The Comparative Study of Treated Sewage Water on Mechanical Properties of High Performance Concrete M40 with Conventional Concrete

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Abstract. Concrete, the widely used building material in construction industry. Cement is the primary constituent of concrete, during its production releases the large amount of carbon dioxide in the atmosphere creating the serious environmental threats like air pollution. The paper discuss the ways to reduce cement composition as building material, so that the construction industry will be more environment friendly by replacing the cement with fly ash to an extent. Fly ash is waste product in thermal power plants creating disposal problems on landfills. Treated water effluent from STPs are used in the preparation of concrete makes benefits to the environment. The study investigates the water quality tests like Ph, dissolved oxygen, turbidity, COD, BOD, TSS. The Mix proportions was obtained for the preparation of M40 grade concrete and the Destructive (compressive strength) tests and non-Destructive Tests (rebound hammer, ultrasonic pulse velocity test) were conducted and analysed and compared with conventional M40 grade concrete test values for different ages of concrete 7, 14, 28 days.

1. Introduction

Concrete a most important Building material causes a large cement production in the world. Cement produces 2.5 billion tons of CO₂ Causing a huge greenhouse effects over worldwide. Fly-ash is a by-product of thermal power plants which presently creating a serious waste Disposing Problem. This study highlights the application of percentage of fly-ash content in mixing the concrete, which slowly decreases the production of cement to some extent. Fly-ash itself acts as a mineral admixtures and increases the life of concrete, plays a major role in reduction of Energy use, decreases the amount of waste reaching to the landfills. Thus, using fly-ash in the concrete is a eco-friendly. Construction industry, utilizes more amount of water in preparing the concrete, curing, of concrete blocks, curing of walls, using of water to clean the concrete mixer after utilization etc. In present scenario the increasing trend of water scarcity and water deficit in areas over the world leads to the conservation of water. The present study was done in order to reduce the usage of tap water in construction industry, and to reuse the treated Sewage water, the treated water is used in concrete mix. Water, the key ingredient forms a paste when mixes with cement and forms a chemical bond through Hydration Process. The quality of water and amount of water used in concrete preparation plays a major role in the fresh and Hardened Properties
including Workability, Compressive strength, durability, Destructive Properties etc. The water parameters variations like chlorides, iron, alkalinity inorganic salts shows their effects on initial strength, strength achievement, bond between cement paste and aggregate, property of concrete. To improve the properties Admixtures are added to concrete during freshly mixing and to achieve certain effectively. Water consumption for the Building construction of 1000 sq.ft

- 20000sq.m X 1000L/sq.= 20,000,000 L or 20000m³

The demand for water varies with respect to season, with respect to source (either Ground water or tap water). In present Scenario the eventualities from the tanker costs Rs. 300/m³

- 300/m³ X 20000m³ = 60.00 lakhs

2. Methodology

In present study, Concrete cubes was prepared with cement, sand, 20mm aggregates and collected treated water samples. Superplasticizer FOSROC SP 430 to maintain the workability. In the study M 40 grade concrete was selected.

**Table 2.1:** Specific gravity tests was conducted on the materials

| S.No | Material        | Specific Gravity |
|------|----------------|------------------|
| 1    | Cement         | 3.15             |
| 2    | Fine aggregate | 2.7              |
| 3    | Coarse aggregate | 2.7             |

According to the IS 456:2000 (CODE OF PRATICE AND REINFORCED CONCRETE), Materials used in the preparation of concrete,

- Cement : 53 grade
- Flyash : IS 3812
- Coarse aggregate: 20mm passed aggregate IS:383
- Super Plasticizer : FOSROC SP 430

**Table 2.2:** Mix proportioning of the concrete was tabulated

| Materials used       | Volume in Kg/m³ | Proportion |
|----------------------|-----------------|------------|
| Cement + flyash      | 465             | 1          |
| Water                | 186             | 0.4        |
| Fine aggregate       | 684             | 1.47       |
| Coarse Aggregate     | 1160            | 2.494      |

![Fig. 2.1 Workability test](image-url)
The treated water is collected from STP, PATEL CHERVU, NACHARAM, HYDERABAD. 
Sewage treatment plant (STP) is 25 MLD PLANT
The sewage treatment involves mainly the following steps

![Flowchart of Sewage treatment](image)

**Fig. 2.2**: Flowchart of Sewage treatment

### 2.1 Ultra sonic pulse velocity

It is a non-destructive in situ test, to check the quality of the concrete, the strength and quality of concrete is assumed by measuring the velocity of an ultrasonic pulse passing through a concrete structure. From the pulse velocity travelling through the concrete, the length of the cube density of concrete Dynamic modulus of elasticity values can be calculated.

![Ultrasonic Pulse Velocity Test](image)

**Fig 2.1.1** Ultrasonic Pulse Velocity Test
2.2 Rebound hammer
Also known as a Swiss hammer or a rebound hammer or concrete hammer test, the elastic properties or strength of concrete can be measured by this hammer test.

![Rebound Hammer Test](image1)

**Fig 2.2.1** Rebound Hammer Test

2.3 Compressive strength
This gives the capacity of the concrete to withstand loads. It gives all the characteristics of concrete, under the action of compressive forces, the resistance offered by the concrete can be measured.

![Compressive Strength Test](image2)

**Fig 2.3.1** Compressive strength test

2.4 Water quality parameters
The treated water is analysed in the laboratory to determine the various parameters like Alkalinity, pH, chloride, calcium chloride, iron, sulphates, Total dissolved and suspended salts. The water quality for construction plays a major role in the initial strength of concrete, workability of...
the concrete under drying conditions, the salts can rise upon the surface by evaporation process and in extreme conditions causes cracking and scaling. Suspended solids presence creates the turbidity, which reduces the bonding nature between cement paste and aggregate further reduces the strength of concrete considerably. The presence of chloride slats in the mixing shows it effect in long-term on reinforcement of the slab.

![Fig 2.4.1 Water sample](image)

3. Results & discussions:
The concrete cubes of sizes 150X 150X150 mm$^3$ was prepared by the treated water and as well as with normal water has been tested for UPV, Rebound hammer, Compressive Strength and Dynamic Modulus of elasticity.

| S No | Age of Concrete in Days | UPV in km/sec | Rebound hammer result in N/mm$^2$ | Compressive strength in N/mm$^2$ | Dynamic modulus of elasticity in GPa |
|------|-------------------------|---------------|-----------------------------------|----------------------------------|-----------------------------------|
|      |                         | Normal water  | Treated water                     | Normal water                     | Treated water                     | Treated water                     |
| 1    | 7                       | 4.65          | 4.5                               | 38.96                            | 33.86                            | 33.7                              | 30                                | 46.3                             |
| 2    | 14                      | 4.7           | 4.6                               | 40                               | 31                               | 36.3                              | 32.88                             | 47.4                             |
| 3    | 28                      | 4.8           | 4.7                               | 41.25                            | 35.66                            | 42.77                             | 40.77                             | 49.57                            |

Some physical and chemical properties of treated water are evaluated in the laboratory from the tests namely Ph, Alkalinity, chemical oxygen demand, biological oxygen demand, dissolved oxygen, turbidity

Table 3.2: Results of physical and chemical properties of treated water

| S.no | Parameter   | Unit  | Test value |
|------|-------------|-------|------------|
| 1    | pH          | -     | 7.99       |
| 2    | Dissolved oxygen | mg/L | 4.5       |
| 3    | Turbidity   | NTU   | 3.00       |
| 4    | COD         | mg/L  | 30         |
| 5    | BOD         | mg/L  | 7          |
| 6    | chlorides   | mg/L  | 280        |
4. Conclusions
   a. Based on the test results, the slight variations has been observed in the mechanical properties of concrete, when comparison was done between normal concrete and treated water concrete.
   b. The usage of treated water decreases the cost of construction to an extent in a place where tanker water are used in construction.
   c. Both reuse of treated water and utilization of flyash in construction is a eco-friendly method avoiding the dumping problem of waste in landfills and also conserving of fresh water.
   d. The variations was studied for 28 days test results having UPV 2.08%, Rebound hammer test 13.55% and compressive strength 4.67%.
   e. Rebound hammer test value indicates the long-term effects might show on the concrete prepared with treated water.
   f. The presence of chlorides in treated water shows its hardened effect causing the variation in compressive strength percentage

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