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RESEARCH ARTICLE

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FEASIBILITY OF USE OF WASTEWATER IN REINFORCED CEMENT CONCRETE-A SUSTAINABLE APPROACH

CHETAN S. CHAVAN[1], PRATIK D. MORE[2], AKSHAY R. PARDESHI[2], AJIT K. KAKADE[2], ABHAY K. KAKADE[2], PRITAM P. PAWAR[2]

[1]Assistant Professor, Department of Civil Engineering, JSPM's, ICOER, Wagholi, Pune.
[2]Graduate Students, Department of Civil Engineering, JSPM's, ICOER, Wagholi, Pune.

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ABSTRACT

With the current water crises in India there is a need as well as opportunities to look for alternative sources of water and its management in construction industry. This research aims at finding out the feasibility of wastewater to use in Reinforced Cement Concrete and finding out increase in rate of corrosion of steel by standard Open Circuit Potential (OCP) measurement and chemical analysis of steel and concrete with increasing age. From this study we found that strength of the Plain Cement Concrete reduces with the use of treated wastewater as compared to Normal Water and the accelerated rate of corrosion increases due to use of wastewater in Reinforced Cement Concrete.

Keywords: Chemical Analysis, Corrosion, Open Circuit Potential, Reinforced Cement Concrete, Wastewater

I. INTRODUCTION

Water in India is primarily a state subject. Water is the main part of our life. It is a fact that if water is used there will be waste. So the waste water generation will never stop. Hence, the ultimate and last option will be treating the waste water and using it. But the humans have not accepted or will never accept the treated waste water for drinking purpose. Therefore, increasing the awareness of use of wastewater in the Reinforced Cement Concrete is necessary which will ultimately prevent the scarcely available potable water.

So we can use this treated waste water in the construction industry where the large amount of share of water is used and save the freshwater. In construction industry concrete being the most widely used construction material, uses most of the water. This fresh potable water used in concrete can be replaced with wastewater. The use of wastewater in Reinforced Cement Concrete will develop some issues regarding corrosion of steel. As per provision of IS 10262-2009, 186 liters of water is required for 1m3 of concrete. On an average 150 liters of water is required for 1m3 of concrete. Approximately 3.76 billion cubic meter of concrete are used each year which results in large consumption of potable water being used for concreting which can be saved if, we use wastewater for concrete production. Previous research in this area shows that use of wastewater in Plain Cement Concrete has decreased its compressive strength but no experimental investigation has been done on the effect of wastewater on corrosion of steel. This paper gives

fair idea about the research to be conducted in this field and associated work to be performed.

II. METHODOLOGY

An experimental investigation is to be carried out to evaluate the feasibility of wastewater in Reinforced Cement Concrete. For the purpose specimen of Reinforced cement concrete beam is casted with the use of Normal Water-NW (Potable), Untreated waste water - UTWW (After Screening Process) and Primary Treated waste water - PTWW (After Coagulation Process) obtained from sewage Treatment Plant located in Mundhwa, Pune. Casting of beam specimen is done at the RMC plant of J.Kumar infrastructure ltd. situated near Hadapsar, Pune under the Guidance of RMC head Mr.Yusuf Inamdar. Chemical analysis on Concrete and Steel is being carried out at Durocrete material testing Lab on Sinhgad road, Pune.

III. EXPERIMENTAL WORK

A. Consistency of cement, Initial and Final setting time of cement:

Consistency of cement paste is found using Vi-cat apparatus. The procedure used to perform this experiment is followed by IS 4031(Part 4) after finding out Consistency of cement paste, Initial and Final setting time of cement paste is found.

B. Compressive strength of Cement:

Compressive strength of cement is obtained by preparing mortar cube of 53 grade to be cured for 28 days. The water used for casting was NW, UTWW and PTWW. The mortar is mixed according to the IS 4031:1988 and compressive strength test is carried out.

C. Casting of Beam Specimen:

A standard beam specimen of size 0.15 m x 0.15 m x 0.7 m are casted of commercial grade M-35 with steel reinforcement as shown in Fig 3 and 4. Eighteen numbers of beam specimen are casted, Six each with NW, UTWW, PTWW to be tested at 28 days interval.

D. Open Circuit Potential (OCP) measurement:

The tendency of any material to react with an environment is indicated by the potential it develops in contact with the environment. In reinforced concrete structures, concrete acts as an electrolyte and the reinforcement will develop a potential depending on the concrete environment, which may vary from place to place. The schematic diagram for Open Circuit Potential measurement is as shown in Fig 1.

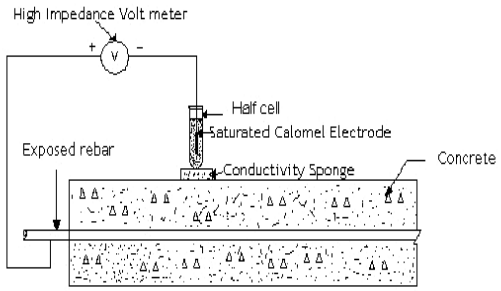

Fig.1Schematic representation for open circuit potential (OCP) measurement

The principle involved in this technique is essentially measurement of corrosion potential of rebar with respect to a standard reference electrode, such as saturated calomel electrode (SCE), copper/copper sulfate electrode (CSE), silver/ silver chloride electrode etc. As per ASTM C- 876 [6] standards which are shown in Table 1.

Table 1Standard OCP Values for various corrosion conditions

Open Circuit Potential (OCP) Values		Corrosion Condition
mV vs SCE	mV vs CSE	
< -426	< -500	Severe Corrosion
< -276	< -350	High (<90% risk of corrosion)
-126 to -275	-350 to -200	Intermediate corrosion risk
> -125	> -200	Low (10% risk of corrosion

Fig. 2 Casted specimen of beams with reinforcement

IV. RESULTS AND DISCUSSION

Table 2 Result of Consistency of Cement

Sample Type	Percentage
NW	28%
UTWW	30.50%
PTWW	28.75%

Table 3 Results of initial and final setting time of cement

Sample Type	Initial setting time (min.)	Final setting time (min.)
NW	102	330
UTWW	118	347
PTWW	108	335

Table 4 Compressive strength of cement

Sample	Comp. strength of cement
NW	53.49
UTWW	50.63
PTWW	52.09

Table 5 Results of OCP test

Sample	BC	28 days	56 days	84 Days
NW	-9	-11	-15	-17
UTWW	-78	-96	-109	-121
PTWW	-54	-63	-63	-98

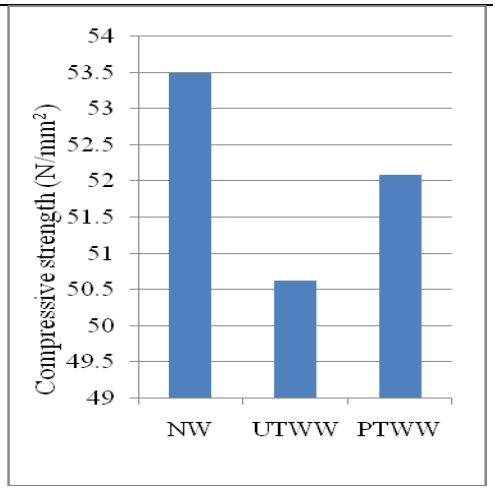

Chart No.1 Comp. Str. of Cement

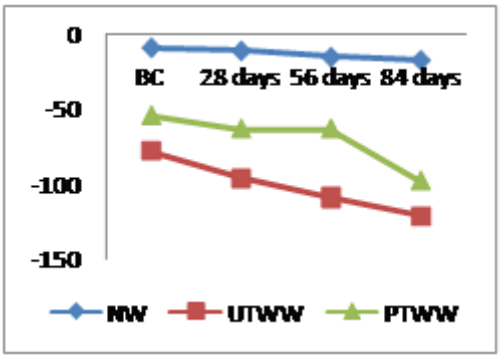

Chart 2 OCP test

V. CONCLUSION

From the most of the Research paper referred it can be seen that strength of the Plain Cement Concrete reduces with the use of wastewater as compared to Normal Water.

This study aims at increasing the awareness of use of wastewater in the Reinforced Cement Concrete which ultimately prevent the scarcely available potable water. At the end of this study we will find the accelerated rate of corrosion which will increase due to use of wastewater in Reinforced Cement Concrete. Further extension of study will be to find remedial measure to decrease the rate of corrosion to acceptable limits.

VI. ACKNOWLEDGMENT

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