

UTILIZATION OF EFFLUENT WATER IN CONCRETE BY INVESTIGATING THEIR DURABILITY PROPERTIES

¹ R.Mohanapriya, ² E.Nikashini, ³ S.Prema

1.Assistant Professor, Civil Department , Nandha College Of Technology, Erode , TamilNadu, monacivil.92@gmail.com

2.Assistant Professor, Civil Department , Nandha College Of Technology, Erode , TamilNadu nikashiniieswaramoorthy@gmail.com

3.Assistant Professor, Civil Department , Nandha College Of Technology, Erode , TamilNadu, spremacivil@gmail.com

Abstract — This paper deals with study of possible utilization of textile water in concrete by analyzing their durability properties. An attempt was made to use the waste water from textile dyeing industry for construction purpose, so that the shortage in water can be greatly reduced and the waste water can be suitably disposed for safe guarding the environment. The basic properties of different stages of effluent such as raw effluent, anaerobic process outlet, and tertiary treated outlet, reverse osmosis feed effluent from the textile industry were tested and the results were found to be satisfactory such that it can be used for construction purposes. By using the four stages of treated effluent, concrete specimens were casted and tested for its mechanical properties (compressive strength and tensile strength) and the results were found to be optimum for anaerobic and tertiary treated outlet. Hence the study was planned to continue for durability properties (Acid attack-sulphuric acid and hydrochloric acid) of specimens using anaerobic and tertiary effluent.

Keywords- Concrete, raw effluent, anaerobic effluent, tertiary treated outlet.

1. INTRODUCTION

Due to urbanization and expanding economic activities, about 13% of the world's population do not have access to safe drinking water. With current trend of water demand, water shortage will become even more intense and approximately, half of the world's population will suffer from major water scarcity by the year 2030 said by UNESCO. Industrial sector, contributes about 20% of the national income. Textile industry contributes nearly 14% of the total industrial production in India. There are about 10,000 garment manufactures and 2100 bleaching and

dyeing industries in India. Textile waste water includes a large variety of dyes and chemical additions that pose an environmental challenge for textile industry not only as liquid waste but also due to its chemical composition. The shifting of irrigation water to fulfil the need of industrial use as well as water quality and lowering of water table around. The surface as well as ground water quality induces environmental degradation over long period of time because of discharge of highly contaminated effluent accelerated by over exploitation of existing water resources. The world bank estimates that 17 to 20 percent of industrial water pollution comes from textile dyeing and finishing treatment given to fabric majority are concentrated at Tirupur and Karur in Tamil Nadu, Ludiyana in Punjab and Surat in Gujarat. In recent decades, major research project are undergone to develop the utilisation of industrial waste into useful one. An attempt was made to the use the waste water from textile dyeing industry for construction purpose, so that the shortage in water can be greatly reduced and the waste water can be suitably disposed for safe guarding the environment and on the other hand the use of alternatives pozzolonic material like flyash in concrete production may greatly reduce the disposal and minimises the usage of cement.

ASTM C 1602/C 1602M-06 (2006) outlined the requirements of non potable water to be used as mixing water in concrete. The compressive strength of concrete made with non potable water should not be less than 90% of the compressive strength of control mix and the deviation in the time of set of concrete should be 1.00 hours to 1.30 hours. The objective of this study is to finding out the feasibility of using textile water in concrete. This paper describe about the mechanical properties of concrete made with anaerobic and tertiary treated water and methodology for durability tests.

2. MATERIALS

2.1 Cement

Cement is a water-based binder used to bind other building materials together. The ordinary Portland cement (OPC) of 53 grade was used for the study. The properties of cement are given in Table 1

Table 1: Properties of cement

Properties	Observed values
Specific gravity	3.15
Consistency	35%
Initial setting time	90 mins
Final setting time	225 mins

2.2 Fly Ash

Fly ash, also known as flue-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases Class F fly ash was used for 30% replacement of cement The properties of fly ash are given in table 2

Table 2: Properties of fly ash

Properties	Observed values
Consistency	33%
Initial setting time	40 mins
Final setting time	235 mins

2.3 Fine Aggregate

Good quality river sand was used as a fine aggregate. The properties are conducted as per BIS 2386-1963 and are presented in Table 3.

Table 3: Properties of fine aggregate

Properties	Observed values
Specific gravity	2.69
Zone	III
Fineness Modulus	3.2
Moisture content	0.02%

2.4 Coarse Aggregate

Good quality crushed aggregate of 20mm was used in the experimental study. The properties are given in table 4.

Table 4: Properties of fine aggregate

Properties	Observed values
Specific gravity	2.62

Impact value	21%
Moisture content	Nil

2.5 Water

Effluent samples such as two stages Anaerobic and Tertiary treated outlet were taken from textile dyeing industry in karur. And also potable water from tap was used for experimental study.

3. EXPERIMENTAL STUDY

3.1 Cement paste

Cement pastes were made to study the consistency, setting time for the various water samples taken. Consistency and setting time is essential for proper concrete. Setting time was followed after the consistency tests with 3 sample of water including potable water. The test were conducted in the accordance with the IS codes 12269-1987(clause 4) 4031(Part 4)-1988, 4031 (Part5) -1988.

3.2 Formulation of concrete

Concrete specimens were prepared to study the mechanical properties of concrete such as compressive strength. To the mix design arrived, the quantities per m³ of concrete were given below in Table 4.

Table 5: Mix proportion

Cement Kg/m ³	Fine aggregate kg/m ³	Coarse aggregate kg/m ³	Water kg/m ³
425	630	1139	191

Table 6: Mix proportion (30% fly ash replacement)

Cement kg/m ³	Fly Ash kg/m ³	Fine aggregate kg/m ³	Coarse aggregate kg/m ³	Water kg/m ³
298	127	616	1115	191

Concrete cubes were casted for three water samples (Anaerobic, tertiary and potable water) Nine specimens for fly ash and nine specimen for conventional were casted to conduct the compressive strength for 28 days. Further, 108 concrete cubes were prepared for testing durability properties such as Sulfuric acid and Hydrochloric acid for 30, 60 and 90 days.

4. RESULT AND DISCUSSION

4.1 Compressive Strength

Table 6 and 7 shows about the compressive strength of concrete made with two stages of textile water and potable water. Compressive strength was tested after 28 days of curing in water. AOW shows good strength compared to potable water both with flyash and without flyash concrete.

Table 7 Compressive strength of concrete cubes without fly ash

Water	28 days strength in N/mm ²
PW	43.6
AOW	45
TCW	36.4

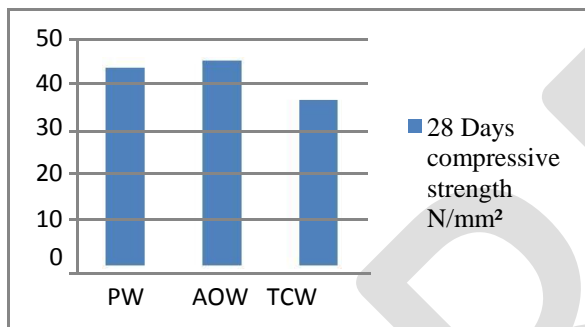


Chart 1- Compressive strength of concrete cubes

Table 8 Compressive strength of concrete cubes with fly ash

Water	28 days strength in N/mm ²
PW	32.8
AOW	38.8
TCW	31.5

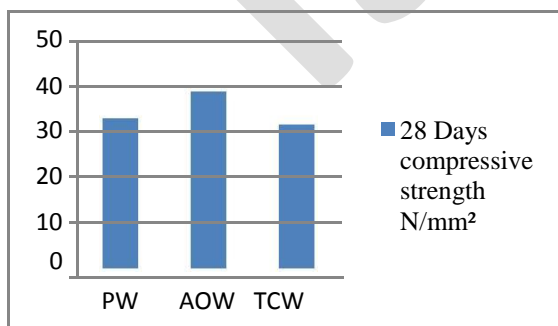


Chart2- Compressive strength of concrete cubes

4.2 Behavior of concrete in acid medium

4.2.1 Sulfuric Acid

Table 8 and 9 shows about the weight loss and compressive strength of concrete cubes with and without fly ash after 28 days of normal curing followed by 1% sulfuric acid curing with pH of 1.7 for 28 days.

Table 9 Loss of weight and compressive strength of concrete cubes without fly ash

Water	% Weight loss	% compressive strength loss
PW	1.2	5
AOW	3.2	6.5
TCW	1.3	4.55

Table 10 Loss of weight and compressive strength of concrete cubes with fly ash

Water	% Weight loss	% compressive strength loss
PW	4.6	3.9
AOW	1.5	5.9
TCW	1	3.8

4.2.2 Hydrochloric acid

Table 10 and 11 shows about the weight loss and compressive strength of concrete cubes with and without fly ash after 28 days of normal curing followed by 1% Hydrochloric acid curing with 1.11pH for 28 days.

Table 11 Loss of weight and compressive strength of concrete cubes without fly ash

Water	% Weight loss	% compressive strength loss
PW	1.7	8.25
AOW	1.72	6.5
TCW	4.7	5.55

Table 12 Loss of weight and compressive strength of concrete cubes with fly ash

Water	% Weight loss	% compressive strength loss
PW	2.9	3.9
AOW	3	5.9
TCW	3.6	4.76

5. CONCLUSION

This study shows the possible utilization of textile water in making concrete cubes with good and equivalent strength of concrete cubes made with potable water.

Compressive strength of concrete cubes made with AOW and TCW was good and equivalent to potable water.

The behavior of acid attack on concrete cubes made with TCW was less compare to the potable water.

A fly ash concrete cube shows better results than the normal cubes in compressive strength after acid curing.

Further durability studies are needed and planned to know the durability properties in detail.

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