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Sustainable Use of Resources – Recycling of RMC used Wash Water in Mortar

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Abstract: ***As the world is progressing in construction of high rise high strength structures for which high strength concrete is the predominant requirement in the area of construction. Concrete is the second mostly used construction material after water. A huge quantity of concrete is asked by the society per year. This need of concrete is fulfilled by local RMC plants. But these Ready Mix Concrete factories use lot of fresh water for making of concrete. When this fresh water came out as waste water of RMC it is highly alkaline, having metal content, high pH and other impurities thereby. This waste wash water can contaminate the land, river, underground water source where it get disposed off, if it discharged without any proper treatment. In some of the countries of world, all sludge waste water has been used in fresh concrete as admixture, but due to this quality of fresh as well as hardened concrete is get deteriorate such as slump loss, irregular compressive strength. In other hand, use of wash water in fresh concrete enhanced the properties of fresh concrete such as reduction of capillaries in concrete structure, water absorption which improves integrity of concrete. It also helps to reduce water cement ratio. Here we decided to differentiate alkaline water and total solids from RMC waste sludge. After treatment of alkaline water we will use both the treated and untreated water in fresh concrete. While, total solids will be kept aside for disposal like filling or dumping. This paper basically shows the characteristics of RMC waste wash water and gives various techniques to reuse in fresh concrete.***

Keywords: Scarcity , RMC, Waste water, Mixing and curing, Compressive Strength.

I. INTRODUCTION

The ready mix concrete industry in India is one of the most growing industry due to various advantages such as superior concrete quality, ease of handling, no need for storage space at site etc. at early career f RMC consumption of cement was 2 % of total production of cement in India, But now a days it consumes almost 60% of the total production of cement in India. Also water consumption by RMC is more for concreting as well as washing of mixer. Approximately a RMC plant consumes quantity of 2000 lit/day. At the same time sludge and waste wash water which is considered as hazardous waste which could lead to environmental problem also came out of the plant. According to our test observation the typical pH value of wash water is almost 12. Moreover, this wash water also considered as problematic due to its high alkaline nature. With addition to this waste wash water also contains high sulphate and chloride content due to cement as a main constituent. Total solids are one of the constituent due to which turbidity occurs in the water. The contaminated water were analyzed and compared with WHO drinking water standards and CPCB effluent water quality standards. However, the test for mortar cubes properties were performed according to IS 4031 – part 6, which includes different tests on mortar cubes after 7 days of curing and tested under Universal Testing Machine.

II. MATERIALS AND METHODOLOGY

In this research work, the contaminated waste wash water analyzed and then using appropriate physical and chemical treatment the contaminants were lowered down to a acceptable limit. Then this treated water were use to cast mortar cubes of size 7.07x7.07x7.07 cm under standard condition and using standard materials and proportions. After 7 days of standard immersed curing compressive strength of mortar cubes were found out.

A. Materials

1) *Cement* - An ordinary Portland cement of 43 grade confirming to IS 12262-1987 cement were used which comply with the standard.
2) *Sand* – Ennore sand which is standard sand among the country India confirming to IS 650 was used for mortar cubes.
3) *Water* – Ready Mix Concrete waste wash water were collected from a single source, from Shree Sai RMC, Punavale, Pune.

The treated Ready Mix Concrete Waste Wash Water will be used for cube making purpose.

The laboratory test will be carried out as per IS 3025.
Optimum dosage for different water cement ratio is found out by try & error method.

B. Methodology

TABLE I PROPERTIES OF WATER SAMPLE

Parameters	Raw water (Bore water)	RMC waste wash water
Apparent color	Colorless	Grayish
Turbidity	0.67 NTU	10.6 NTU
pH	7.42	11.72
Alkalinity	15 mg/l	55 mg/l
Hardness	258 ppm	1200ppm
Chlorides	116 mg/l	1090 Mg/l
COD	-	220 mg/l
BOD	-	-
Total solids	276.01ppm	1990.02ppm
Fluorides	0.73 mg/l	1.05 mg/l
Temperature	18.5^0C	18.5^0C
Oil and grease	-	2mg/l

C. Treatment of Waste Wash Water

1) Settling
2) Elimination of Oil and Grease
3) Addition of Hydrochloric acid.

D. Mix Design

According to IS Code manual test for cement consistency, initial and final setting time were adopted. Using these results mix proportions are made, they are as follows;

Proportion – 1:3
Cement – 200 gm
ENNORE sand – 600 gm
Moulds – 7.07x7.07x7.07 cm
Water – 84 ml (consistency 28 %)
Water cement ratio - 0.42

III. EXPERIMENTAL STUDY

A. Compressive Strength Test

1) Raw Water Cubes

Age of curing	Sr.No	Crushing load	% area	Compressive strength (N/mm^2)	Average strength (N/mm^2)
3 days	1.	124255	5000	24.85	22.70
	2.	104556	5000	20.91	
	3.	112025	5000	22.40	
7 days	1.	150414	5000	30.08	28.50
	2.	144339	5000	28.86	
	3.	132223	5000	26.44	
28 days	1.	210211	5000	42.04	43.10
	2.	214956	5000	42.99	
	3.	222123	5000	44.42	

03 days compressive strength of raw water cubes is found as 22.70 N/mm^2
07 days compressive strength of raw water cubes is found as 28.50 N/mm^2
28 days compressive strength of raw water cubes is found as 43.10 N/mm^2

2) Waste Wash Water Cubes

Age of curing	Sr.No	Crushing load	% area	Compressive strength (N/mm^2)	Average strength (N/mm^2)
3 days	1.	94500	5000	18.90	18.40
	2.	90320	5000	18.06	
	3.	92555	5000	18.51	
7 days	1.	120325	5000	24.06	24.40
	2.	121250	5000	24.25	
	3.	125025	5000	25.00	
28 days	1.	214312	5000	42.86	43.40
	2.	214110	5000	42.82	
	3.	222755	5000	44.55	

03 days compressive strength of waste wash water cubes is found as 18.40 N/mm^2
07 days compressive strength of waste wash water cubes is found as 24.40 N/mm^2
28 days compressive strength of waste wash water cubes is found as 43.40 N/mm^2

3) Treated Water Cubes

Age of curing	Sr.No	Crushing load	% area	Compressive strength (N/mm^2)	Average strength (N/mm^2)
3 days	1.	124833	5000	24.96	23.60
	2.	126825	5000	25.36	
	3.	102511	5000	20.50	
7 days	1.	152626	5000	30.52	28.60
	2.	145000	5000	29.0	
	3.	131235	5000	26.24	
28 days	1.	214301	5000	42.86	43.10
	2.	210000	5000	42.0	
	3.	222095	5000	44.41	

03 days compressive strength of treated water cubes is found as 23.60N/mm^2

07 days compressive strength of treated water cubes is found as 28.60 N/mm^2

28 ays compressive strength of treated water cubes is found as 43.10 N/mm^2

IV. RESULTS

A. *Average Compressive Strength Of Mortar Cubes (Raw Water For Both The Mixing And Curing)*

The mortar cubes of 1:3 proportions were prepared by using raw bore water. This compressive strength test is carried out on each specimen and result is depicted in fig1.

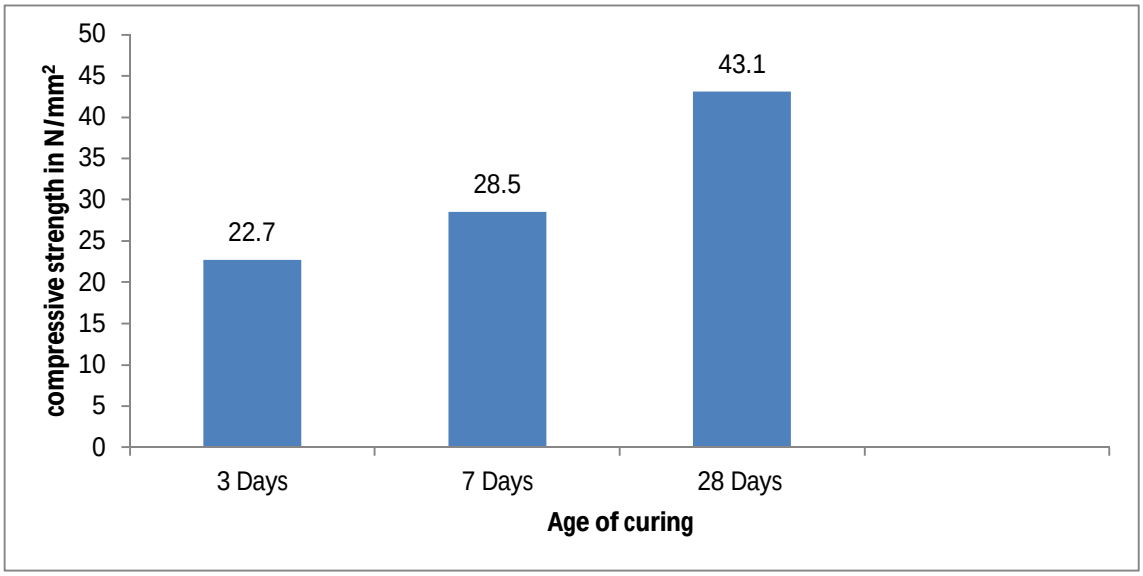

Fig 1 : Compressive strength v/s Age of curing for Raw Bore Water

B. *Average Compressive Strength Of Mortar Cubes (Rmc Waste Wash Water)*

The mortar cubes of 1:3 proportions were prepared by using RMC waste wash water. This compressive strength test is carried out on each specimen and result is depicted in fig 2.

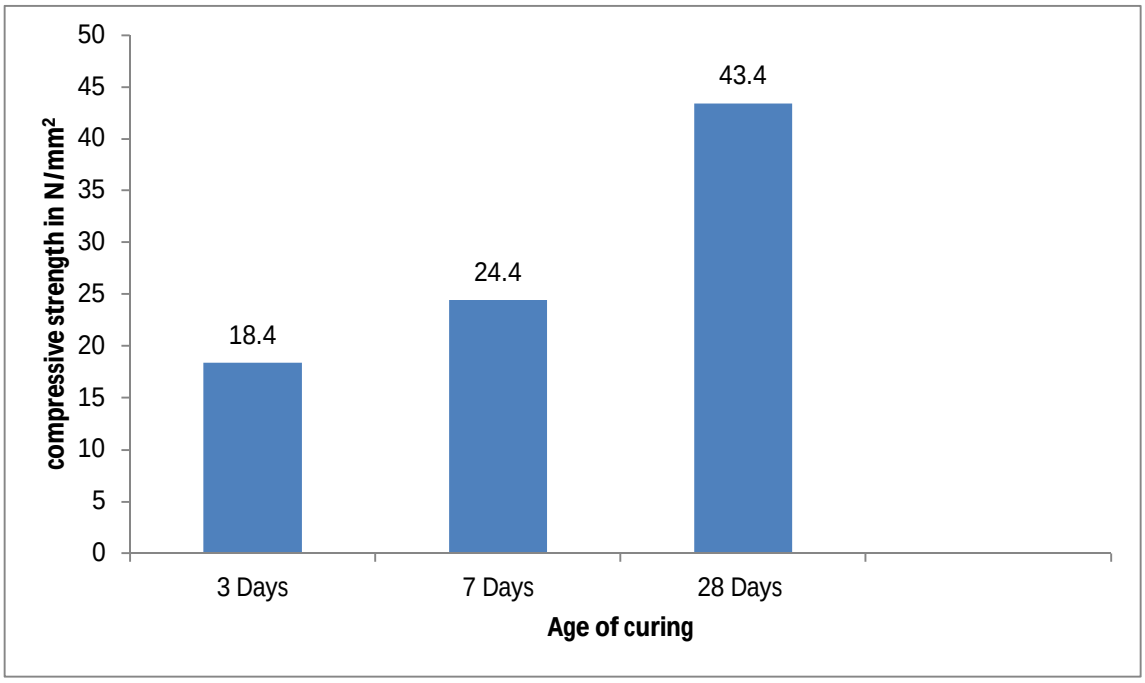

Fig 2 : Compressive strength v/s Age of curing for RMC waste wash water

C. Average Compressive Strength Of Mortar Cubes (Treated Water)

The mortar cubes of 1:3 proportions were prepared by using raw treated water. This compressive strength test is carried out on each specimen and result is depicted in fig3.

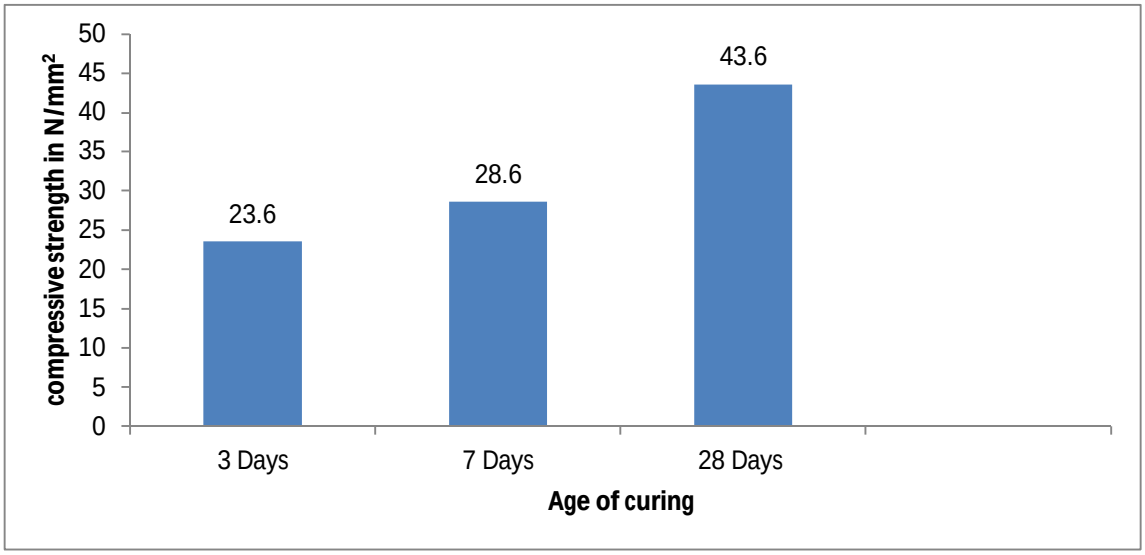

Fig 3 : Compressive strength v/s Age of curing for Treated Water

V. CONCLUSION AND RESULT DISCUSSION

A. FIG 1 shows age v/s compressive strength for raw bore water sample that was collected for making of mortar cubes. From fig, it is observed that hydration of cement is done properly, so 50 % strength is achieved at 3 days and 7 days of curing. Target mean strength is observed after 28 days of curing.

B. FIG 2 shows age of curing v/s compressive strength for RMC used waste wash water sample collected from outlet of RMC plant for making of mortar cubes. From fig, it is observed that due to high contamination and presence of oil in mixing as well as curing water the strength for 3 day and 7 day curing is less that target mean strength at that age of curing. While, strength after 28 days of curing is same as target mean strength for 28 days of curing.

C. Fig 3 shows that age v/s compressive strength for RMC treated water sample which is used for making of mortar cubes. From fig, it is observed that target men strength is achieved for 3 days, 7 days and 28 days of curing, the target mean strength is observed due addition of HCL.

D. On other hand pH does not affect the performance of mortar, from graph the pH values from 6.5-12.5 are absolutely desirable. pH value less than 6.0 should be avoided

E. Total solid content seem to be increase compressive strength which working as filler material in micro structure of mortar.

F. If proper treatment such as sedimentation, oil removing, addition of HCL is given to the RMC waste water then it can be used as mixing as well as curing water for normal concrete work.

G. Concluding this article, clearly it would be advantageous and cost effective not to treat the RMC waste wash water since it enhances the mortar properties. However several countries restrict the concrete mixing pH value below 7.5 for which addition of HCL would be the perfect solution which reduces the pH considerably as well as increases compressive strength of concrete.

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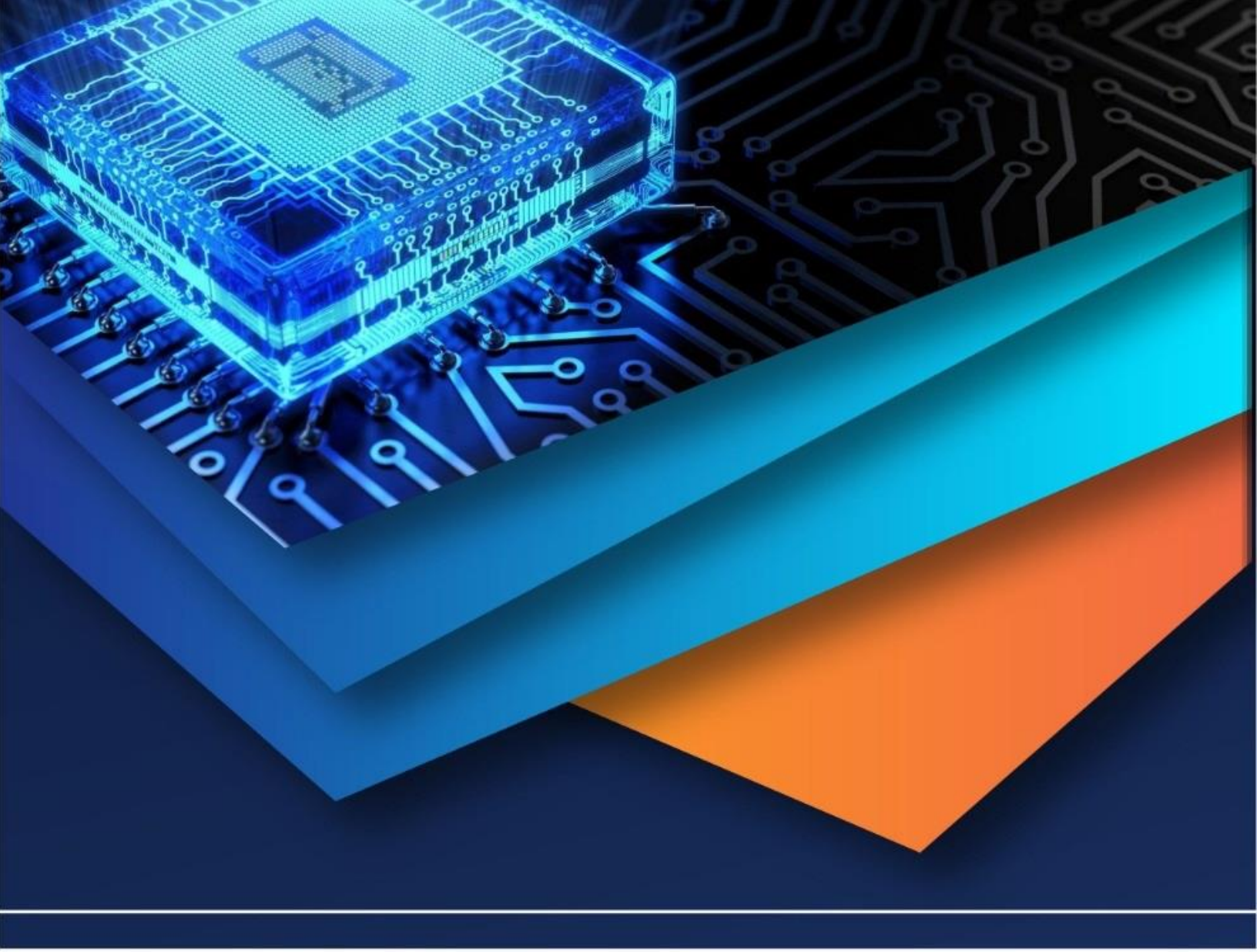

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