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EXPERIMENTAL INVESTIGATION ON USAGE OF GREY WATER IN CONCRETE PRODUCTION

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Abstract - ***An experimental study has been carried out to study the workability and strength behavior of concrete made using grey water and conventional concrete both in fresh and hardened states. To conduct the study, treated water from a treatment plant at two different stages of treatment has been collected and its effect on workability and strength of a mix M20 was studied. Workability was checked by slump and compaction factor method for each set of preparation of the samples. Strength behavior was studied with reference to compression strength, split tensile strength and flexural strength of the concrete specimens by destructive methods. The result confirms that the use of secondary treated water will not alter fresh and hardened properties of the concrete significantly when compared with that prepared with potable water. The study also concludes that there may be possibilities of corrosion of reinforcement due to the organic and inorganic impurities present in the grey water. Hence concrete made using grey water is suitable for plain concrete.***

Key Words: *Grey Water, Manufactured sand*

1. INTRODUCTION

The need of a sustainably developed and environmental friendly concrete industry is aggravated by population growth and scarcity of water. Shortage of water is perhaps the most critical environmental problem in several countries. The concrete industry alone uses over one trillion gallons of watereach year worldwide, not including wash water and curing water. There is a growing trend of considering water reuse as an essential component of water resources management and sustainable development, not only in dry and water deficient areas but in water abundant regions as well. Therefore it is essential to conduct research on substitution of potable water by recycled water partially or totally to produce concrete.

This study has been carried out to study the properties of concrete both in fresh and hardened state prepared using grey water. The concrete properties studied here are workability, compressive strength, split tensile strength, flexural strength. The test results were compared with the results of concrete made using potable water. Treated water from both primary and secondary treatment plant was used for preparation of concrete.

2. LITERATURE SURVEY

Several research works have been carried out on beneficial use of treated water in concrete production.

K.J.Kucche etal reviewed the literature related to quality of water for making concrete. The study concluded that the use of impure water for concrete mixing is seen to favorable for strength development at early ages and reduction in long term strength.

Marcia Silva and Tarun R.Naik Studied the effect of usage of sewage treated water in preparing mortar.The study revealed that significant difference do not exixt between mortar cube made of potable water versus sewage treatment plant water.

G.L.Low .etal studied the behaviour and usage limit of recycled cement based slurry water for concrete making. The study concluded that concrete producedwith slurry water was able to meet the performace criteria in terms of compressive strength, setting time and drying

shrinkage when specific gravity of the slurry water used was less than 1.03

Leigh M.Mcharthy submitted a thesis titled "Analysis of alternative water sources for the manufacture of concrete".The report concluded that even a simplest purifying process provides water suitable for manufacture of concrete from wash out water. These results were compared to a series of alternative water sources. Thewater sources included treated effluent, sea water and dam water and were subjected to same testing parameters as the reference. Analysis of these results found that despite having higher levels of organic and inorganic properties, the water from these sources was found suitable for manufacture of plain concrete.

An Australian Laboratory called "Cement concrete aggregates-Australia" submitted a report entitled "Effect of wash water and underground water on properties of concrete". The report presented current information on the quality of concrete mixing water in terms of mandatory limits and guidelines on impurities, as well as permissible performance variations stipulated in leading National and International Standards.

3. METHODOLOGY

The constituent materials used for this study include namely Ordinary Portland Cement, Manufactured sand, coarse aggregates and water from two different treament plants and potable water.

The table below (**Table.1**) gives the characteristics of treated water (data obtained from treatment plant) used for concrete production.

TABLE 1

Parameter	Primary treated water	Secondary treated water
Turbidity	140 ntu	90ntu
BOD	410 mg/l	235 mg/l
COD	>75 mg/l	60mg/l
Chloride	180 mg/l	1 mg/l
Sulphate	220mg/l	216 mg/l
Alkalinity	340 mg/l	200mg/l
DO	22mg/l	42mg/l
pH	7.2	7.75
Colour	Greenish	Colourless

Various tests conducted on materials include

- Standard consistency, initial setting time, final setting time, Specific gravity of cement.
- Water absorption, specificgravity, Abrasion test, impact test on aggregates

4. DESIGN OF CONCRETE MIX

A M20 mix was designed in the laboratory as per IS method of mix design (IS 10262) assuming a good quality control with mild exposure for designing a mix. Based on the material properties of the ingredients the following mix proportion (SP-23, 1982) was arrived.

Cement: Fine Aggregate: Coarse aggregate: Water = 1: 2.889: 4.447: 0.60

Quantity of ingredients per m^3 of concrete:

Cement: Fine Aggregate: coarse aggregate: Water= 320kg: 924kg: 1423kg: 191kg

Various tests on concrete were conducted to determine fresh and hardened properties using treated water and potable water. The tests include slump test, compressive strength test, Flexural strength test, Split tensile strength test. Comparison of the test results was made to understand the effect of treated water in concrete.

5. RESULTS AND DISCUSSIONS

The following test results were obtained.

Fresh properties

- **Slump Test**

Type of concrete	Concrete Made using potable water	Concrete Made using Primary treated water	Concrete Made using Secondary treated water
Slump Value	120 mm	85 mm	110 mm

Hardened properties

A) Compressive strength

Type of concrete	7 Day strength	14 Day Strength	28 Day Strength
Concrete Made using Potable water	24.54 N/mm^2	31.2 N/mm^2	32.6 N/mm^2
Concrete Made using Primary treated	21.31 N/mm^2	30.29 N/mm^2	31.44 N/mm^2

water			
Concrete Made using secondary treated water	23.64 N/mm^2	30.84N/mm^2	31.64N/mm^2

B) Flexural strength

Type of concrete	**7 Day strength**	**14 Day Strength**	**28 Day Strength**
Concrete Made using Potable water	6.79 N/mm^2	7.15 N/mm^2	7.6 N/mm^2
Concrete Made using Primary treated water	6.39 N/mm^2	6.6 N/mm^2	6.95 N/mm^2
Concrete Made using secondary treated water	6.4 N/mm^2	7.05N/mm^2	7.1N/mm^2

C) Split Tensile Strength

Type of concrete	**7 Day strength**	**14 Day Strength**	**28 Day Strength**
Concrete Made using Potable water	2.45 N/mm^2	3.3 N/mm^2	3.4 N/mm^2
Concrete Made using Primary treated water	2.23 N/mm^2	2.9 N/mm^2	3.12 N/mm^2
Concrete Made using secondary treated water	2.4N/mm^2	3.1N/mm^2	3.3N/mm^2

6. CONCLUSION

- There is a decrease in the workability of concrete using primary treated water whereas secondary treated water gave better workability to concrete.
- There is no significant diffrence in the compressive strength value of concrete made using primary treatedwater, secondary treated awter and potable water.
- The tensile strength of concrete made using sewage treated water was found to be lesser compared to that of potable water.
- Considerable construction cost can be reduced by utilizing the treated water for plain cement concrete.

7. OUTCOME

- Concrete made using sewage treated water showed good fresh and hardened properties. Hence its usage can be beneficial for the concrete industry in terms of cost saving.
- Usage of sewagetreated water is most suitable for sustainable development. Potable water can be saved to a great extent.
- Concrete made using sewage treated water is more suitable for plain concrete as there are possibility of corrosion of reinforcement due to the organic and inorganic impurities present in the sewagetreated water.
- Further research on usage of sewage treated water for production of reinforced cement concrete can be carried out by studying the corrosion of reinforcement.

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REFERENCES

[1]K.J.Kucche,Dr.S.S.Jamkar,Dr.P.A.Sadgir "Quality of water for making concrete: A review of Literature" , *International Journal of Scientific and research publications*. (2015),

[2]Marcia Silva and Tarun R.Naik ,"Sustainable use of resources-Recycling of Sewage treatment plant water in concrete", *Second international conference on sustainable construction materials and Technologies,* (2010)

[3]G.L.Low,K.Y.Ng,W.L.Ng,C.T.Tam,R.B.W.Heng, " Use of Recycled cement based slurry water for making concrete", *Journal of The Institution of Engineers, Malaysia,* (2007),

[4]Rickert.J and Grube.H, "Influence of recycled water from fresh concrete recycling systems on the properties of fresh and hardened concrete", *VDZ, Concrete Technology Reports.Dusseldorf, Germany.* (2003)

[5]Chini.S.A and Mbwambo.W.J "Environmentally friendly solutions for the disposal of concrete wash water from ready mix concrete operations", in *Proceedings of CIB W89 Beijing International Conference,* (1996)

[6]Cebeci.O.Z & Saatci.A.M, "Domestic sewage as mixing water in concrete", *ACI Materials Journal, 86(5):503-5066*