# Behavioural Assesment of Concrete Strength due to the use of treated Waste Water

**Sagar C Rode[1] Prof. K. K Tolani[2]**
[1]ME Student [2]PG Co-Coordinator
[1,2]Department of Civil Engineering
[1,2]Late G.N Sapkal College of engineering and research Centre, Anjeneri Nashik, Pune University, Maharashtra

*Abstract*— In construction industry concrete being most widely usable material as per is provision 10262-2009 averagely 150 liter water is required. for 1umsum of concrete also construction Industry water is use for mixing aggregate washing curing of concrete and washing of concrete related mechanical machine the mixing water which fit for drinking for purpose for but about 97 percent of water is held in oceans while only 3 percent fresh water. The ultimate and last option will be treating waste water and using it. But humans have not accepted or will never accept treated waste water for drinking purpose this works aims to explain how treated waste water can be used in construction industry and reduce load on nature. The number of test have to been carried out for evaluation treatment means removing impurities from water being treated and some method of treatment applicable to both water and wastewater. wastewater treatment process are designed to achieve improvement in quality of wastewater the various treatment may reduce suspended solid, biodegradable organic, pathogenic bacteria, nutrients , secondary biological treatment, tertiary treatment, phase separation. The waste water tested in laboratory to find characteristics of PH, TSS, hardness BOD, COD if treated water used in construction industry and lot of fresh water can be saved and awareness can be spread about importance of water recycling. Purpose of this research identify of civil work where this water can be used without compromising structural strength parameter.

***Key words:*** Treated Waste Water, Waste Water Characteristics, Structural Strength

## I. Introduction

In construction industry concrete being most widely construction material used, uses most of water. About 5 billion cubic yards of concrete are used each year; annual production is about two tons per person on the plane. As per provision of IS10262-2009 186 liters water is required for 1m3 of concrete. On an average 150 liters water is required for 1m3 of concrete. The construction of 100,000 sq. ft. multi- stores structure can require about 10 million liters water for production, curing and site development activity. A double lane flyover can consume 70 million liters water on the same scale. Also in construction industry water is used for mixing, aggregate washing, curing of concrete and for washing concrete related mechanical machines.As the precipitation flows over the earth's surface, it collects particles of soil, tree leaves, garbage, pesticides and other human, animal or chemical wastes and also other decayed organic matter. Such water flowing on the surface is called as surface. Nallas, streams and rivers are the form of surface source. Sewage and industrial effluents are often discharged in surface water causing further pollution of water. Water, either from surface or underground source, contains various impurities which change the quality of water.

### A. Impurities inwater

Water, either from surface or underground source, contains number of impurities in varying amounts. Impurities are classified as follows

1) Suspended impurities
2) Colloidal impurities
3) Dissolved impurities.

### B. Wastewater

Wastewater, also written as waste water, is any water that has been adversely affected in quality by anthropogenic influence. Treated wastewater is discharged into receiving water by an effluent pipe. Wastewaters generated in areas without access to centralized sewer systems rely on on-site wastewater systems. These typically comprise a septic tank, drain field, and optionally an on-site treatment unit Sources of Wastewater

1) Storm drains (may include trash)
2) Manmade liquids (illegal disposal of pesticides, used oils, etc.)
3) Industrial waste lubricating and hydraulic oil manufacturing, etc.)
4) Agricultural drainage, direct and diffuse.
5) Hydraulic fracturing
6) Produced water from oil & natural gas production

### C. Waste Water Constituents

1) Water (more than 95 percent), which is often added during flushing to carry waste down drain.
2) Pathogens such as bacteria, viruses, prions and parasitic worms.
3) Non-pathogenic bacteria.
4) Organic particles such as faeces, hairs, food, vomit, paper fibers, plant material, humus, etc.
5) Soluble organic material such as urea, fruit sugars, soluble protein, drugs, pharmaceutical etc.
6) After it has undergone some treatment, the "treated

*1) wastewater" remains, e.g.:*

- Septic tankdischarge
- Sewage treatment plant discharge

### D. Wastewater treatment plants

Wastewater treatment plants may be distinguished by the type of wastewater to be treated, i.e. where it is sewage, industrial wastewater, agricultural wastewater or leachate.

1) Sewage treatment plant
2) Industrial wastewater treatment plants
   - An API oil-water separator, for removing separate phase oil from wastewater.

– System with exchange membranes

3) Agricultural wastewater treatment plants

Agricultural wastewater treatment for continuous confined animal operations like milk and egg production may be performed in plants using mechanized treatment units similar to those described under industrial waste water Leachate treatment plants

### *E. Treatment of water*

The complete process of removal of undesirable matter, in order to make the water acceptable for domestics or industrial us, is commonly termed as treatment of water or purification of water. Since, treatment is a costly affair, various purification units are constructed and maintained by public bodies like municipality, corporation, industrial development boards or government.

### *F. Methods of purification of water*

The various methods or the techniques which may be adopted for purifying the public water supplies are

1) Screening
2) Plain sedimentation
3) Sedimentation aided with coagulation
4) Filtration
5) Disinfection
6) Aeration
7) Softening
8) Miscellaneous treatments, such as fluoridation, re-carbonation liming, desalination, etc.

### *G. Wastewater treatment*

It is a process used to convert wastewater which is water no longer needed or suitable for its most recent use into an effluent that can be either returned to the water cycle with minimal environmental issues or reused. The latter is called water reclamation and implies avoidance of disposal by use of treated wastewater effluent for various purposes.

The various treatment processes may reduce:

1) Suspended solids (physical particles that can clog rivers or channels as they settle under gravity)
2) Biodegradable organics (e.g. BOD) which can serve as “food” for microorganisms in the receiving body.

Primary (mechanical) treatment is designed to remove gross, suspended and floating solids from raw sewage. It includes screening to trap solid objects and sedimentation by gravity to remove suspended solids.

Secondary (biological) treatment removes the dissolved organic matter that escapes primary treatment.

Tertiary treatment is simply additional treatment beyond secondary. Tertiary treatment can remove more than 99 percent of all the impurities from sewage, producing an effluent of almost drinking-water quality.

#### *1) Sedimentation*

Solids and non-polar liquids may be removed from wastewater by gravity when density differences are sufficient to overcome dispersion by turbulence. Gravity of solids is the primary treatment of sewage, where the unit process is called "primary settling tanks"

#### *2) Filtration*

Colloidal suspensions of fine solids may be removed by filtration through fine physical barriers distinguished from coarser screens or sieves by the ability to remove particles smaller than the openings through which the water passes. Other types of water filters remove impurities by chemical or biological processes described below.

#### *3) Oxidation*

Oxidation reduces the biochemical oxygen demand of wastewater, and may reduce the toxicity of some impurities. Secondary treatment converts some impurities to carbon dioxide, water, and bio solids. Chemical oxidation is widely used for disinfection.

#### *4) Chemical oxidation*

Chemical oxidation may remove some persistent organic pollutants and concentrations remaining after biochemical oxidation. Disinfection by chemical oxidation kills bacteria and microbial pathogens by adding ozone, Chlorination of waste water.

#### *5) Polishing*

Polishing refers to treatments made following the above methods. These treatments may also be used independently for some industrial wastewater.

### *H. Effect of water on concrete*

Combining water with a cementations material forms a cement paste by the process of hydration. The cement paste glues the aggregate together, fills voids within it, and allows it to flow more freely. Less water in the cement paste will yield a stronger, more durable concrete;

### *I. Concrete strength*

The first rarely mentioned fundamental assumptions for the strength versus water-cement ratio relationship are discussed; the strength of structural concrete is controlled by the strength of the cement

### *J. Workability*

Workability depends on water content, aggregate (shape and size distribution), cementitious content and age (level of hydration), and can be modified by adding chemical admixtures. Raising the water content or adding chemical admixtures will increase concrete workability. Excessive water will lead to increased bleeding (surface water) and/or segregation of aggregates (when the cement and aggregates start to separate), with the resulting concrete having reduced quality

### *K. Durability*

Durability is a very important concern in using concrete for a given application. Concrete provides good performance through the service life of the structure when concrete is mixed properly and care is taken in curing it. Good concrete can have an infinite life span under the right conditions. Water, although important for concrete hydration and hardening, can also play a role in decreased durability once the structure is built

## II. METHODOLOGIES

Methodology adopted during the dissertation work is shown in flow chart below.

### A. FlowChart:

### B. Materials:

#### 1) Cement

- Used ACC Ordinary Portland cement 53 grade was used.
- Initial setting time of cement shall not be less than 30 minutes and final setting time of cement should not more than 600 minutes as per the IS269-1989.

#### 2) Aggregates

a) Fine aggregates

Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand and crushed Sand is being used as fine aggregate conforming to the requirements of IS: 383.

b) Coarse aggregate

Maximum size of aggregate was selected for this mix design is 20 mm. conforming to IS: 383. Specific gravity of aggregate was 2.61 and water absorption 0.3%.

#### 3) Water

- Tap water were collected from Shirdi and used for mixing and curing as per IS 456:2000.
- Primary treated waste water- remove large size of floating matter like sand, silts particles.
- Secondary treated waste water- removal of suspended solid, organic matter and biodegradable organic waste.

#### 4) Closure

This chapter gives the brief idea about the consideration and terminology made in this project and about how exactly the project work will be carried out i.e. methodology of the project. Next chapter deals with exact experimental program of this study i.e. casting of specimen, curing of specimen, de-molding of specimen, and coloring, marking, transporting then setting up in experimental setup and finally testing of specimen

## III. EXPERIMENTAL PROGRAMS

### A. Importance of pH in water

#### 1) Determination of pH

#### 2) Standards recommended for drinking water

a) Hardness

b) COD &BOD

### B. Test on cement

1) *Consistency of cement*
2) *Initial Setting Time*
3) *Final Setting Time*

### C. Aggregate Tests

1) *Fineness Modulus*
2) *Determination of specific gravity and water Absorption of aggregate (IS 2386P-III-1963)*
3) *Determination of moisture content of aggregate*
4) *Bulk density of fine and coarse aggregate (IS 2386 (Part 3) –1963)*
5) *Aggregate Impact Value*
6) *Aggregate Crushing Value (IS 2386 Part 4 -1963)*

### D. Methodology Adopted For Mix Design

#### 1) General

Mix design is a process of selecting suitable ingredients for concrete and determining their proportions which would produce, as economically as possible, a concrete that satisfies the job requirements.

| | |
|---|---|
| Grade Designation | M 30 |
| Type of Cement | OPC 53 |
| Maximum Size of aggregates | 20 mm |
| Minimum Concrete content | 320 Kg/m2 |
| Maximum Water Cement Ratio | 0.45 |
| Exposure Condition | Severe |
| Method of Concrete Placing | Manual |
| Degree of Supervision | Good |
| Type of Aggregate | Crushed Angular |

Table 4.1: Stipulations for Proportioning

Mix Design Procedure for concrete containing natural sand: M30

#### 1) Step 1: Target Mean Strength

For the degree of quality control specified namely "Good" the value of standard deviation is

$\sigma = 4.0$ N/mm$^2$ (I.S: 10262-2009). Hence the targeted mean strength for the desired

Compressive strength

fck = fck + 1.65xs          s - IS 10262Table1

= 30 + (1.65 x 5.0)

fck=38.25 N/mm$^2$.

#### 2) Step2: Selection of Water Cement Ratio from Table 5 of IS 456 – 2000 Maximum water-cement ratio is 0.45.

#### 3) Step 3: Selection of Water content Size of maximum aggregate =20 mm Maximum volume of water = 186 liters considering (trial): 180 liters

#### 4) Step4: Selection of Cement content Water cement ratio: 0.45 Cement content = 180/0.4 = 400.00 kg/m$^3$ 400.00 kg/m3 > 320 kg/m$^3$ minimum cement content for mild exposure. Therefore OK.

#### 5) Step5: Proportion of Volume of Coarse Aggregate and Fine Aggregate Content From Table 3 volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (Zone1) for water cement ratio of 0.45 = 0.60 As per our experience we considered water cement ratio as 0.45 and for that we made no change in value and no effect of pump able concrete to be provided. Therefore volume of coarse aggregate required = 0.60 Volume of fine aggregate: 1 – 0.60 = 0.40

#### 6) Step6: Mix Calculation

Volume of Concrete =1m3 (a)

Volume of Cement content = Mass/Sp .gravity) x (1/1000)

= (400/3.15) x (1/1000)

=0.12698 m$^3$

….. ……. (b)

Volume of Water = 180 x (1/1000)

=0.180m$^3$ (c)

Volume of Aggregate = [a-(b+c)]

= [1-(0.1328+0.180)]

=0.6872m$^3$

Mass of coarse aggregate

=d x vol$^m$ ofC.Axspecificgravityx1000

= 0.6872 x 0.60 x 2.61 x 1000

= 1076.16 kg
Mass of Fine Aggregates =d vol. ofF.A xspecificgravityx1000
= 0.6872 x 0.40 x 2.71 x 1000
= 744.92 kg

| | Water (Lit.) | Cement (kg/m3) | Fine Aggregate (kg/m3) | Coarse Aggregate (kg/m3) |
|---|---|---|---|---|
| By weight (Kg) | 180 | 400.00 | 744.92 | 1076.16 |
| By volume($m^3$) | 0.45 | 1 | 1.78 | 2.70 |

Table 4.2: Mix Design Values

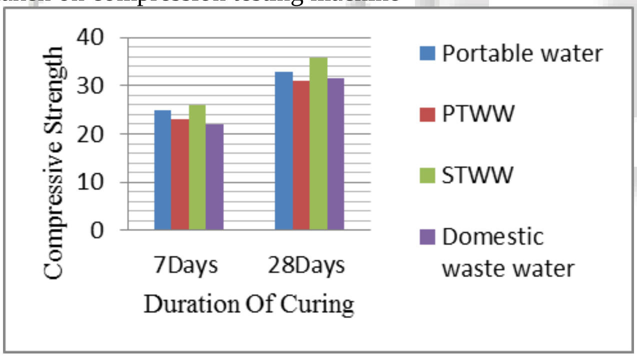
This ratio is obtained by manual design as per IS 10262: 2009

## IV. RESULTS

### *A. Compressive strength of mortar cubes*

Compressive strength of cement was obtained by preparing the mortar cube for the curing of 7 and 28 days. The proportion of material for mortar mixture was one part of ordinary Portland cement to the three parts of standard sand. The water cement ratio was 0.45. The dimensions of mortar cubes were 70 x 70 x 70 mm. The water used for casting was PTWW, STWW, Domestic waste water and Portable water. The mortar was mixed according to IS4031-1988.

The compression test of the concrete cube was taken on compression testing machine




Graph 5.1: Compression Strength of Cement mortar cube

### *B. Workability of concrete*

For PTWW, STWW, Potable water and Domestic water the slump value varied between 90 – 100 mm. Slump of concrete is not affected by adding PTWW, STWW, Domestic water compared to Potable water

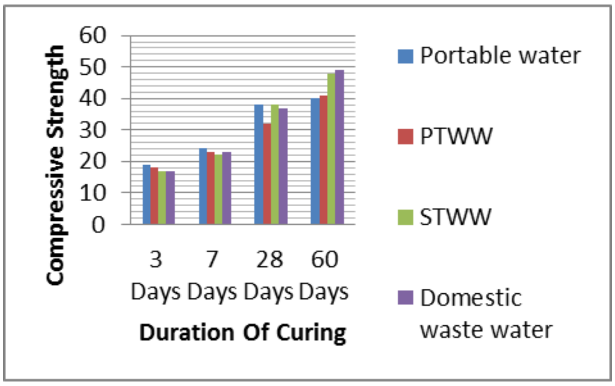
| Type of water | Tap Water | PTWW | STWW | Domestic waste water |
|---|---|---|---|---|
| Value in mm | 140 | 80 | 90 | 87 |

### *C. Compressive strength of concrete*

#### *1) Calculation*

Compressive strength= Max. Load Applied to the Specimen / (N/mm2) Cross-Sectional Area of Specimen.

Table No. 5.2Compressive Strength of Concrete



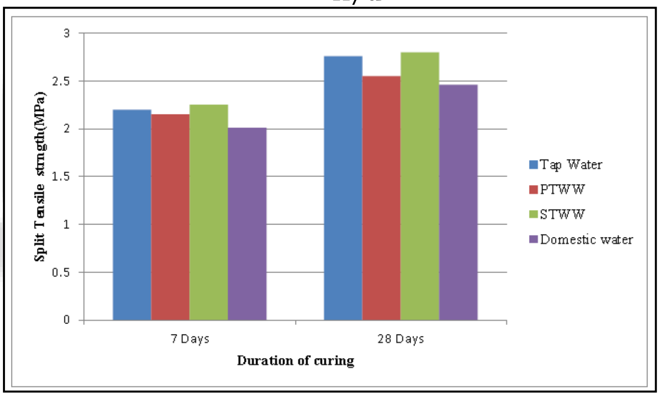

### *D. Splitting Tensile Strength*

Splitting tensile strength tests were performed on cylindrical specimen. Three samples per batch were tested with the average strength values reported in table

The measured splitting tensile strength fc, of the specimen shall be calculated to the nearest 0.05 N/mm2 using the following formula:

Where,
P = maximum load in Newton's applied to the specimen,
I = length of the specimen and
d = cross sectional dimension of the specimen

$$f_{ct} = \frac{2p}{\Pi/d}$$




### *E. Flexural strength*

The flexural strength of the specimen shall be expressed as the modulus of rupture fb, which, if „a" equals the distance between the line of fracture and the nearer support, measured on the Centre line of the tensile side of the specimen, in cm, shall be calculated to the nearest 0.5 kg/sq. cm as follows:

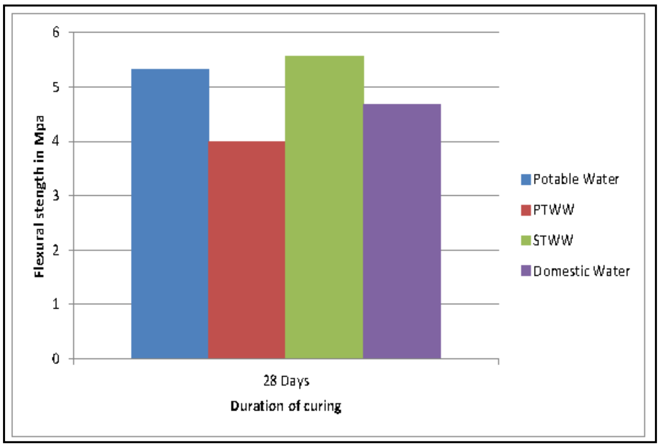
when „a" is greater than 20.0 cm for 15.0 cm specimen, or greater than 13.3 cm for 10.0 cm specimen, or

$$f_b = \frac{3pa}{bd^2}$$

When „a" is less than 20.0 cm but greater than 17.0 cm for 15.0 cm specimen or less than 13.3 cm but greater than 11.0 cm for a 10.0 cm specimen

b = measured width in cm of the specimen,
d = measured depth in cm of the specimen at the point of failure,
l = length in cm of the span on which the specimen was supported, and
p = maximum load in kg applied to the specimen

If „a" is less than 17.0 cm for a 15.0 cm specimen, or less than 11.0 cm for a 10.0 cm specimen, the results of the test shall be discarded.




Graph 5.4: Flexural Strength of concrete

*1) Flexural strength test for reinforced concrete beam*

As per the IS guide line the use of reinforcement of 4 No's of 8 mm dia. and 6 mm bar of 150 mm c/c spacing in beam of size 150mm x 150 mm x 1000 mm and cured for 28 days.

$$\mathbf{Fb = \frac{pl}{bd^2}}$$

| Sr. No | Water | Specimen Size (mm) | Strength at 28 Days N/mm$^2$ |
|---|---|---|---|
| 1 | Portable Water | 150x150x1000 | 12.25 |
| 2 | PTWW | 150x150x1000 | 11.45 |
| 3 | STWW | 150x150x1000 | 12.20 |
| 4 | Domestic Waste Water | 150x150x1000 | 11.60 |

*2) Discussion on Results*

1) From the above results the STWW given less strength compare to the portable water.
2) The PTWW shown the slightly less strength compare to the Domestic wastewater
3) The as per the above results the reinforcement carrying a better results than the plane concrete but not suitable because need to study on corrosion of reinforcement.

## V. CONCLUSIONS

- From this experiment we conclude that STWW contains less impurities and is fit as per IS provision.
- The consistency, initial and final setting time of cement paste by mixing STWW is within the IS limit.
- There is no any significant difference in tensile strength and flexural strength is improved by using STWW.
- There is no much more difference in the reinforced concrete beam but need to study the corrosion of reinforcement

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