A Study on Compressive Strength of Concrete Using Treated Domestic Waste Water

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Abstract— In the present day there is a scarcity of fresh water and construction activities are increasing day by day consuming huge quantity of fresh water. Therefore research is going on to use treated domestic waste water in the preparation of concrete. The concrete specimens prepared with M20 and M40 grade concrete. The concrete specimens cast by using 0%, 50%, and 100% treated domestic waste water and cured in treated domestic waste water for 7days 14days and 28days. Increase in compressive strength from 7 days to 14days for all the 4 mixes is marginal for both the grades of concrete i.e. M20 and M40. At 28days curing age decrease in compressive strength was observed from mix M1 to M4 expect mix M2. This decrease in compressive strength may be due the use of treated domestic waste water for mixing and curing. Lowest strength is exhibited by Mix M4 i.e. 28.77Mpa however this strength is higher than the target mean strength of 26.4Mpa.The excess quantity of bicarbonates in treated domestic waste water as mixing water results decrease in compressive strength concrete specimens.

Key words: Cement, Fine aggregate, Coarse aggregate, Treated domestic waste water cement concrete

I. INTRODUCTION

The most widely used construction material is concrete, commonly made by mixing portland cement with sand, crushed rock and water. Normal concrete contains about 70 percent aggregate, 20 percent cement and 10 percent mixing water by mass approximately. Concrete industry is consuming annually 1 billion tons of mixing water in the world. Moreover large quantity of fresh water is used for curing of concrete. The concrete industry has therefore serious impact on the environment with regard to consumption of water. Therefore there is a need to study alternative to fresh water for mixing and curing of the concrete, so number of researches are in progress to utilize waste water for mixing and curing of the concrete. Impurities in water used for mixing concrete, when excessive, may affect not only the concrete strength but also setting time and may cause efflorescence staining .Therefore, certain optional limits may be set on chlorides, sulfates, alkalis, and solids in mixing water or appropriate tests can be performed to determine the effects that impurity can have on various properties.

II. LITERATURE REVIEW

A. Materials:

Vasavadatta cement Opc 43 grade confirming to IS 12262-1987 [9] was procured from single source with specific gravity of 3.13. Super plasticizer in the present investigation is Fosroc conplast SP 430 was used. Locally available fine aggregate belonging to zone-II of specific gravity 2.79 was used. The maximum size of the coarse aggregate was limited to 20mm and 12.5mm to get the maximum increase in compressive strength with a specific gravity of 2.8 and 2.76 respectively. The treated domestic waste water is collected from kotnoor water treatment plant which is designed to receive 27MLD.

B. Properties of Fresh Concrete:

1) Workability:

According to Ibrahim Al-ghusain and mohammad J. Terro (Kuwait), the type of mixing water did not affect the slump in the testing. This is not unexpected since slump should be affected by water content and not water quality (naville 1981). Slump values varied between 70 to 80mm for the four types of concrete tested.

According to Mohammad Shekarchi, mahdi yazdian and naser mehrdadi (Iran), the results indicate that treated waste water slightly decreases the slump value and the presence of dissolved solids lowers this parameter of fresh water. However , the air void contents remain constant in using treated waste water as mixing water.

2) Initial And Final Setting Setting Time:

According to Ibrahim Al-ghusain and mohammad J. Terro (Kuwait), minor variations is observed between the initial setting times for the different types of concrete. Ammonium salts have been reported to cause bleeding action.From the literature the dissolved organic matter in the mixing water (constituents of COD) retard the final setting time (Naville 1981). Cebeci and saatci (1989) also reported retardation in the setting time when untreated waste water was used for mixing the concrete.

According to Mohammad Shekarchi, mahdi yazdian and naser mehrdadi (Iran), the salts dissolved in water can affect the time of setting. ASTM C94 requires the time of setting of cement made with the questionable water supplies to be not more than 60 minutes earlier (initial setting time) and not more than 90minutes later (final setting time). According to Mohammad Shekarchi, mahdi yazdian and naser mehrdadi (Iran), the treated waste water slightly decreases the slump value and the presence of dissolved solids lowers this parameter of fresh water. However, air void contents remain constant in using treated waste water as mixing water.

III. EXPERIMENTAL PROGRAM

A. Mix Design;

In order to study the effect of treated domestic waste water on the fresh and hardened state properties of concrete. two grades of concrete i.e. M20 and M40 were selected for the study. M40 grade of concrete was selected to study the effect of treated domestic waste water on lower water-cement ratio. Mix design was carried out as per IS10262-2009 for M20 and M40 grade concrete.

B. Casting:

The concrete cubes were cast according to the mix proportions. For M20 grade concrete three different combination of concrete mixing were carried out as given below.

- Specimens cast using 100% laboratory tap water
- Specimens cast using 50% laboratory tap water, 50% treated domestic waste water.
- Specimens were cast using 100% treated domestic waste water.

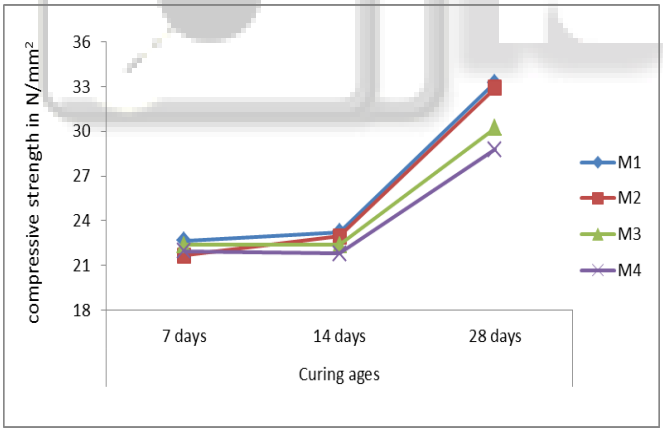
C. Curing:

Curing is done by immersing the specimens in curing ponds of laboratory tap water and treated domestic waste water under regular supervision. For each of these above three mixes, three curing ages were selected i.e. 7days, 14days, & 28days and two types of curing water were used.

(1) Specimens cast using 100% laboratory tap water, and cured under laboratory tap water (Mix M1).
(2) Specimens cast using 100% laboratory tap water, and cured under treated domestic waste water (Mix M2).
(3) Three specimens cast using 50% laboratory tap water, 50% treated domestic waste water and cured under treated domestic waste water (Mix M3)
(4) Three specimens were cast using 100% treated domestic waste water and cured under treated domestic waste water (Mix M4)

Similarly for M40 grade concrete specimens designated as M5, M6, M7 and M8 respectively.

IV. Discussion of Results

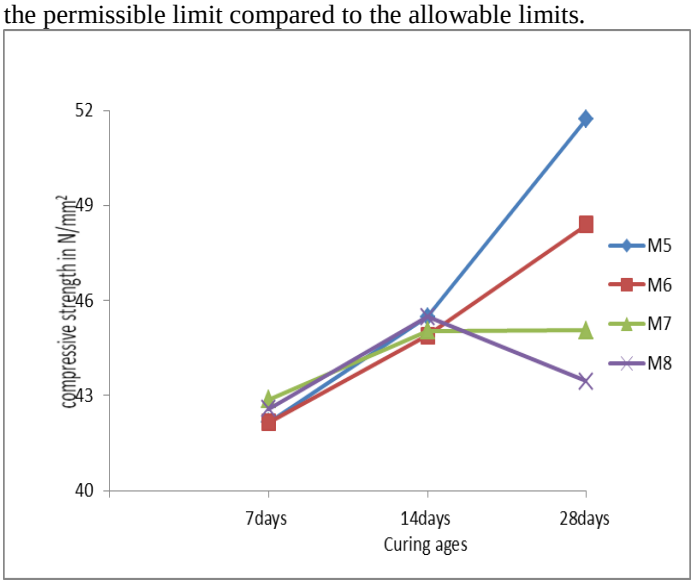


It is observed from the above fig that, 7 days compressive strength for all the 4 mixes is nearly same. At the age of 14days marginal increase in strength is observed in case of mix M1 & M2 but in case of mix M3 & M4 compressive strength remains same as that of 7days.

Increase in compressive strength is observed at the age of 28days for all the 4 mixes. All the 4mixes have resulted in compressive strength higher than the target mean strength.

At 28days curing age decrease in compressive strength was observed from mix M1 to M4. This decrease in compressive strength may be due the use of treated domestic waste water for mixing and curing.

A decrease in compressive strength of 1.11%, 9.19%, and 13.55% for M2, M3, and M4 were observed compare to control concrete. This decrease in strength may be due to the presence of bicarbonates content higher than the permissible limit compared to the allowable limits.



It is observed from the fig that, 7 days compressive strength for all the 4 mixes is nearly same. At the age of 14days marginal increase in compressive strength is observed for all the 4 mixes.

Increase in compressive strength is observed at the age of 28days for mix M5 & M6 but in case of mix M7 compressive strength remains same as that of 14days and in case of mix M8 compressive strength decreases as compared to 14days compressive strength results.

The mix M5 & M6 resulted in compressive strength higher than the target mean strength but the mix M7 & M8 resulted in compressive strength lower than the target mean strength, this decrease in strength may be due to the use of treated domestic waste water for mixing or curing.

A decrease in compressive strength of 6.45%, 12.91%, and 16% for M6, M7, and M8 were observed compare to control concrete. This decrease in strength may be due to the presence of bicarbonates content higher than the permissible limit compared to the allowable limits.

V. Conclusions

(1) Treated domestic waste water can be used in the preparation of concrete both for casting and curing purposes, without affecting target mean compressive strength at the age of 28days curing for M20 grade concrete.
(2) Increase in compressive strength from 7 days to 14days for all the 4 mixes is marginal for both the grades of concrete i.e. M20 and M40
(3) Seven days and fourteen days compressive strength for M20 and M40 grade concrete is same for all the four mixes M1 to M4 and M5 to M8 respectively.
(4) Compressive strength decreases from M1 to M4 and M5 to M8 at the age of 28 days curing for M20 and M40 grade concrete respectively.
(5) Concrete cast and cured using treated domestic waste water into (i.e. M4 mix) as exhibited compressive strength higher than the target mean compressive strength for M20 grade concrete.

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