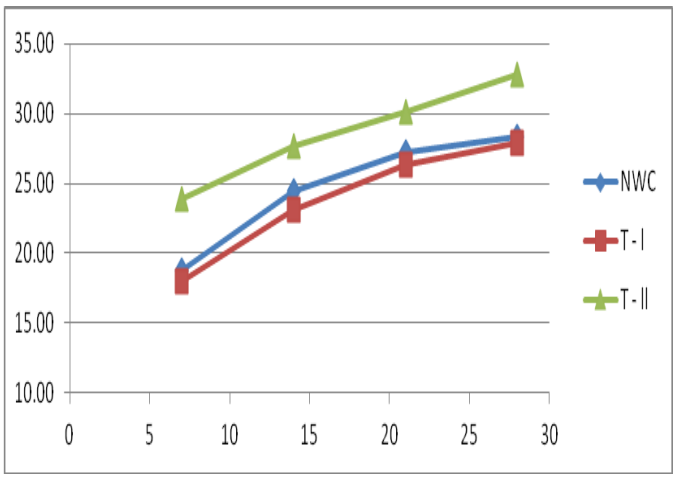
4.3 Secondary Treated Waste Water

4.4 Tertiary Treated Waste Water

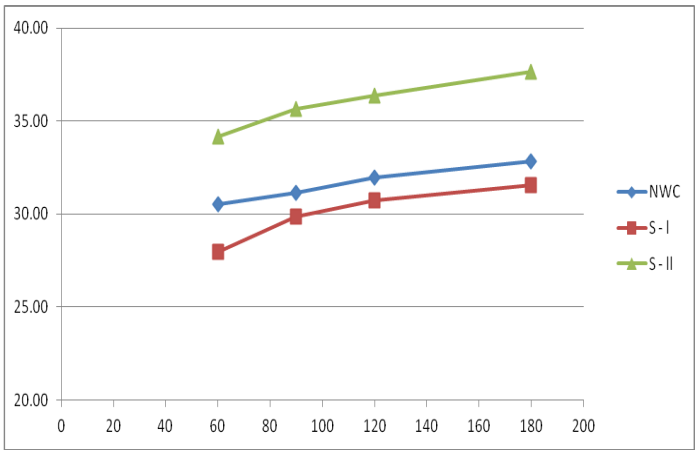
Fig 4 :Compressive Strength Test Results in N/mm²



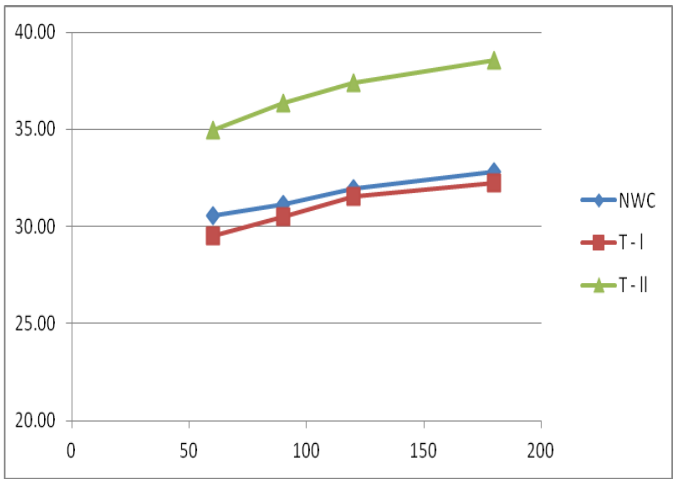
Comparison of compressive strengths of NWC, S-I concrete and S-II concrete Upto 28 days



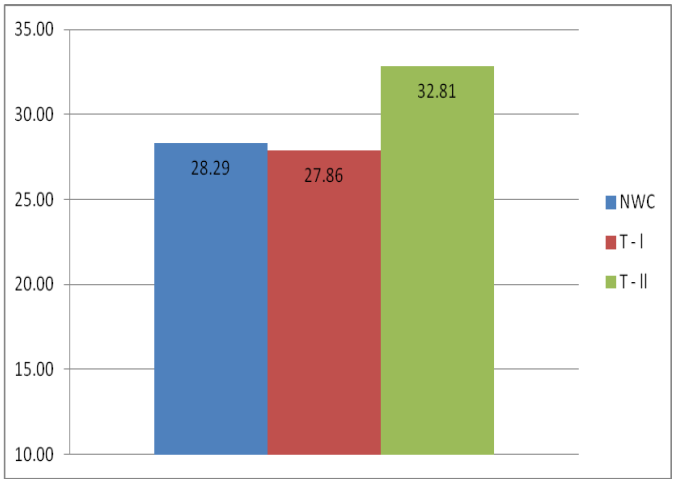
Comparison of compressive strengths of NWC, T-I concrete and T-II concrete Upto 28 days



Comparison of compressive strengths of NWC, S-I concrete and S-II concrete from 60 - 180 days

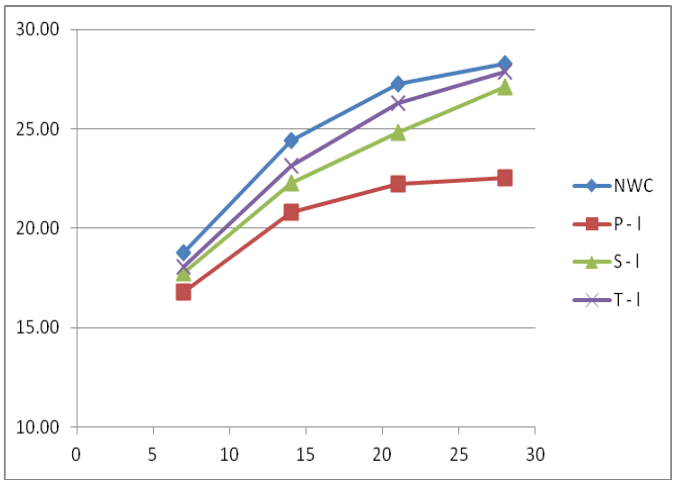


Comparison of compressive strengths of NWC, T-I concrete and T-II concrete from 60 - 180 days

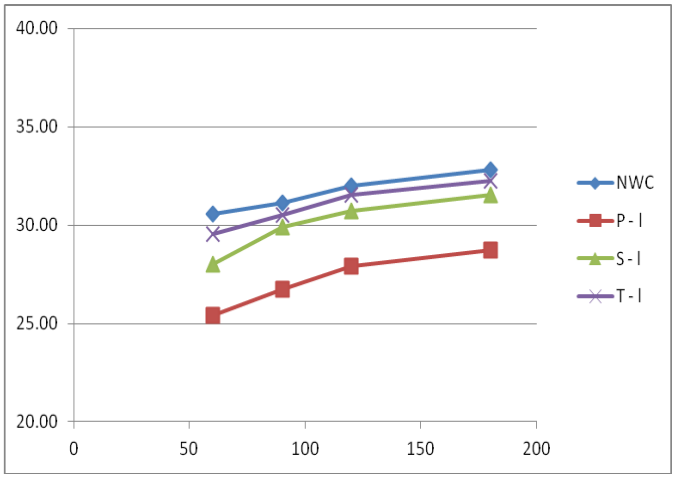


Compressive strengths of NWC, T-I concrete and T-II concrete at 28 days

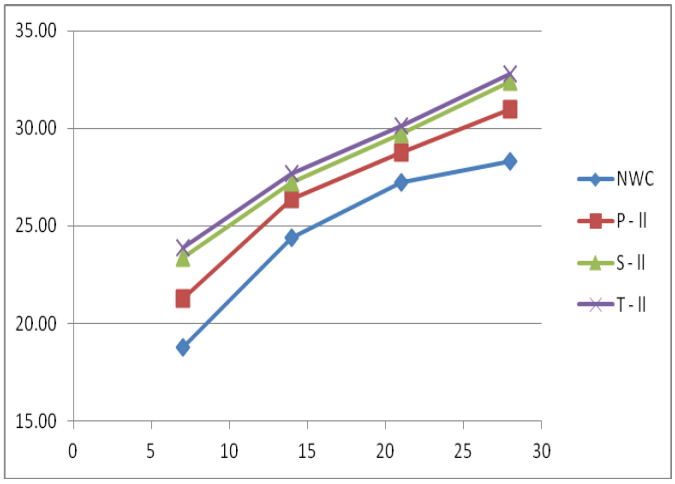
4.5 Comparison of Compressive Strengths of Concrete made of Different Water



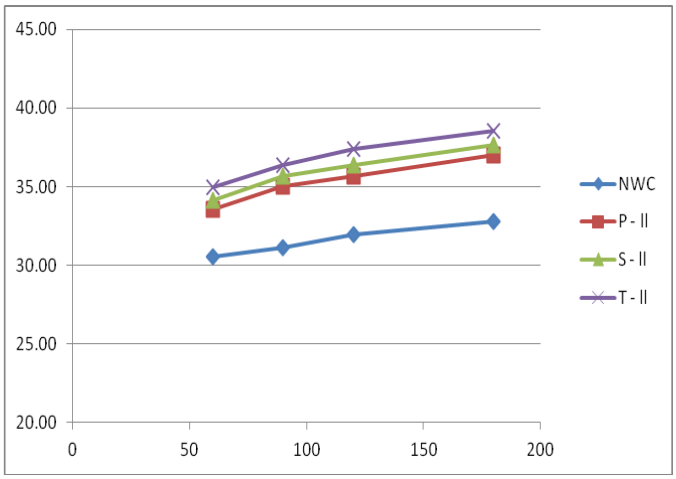
Comparison of compressive strengths of NWC, P-I concrete, S–I concrete and T-I concrete upto 28 days



Comparison of compressive strengths of NWC, P-I concrete, S–I concrete and T-I concrete from 60 – 180 days



Comparison of compressive strengths of NWC, P-II concrete, S-II concrete and T-II concrete upto 28 days



Comparison of compressive strengths of NWC, P-II concrete, S–II concrete and T-II concrete from 60 to 180 days

5. CONCLUSIONS

1. The workability of magnetic water concrete is slightly more compared to normal water concrete.

2. The compressive strength test results show that the strength of the concrete made with Primary Treated Waste Water, Secondary Treated Waste Water and Tertiary Treated Waste Water are 20.37%, 4.15% and 1.54% less than the concrete made with Normal Water respectively.

3. The strength of the concrete made with Magnetised Primary Treated Waste Water is 37.51% higher than the concrete made with Primary Treated Waste Water at 28 days.

4. The concrete made with Magnetised Secondary Treated Waste Water 19.45% has shown higher strength than the concrete made with Secondary Treated Waste Water at 28 days.

5. At 28 days, the strength of the concrete made with Magnetised Tertiary Treated Waste Water was 17.8% higher than the concrete made with Tertiary Treated Waste Water.

6. Comparing with Normal Water Concrete, the strengths of Magnetised Primary Treated Waste Water increased by about 9.50%, Magnetised Secondary Treated Waste Water increased by about 14.50% and Magnetised Tertiary Treated Waste Water increased by about 16% at 28 days.

7. This technique of using treated magnetised waste water as mixing water in concrete has given satisfactory results and hence it can be implemented in the field for making concrete.

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