

Experimental investigation to enhance compressive strength of concrete blended with plastic waste using magnetized water

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Abstract – It is expected that in upcoming days, the community of civil engineering have to produce structures with the concept of sustainable development by using high-performance materials and new concept with low environmental impact which are produced at a reasonable cost. But With development of population pollution level and impact of pollution on human life and human health are also increasing. Plastic is one of the main components of pollution as reason is multiple Use of plastic like packaging of verities of product multi-fold in, due to low price and convenience in handling, but however, community of people is not aware about its impact on the human health and environment on littering or dumping. So that it is one of the most important challenge and need of human is to improve the performance of concrete and dispose waste intelligently. For that solution to be find out with use of technology to overcome these problems As the Magnetic water concrete, synthesized from the normal materials used for manufacturing of concrete which provides 10% to 20% extra strength to concrete, provides one route towards this objective. Good thing is normal water can easily replace with magnetic water and dispose waste plastic by which quantity of cement and sand used in any concrete mix reduces and we can made as new Eco-friendly material of construction for future.

Key Words: Coarse Aggregate, Compressive Strength using magnetic water, Magnetic water, Plastic Waste

1.INTRODUCTION

It is worth to mention that use of plastic for packaging's and manufacturing product of different types has increased multi-fold in the last one decade due to low price of plastic and convenience in handling, however, community of people is not aware about its impact on the human health and environment on littering or dumping. In India, every year approximately 15-16 Million tones products of plastic are consumed (2016), which is expected to rise in future. It is also known that about 50-60% of its consumption is converted into waste. Mostly plastics is used in the form of for packaging films, carry bags, wrapping materials like carry bags, fluid containers clothing, toys, like bottles, household applications, industrial products, engineering applications, building materials, domestic use etc.

As conventional plastic waste is non-biodegradable and remains on landscape for several years, responsible for polluting environment because life cycle of plastic waste remains incomplete and ultimately it is dumped on the land-fill sites. It is also well established that all types of plastics waste cannot be recycled; which result that, it accumulated into open drains, open land, beside of roads, low-lying areas, river banks, coastal areas, sea-beaches etc., recycling of a virgin plastic product can be done for 3-4 times only with too much mixing with virgin plastics granules, therefore, after every recycling its strength and quality of plastic product deteriorate. With similar to that, recycled plastic is more harmful to the human health and environment than the virgin plastic due to mixing of color, additives, stabilizers, flame retardants etc., with emission of toxic gas.

Critical issues for disposal of Plastic Wastes:

1. During production and polymerization process lot of toxic fugitive emissions in form of gases are released which are harmful for health;
2. Sub-standard plastic carry bags, packaging films etc. (<40micron) lead to several problems in collection and recycling and ultimately dumped elsewhere;
3. Littered plastic waste chokes the drain line and may responsible for flood during monsoon season with that specially plastic carry-bags/thin films give anesthetic look in the city,
4. Indiscriminate littering and non-biodegradability of plastic waste raise several environmental issues; such as unaesthetic look in city, choking of drains, making land infertile & on ingestion by cattles lead to death.
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For such critical issues for disposal of Plastic Waste we can find one solution with use of concrete blended with plastic. As from the study of papers chemicals and admixtures are added to concrete while mixing concrete to alter the properties of concrete to obtain a concrete with desired quality and property. In many cases, these chemicals and admixtures are added to get concrete with increased strength. The chemicals that are required for increasing the strength will be rarely available in rural areas and it will cost more in case of large projects.

The Magnetic water treatment is one of the finest proposed method of reducing the effects of hard water to make soft, as an alternative for water softening. This softening intensity is based on the magnitude of flux induced to water. Such treated water known as magnetic water or magnetized water. The usage of magnetic water for the preparation of concrete would increase strength of the concrete and also there will be higher workability for the same water cement ratio. Many results of paper show that the compressive strength of concrete samples prepared with magnetic water increases 10-20% more than that of the normal water samples.

The initial research and scientific testing regarding the application of a magnetic field to concrete manufacturing were commenced in Russia in 1962 for military constructions such as airports and jetties. the magnetic field can break down these water molecules and reduce the bond angle and hence increase solubility. It is believed that after applying a strong magnetic field, water will show diamagnetism. Diamagnetism denotes to any substances or material which are magnetized in such a way that its direction is opposite to the direction of magnetic field, having pair-up electrons which cancel each other's magnetic moment because the two electrons in a pair-up rotate opposite to each other. As a result, water molecules are 'directed' to have certain orientation. As a result, require energy for stability is lower and more solute can be packed with same volume of water because electric field of each H₂O (water) molecule contracts, thus increasing solubility of water molecule. This helps for strengthening of bond with cement.

2.METHODOLOGY FOR MAGNETIC WATER:

MAGNETIC DEVICE:

The magnet, which is used in many Household appliances, Automobile industries and Industrial machines can be used as magnetiser. We can use Electromagnet This type of magnet to produce a magnetic field. Advantage of this type of magnet is we can control the magnetic field strength by controlling the voltage of the electric current by passing through the coil wire.

The Ampere's function is used for finding out the magnetic field inside the coil, which is as follows (as per Reitz, 1971):

$$\beta = \mu_0 (N \times I) / L$$

Where:

β : magnetic field (intensity), measured in tesla.

μ_0 : magnetic constant (known as the permeability of vacuum can be exact with formula $4\pi \times 10^{-7}$ N/A², (Newton per ampere squared) in SI units).

N: total number of rolls in the coil in throughout the length(non-dimensional).

I: current passing in wire, measured in amperes.

L: total length of the coil which is rounded along length, measured in meter.

The strength or intensity of a magnet is measured by its magnetic flux density, which is measured in unit of gauss, i.e. (1 gauss = 10⁻⁴ tesla = 100 microtesla (μ T)), the magnet strength of which is used in the study is of (1.2) Tesla, and in SI units of tesla can be given as, 1 T = 1 kg·s⁻²·A⁻¹. An equivalent, but older unit for 1 Tesla was Weber/m². The type of magnetizer used in this study is made for domestic use. Permanent magnet, It is a set of permanent series of ring magnet materials arranged a Poly Venial Chloride (PVC) body of rounded shape to form of magnetic field with length greater than its radius. output of water from magneriser is up to 9 m³/hr., it is made of PVC body.

This study aims to investigate the effect of using magnetized water on concrete properties with and without blended with plastic. Therefore, prior to the proportion of each mix, water is prepared for that specific concrete mix. The water was simply treated by passing it through magnetic field (magnetizer). MW was prepared by passing it through magnetic field i.e. from magnetiser, using an immerseable pump machine to circulate the water through the magnetic field for 60 min, with a velocity of 9 m³/h. In the present study, MW is prepared by passing it through a magnetic field of strength of about 1.2 tesla and with a velocity of 9 m³/h. Compressive strength testing results for cubes were obtained for curing periods of 7 and 28 day.

3. RESEARCH OBJECTIVE

The objectives of the present study are as follow:

1. To perform Slump cone test and Compressive Strength test on concrete blended with plastic waste, and cast with NW and MW.
2. To Perform pH test and TDS test on NW and MW.
3. To check the gaining of compressive strength of concrete with for 7 days and 28 days, which is blended with PW using NW and MW.

4. METHODOLOGY

Materials

- I. **Cement:** the cement used throughout this work was ordinary Portland cement (O.P.C, Ordinary Portland cement of 43 – grade was used as it satisfied the requirements of IS: 269 – 1969 and results have been tabulated
- II. **Fine aggregate (sand):** sand should be river sand from river region, which have black appearance.
- III. **Coarse aggregate (gravel):** Natural uncrushed gravel is to be used and the specific gravity based on material in the saturated surface dry condition.

- IV. **Water:** water (Soft water) is needed for the chemical process (hydration) in which the cement powder sets and hardens into one solid mass. Water used for experiment is normal and magnetized water.
- V. **Plastic:** There are numerous types of industrial plastic waste. The use of such materials in concrete is economical and helps in reducing disposal concerns. Collection and selection of such waste which is feasible and easily get available. Hence Plastic type of (HDPE) high dense polyethylene can be used, having properties of high density and good strength

Concrete of Mix Design M20 Grade Concrete used in which plastic waste, replaced to sand by it's percentage of weight. plastic waste is replaced by sand for 10%, 20%, 30% and 40% by weight.

Process on Plastic Waste:

1. Collection and segregation.
2. Transportation and storage.
3. Cleaning and sun drying
4. Cutting into flex and Storage.

Test Performed:

Concrete consistency(workability): The consistency of concrete i.e. workability is most frequently measured by the slump test. The slump is a good measure for calculation of total water content in concrete mix. The slump cone test for each group of concrete mixes is to be carried out to check slump.

Compressive strength: All the samples are standard size of cubic specimens having dimension of (150*150*150mm) in accordance with IS, and tested immediately after removing from water for 7 and 28 days, compressive strength of each group of concrete will be carried out according to IS 516-1959 specification.

pH Test: pH test carried out on tap water and magnetic water sample to check the variation in pH value sample of water, occurs due to influence of magnetic field.

Sieve Analysis: Sieve analysis helps to determine the particle size and distribution particle such as coarse aggregate, fine aggregates and also used for separation plastic waste in form of flex. This is done by sieving of material like aggregates and Plastic. Particle size of Plastic used are passing through 4.75 mm and retaining on 2.36mm sieve

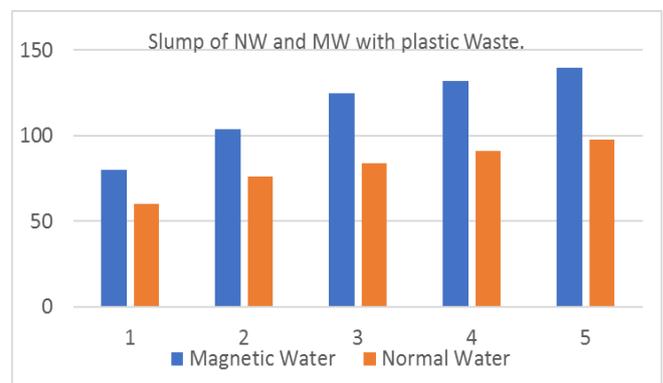
Similarly, TDS (Total dissolve solids) for normal and Magnetic water and Calculation of Intensity of magnetic field using Gauss meter.

5.RESULT AND DISCUSSION

Following results are obtain after performing procedure of experiment and conducting test as per mentioned with aim to achieve Green concrete. As Density directly proportional to weight, but weight of concrete decreases with increase in percentage of Plastic waste content in concrete, which results in decrease in concrete was decreased and workability increases after addition of plastic and use of magnetic water in concrete as per following values.

Table1: Variation of Slump and Weight.

Percentage of Plastic Waste	Workability (in mm) Normal Water	Workability (in mm) Magnetic Water	Weight in kg/m3
0%	60	80	2592
10%	76	104	2307
20%	84	125	2214
30%	91	132	2162
40%	98	140	2085



Graph1: Comparison of Slump for NW and MW.

Similarly, results show that the concrete prepared with MW has a compressive strength higher than that of normal water, for both condition as with plastic waste and without plastic waste, although the same mix proportions were used for all mixes as mentioned above.

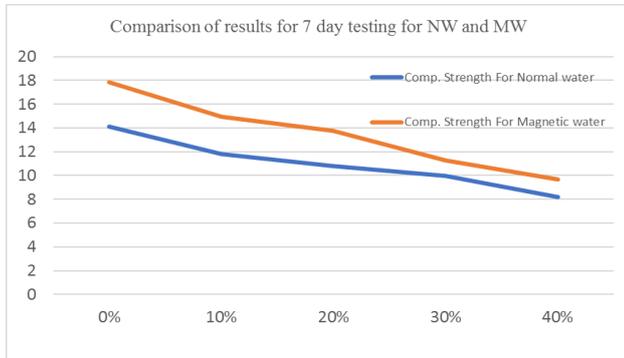
Apart from the increase in compressive strength, the workability (consistency) of fresh concrete also increases significantly in all magnetic mixes specially in mixes, with plastic waste that is prepared with Magnetic water for same curing condition. This means that the consistency of fresh concrete is enhanced by magnetic water for both condition as with plastic waste and without plastic waste.

The concrete cubes, that were prepared (for 0% waste) using MW show that the compressive strength increased up to (25 to 35 %) by using MW as compared to those prepared using ordinary water. Increased compressive strength of concrete by this process leads to an extra effect of saving cement, sand and additives, and useful for dumping plastic waste when MW is used in concrete.

Similarly, the concrete cubes, that were prepared with plastic waste using normal water compressive strength is decreased, while concrete using MW with plastic waste, compressive strength of concrete is more, by this process leads to an extra effect of saving cement, sand and one can use more plastic waste in concrete i.e. up to (25%-30%)

Table2: Percentage variation of result for 7-day testing for NW and MW

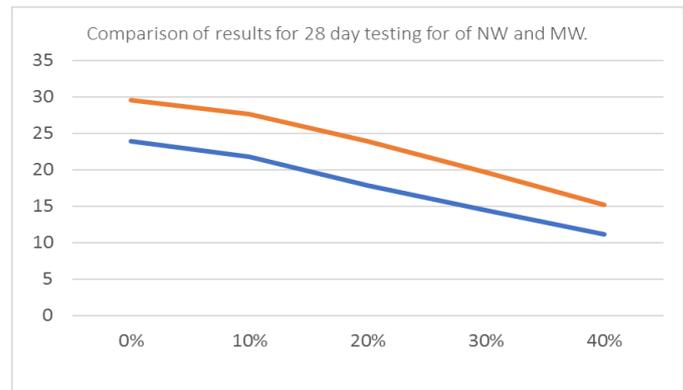
Percentage of Plastic Waste	Percentage increase in compressive strength using MW
0%	26.58
10%	26.25
20%	27.45
30%	13.44
40%	17.84



Graph2: variation of Compressive Strength for 7-day for NW and MW

Table3: Percentage variation of result for 28-day testing for NW and MW

Percentage of plastic waste	Percentage increase in compressive strength using MW
0%	23.50
10%	26.65
20%	33.81
30%	36.51
40%	36.09



Graph3: variation of Compressive Strength for 28-day for NW and MW

6. CONCLUSION

Following conclusions could be drawn Based on the results of the experimental investigation is as follows:

1. In comparison with concrete cast in normal water sufficient increase in compressive strength of concrete is observed when magnetic water is used in casting.
2. Also Change in slump value is increased when concrete with magnetic water and plastic waste.
3. Similarly, changes are observed in Various basic parameter of water, like pH & TDS.
4. After comparing Concrete prepared with normal water and magnetic water we conclude that, Natural sand can be replaced by using concrete with MW and plastic waste can be use up to 20% to 30% to achieve green concrete
5. Similarly, we can dump 10-15% Extra plastic compare to NW using MW. So extra percentage of plastic can be dumped into concrete cast with MW.
6. As percentage of plastic waste increases compressive strength decreases.
7. Similarly, as workability of concrete blended with PW and MW is very high so, one can use super plasticizer to reduce workability.

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