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Effect of Use of Waste Water and Partial Replacement of Cement on Compressive Strength of Concrete: A Review Paper

Md. Aakif Ansari[1], Kuldeep R. Dabhekar[2]
[1]*M. Tech. Student (Structural Engineering, GHRCE Nagpur, India)*
[2]*Assistant Professor (Department of Civil Engineering, GHRCE Nagpur, India)*

Abstract: *This paper reviews the literature related to the use of recycled water and partial replacement of cement by waste material for making concrete. From the literatures it has been noted that the partial replacement of cement by fly ash is favorable up to certain limit. After the optimum percentage of cement replacement by fly ash, an increase in fly ash percentage causes decrease in strength. In case of coconut shell, the compressive strength of the concrete reduces with increasing percentage of the coconut shell replacement. As 25% replacement of cement by Quarry dust shows strength gain, it can also be use as substitute of cement. Use of waste water for making concrete is also favorable for strength development at early stages but the long term strength has some reductions in strength gain. Some literature shows that the primary treated waste water gives effective results as compared to the secondary treated waste water.*
Keywords: *Coconut shell, compressive strength, fly ash,optimum percentage, recycled water*

I. Introduction

India population contributes to the 17.74% of total world population. But only 4% of total world water resources are available in India. In India 163 million and more people do not have access to clean water. In the present era, there is an increase in demand for concrete for infrastructural development. Cement and water are two vital ingredient of concrete. Water usage in cement production varies from 147 liters to 3500 liters per ton of cement. Around 100-240 liter of water per cubic meter of concrete is used in concrete production. Curing of concrete also requires a huge amount of water. In this situation where major part of the country does not have sufficient water to drink, use of recycled water in construction industry is a must. Wastewater from the household can be one of the options to be adopted as replacement of potable water. Wastewater from the household can be divided into two major groups, Grey water and Black water. The water discharge from the outlets of kitchen, sinks, bath, showers, basins and washing machine is termed as Grey water, whereas discharge from the toilet is termed as black water. Black water has higher percentage of nitrogen and phosphorous and also has most of the pathogens, hormones and pharmaceutical residues. Grey water accounts up to 75% of total household waste water. Grey water is relatively low in pollution and thus can be reused after suitable primary treatments.

We can also replace some percentage of cement by fly ash to reduce the demand for cement. A coal combustion product produced in coal-fired boilers as a result of chemical reaction between fine particles of burned fuel with the flue gases is called as fly ash. The main chemical components of fly ash are SiO_2, Al_2O_3, Fe_2O_3, and CaO. Additional cementitious compounds formed as a result of the reaction between fly ash and available lime and alkali in concrete. Replacement of cement by fly ash also decreases the water demand.

II. Literature Review

[2.1] G. L. Low and team have studied the performance of mortar prepared using slurry water. They have observed that for mortar paste the setting time of the cement paste is within the performance specifications when the specific gravity of slurry water used was less than 1.03. However, it was also observed that the water demand increased significantly when the specific gravity was beyond 1.02 and the amount of tap water required producing paste of similar consistence increased by 20% when the specific gravity reached 1.04. Compressive strengthat 7 days and 28 days meets the requirement when concrete casted using slurry water of specific gravity 1.02.

[2.2] Marcia Silva and Tarun R Naik have found that significant differences do not exist between mortar cubes made of potable water versus sewage treatment plant water. For mortar cubes made of potable water and reclaimed water the average flow was 98.1% and 89.5%, respectively. They also found that the organic content present in the sewage treatment plant water may be acting as a dispersing agent, improving the dispersion of particles of cement and reducing clumping.

[2.3] R Nagalakshami have studied the effect of partial replacement of cement by coconut shell and found that the compressive strength, split tensile strength and flexural strength decreased with the percentage replacement.

of coconut shell increases at the age of 7 days, 14 days, 28 days and 56 days. As the percentage of coconut shell increases, the slump of the concrete increased and decrease in comparison with the conventional concrete. Reduction in the compressive strength of the concrete with increasing percentage of the coconut shell replacement was observed. As the percentage of replacement of the conventional material increased the strength of concrete decreased.

[2.4] R. T. Peche, Dr. S. S. Jamkar and Dr. P. S. Sadgir have found that grey water reduces the initial and final setting time but that reduction is marginal and still within the prescribed limits.When grey water was used, increase in compressive strength has been observed. Increase in strength gain may be due to higher alkalinity than potable water.

[2.5] T. G. S. Kiran and M. K. M. V. Ratnam have found that the target mean strength have reached when concrete cubes (with 0%, 5%, 10%, 15% and 20% weight replacement of cement with FA) cured in normal water for 28, 60 and 90 days. Curing of concrete cubes in different concentration of sulphuric acid solution, shows increase in strength up to 10% replacement.

[2.6] Sravani T.,Anitha A. and VardhanVivek C.M. have studied the effect of use of wastewater of battery industry in cement mortars and also replaced the portion of cement by silica fume. They have found that the silica fume is a better partial replacement for cement. The rate of strength gain in silica fume is high. The optimum 7, 28 and 90 days compressive strength had been increased in the range of 8% SF replacement for both de-ionized water and partially treated waste water. Compressive strength increases when the cement is replaced by addition of 8% SF.

[2.7] Abdul Razak B. H. and Dr. D. L. VenkateshBabu have an experimental investigation usage of grey water in concrete production. They have found that there is decrease in the workability of concrete using primary treated water whereas secondary treated water gave better workability to concrete. Marginal difference in the compressive strength value of concrete made using primary treated water,secondary treated water and potable water have been observed. The tensile strength of potable water concrete was found to be more as compared to that of sewage treated water concrete.

[2.8] Vidhya Lakshmi A. and Arul Gideon R. have studied the physical properties of concrete prepared using secondary treated waste water. They have concluded that there is a significant increase in the load carrying capacity, the compressive strength of the secondary treated wastewater concrete when compared with the conventional concrete. 9.62% increase in strength has been observed.

[2.9] Ram Jitendra Kumar and R. C. Singh have worked on fly ash concrete and found out the optimized percentage of fly ash for different grade of concrete. They have found that the optimized quantity of fly ash is 40% for M15 & M20, 25% for M25, 20% for M25 & M30 and 10% for M40. They have concluded that as we move for the higher grade optimized percentage goes to lower.

[2.10] B.K. Varun and Harish B. A. have studied the effect of addition of fly ash and GGBS in cement concrete in hardened and fresh state. They had different combination of Cement, fly ash and GGBS. They have found that partial replacement of cement in concrete gives good results in both fresh and hardened state.

[2.11] Kumar Jayesh studied the performance of fly ash as partial replacement of cement. The values of compressive strength and split tensile strength were recorded. Concrete mix for M40 and M25 grade was done with the replacement of cement. 7days, 14 days and 28 days compressive strength of the samples was recorded.56 days tensile strength test were done. Concrete cured for 14 days has better results than 7 and 28 days strength.

[2.12] Md. Islam Moinulinvestigated the usage of fly ash as substitutes for the cement. 10%, 20%, 30%, 40%, 50% and 60% of cement was replaced by fly ash. The results show that strength increases with an increase in fly ash percentage up to an optimum value, beyond which the strength value starts decreasing. Optimum amount of cement replacement in motors have about 40% higher compressive strength and 8% higher tensile strength as compared to Ordinary Portland Cement mortar.

[2.13] Kumar VenkataSairam has investigated the effect of using quarry dust as a possible substitute for cement in concrete. Partial replacement of cement with varying percentage of quarry dust (0%, 10%, 15%, 20%, 25%, 30%, 35% and 40%) was done. M 20, M 30 and M 40 grade of concrete was selected. From the experimental studies 25% partial replacement of cement with quarry dust showed improvement in hardness of concrete.

III. Conclusion

From the literature reviews we have concluded that the partial replacement of cement by the waste material can be done but is restricted up to some extent. Waste materials like fly ash, GGBS and quarry dust have different optimum percentage of cement replacement. Optimum percentage of fly ash as a substitute of cement falls between 15% and 20% whereas use of quarry dust up to 25% shows improvement in properties of hardened concrete.

Waste water utilization depends on its quality. Concrete made up of primary treated wastewater shows improvement in strength because of higher alkalinity. However secondary treated waste water also has favorable strength.

IV. Future scope

Use of waste material as partial replacement reduces usage of cement in concrete. As the cement usage decreases its demand and production also decreases. Thus the amount of water required in cement production can be reduced. Also waste water utilization in concrete would be effective to solve water scarcity problems.

References

[1]. 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,*The Institution of Engineers, Vol. 68, No.4*, December 2007, pp. 47-55.

[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, ISBN 978-1-4507-1490-7,* June - 2010.

[3]. R. Nagalakshami, Experimental Study on Strength Characteristics on M25 Concrete with Partial Replacement of Cement with Fly ash and Coarse aggregate with Coconut shell, *International Journal of Scientific & Engineering Research, ISSN 2229-5518, Volume 4, Issue 1*, January-2013.

[4]. R. T. Peche, Dr. S. S. Jamkar, Dr. P. S. Sadgir, Grey Water- A Potential Source of Water for Construction,*IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 12-17.*

[5]. T. G. S Kiran, M. K. M. V Ratnam, Fly Ash as a Partial Replacement of Cement in Concrete and Durability Study of Fly Ash in Acidic (H_2SO_4) Environment, *International Journal of Engineering Research and Development, e-ISSN: 2278-067X, Volume 10, Issue 12,* December 2014, PP.01-13.

[6]. Sravani T, Anitha A, VardhanVivek C. M, Use of Partially Treated Wastewater of Battery Industry in Cement Mortars, *Journal of Environmental Research and Development, Vol. 9, No. 3A,* January-March 2015.

[7]. Abdul Razak BH, Dr. DL VenkateshBabu, Experimental Study on Usage of Grey Water in Concrete Production, *International Research Journal of Engineering and Technology (IRJET), Volume No. 2, Issue 08,e-ISSN:2395-0056, p-ISSN:2395-0072,* Nov 2015.

[8]. Vidhya Lakshmi A, Arul Gideon R, Secondary Treated Waste Water in Construction, *International Journal of Science and research (IJSR), Volume 5, Issue 5, ISSN-2319-7064,* May 2016.

[9]. Ram Jitendra Kumar, RC Singh, Optimized Fly ash in Concrete for Grade M15, M20, M25, M30, M35, M40 Using Portland Slag Cement, *International Journal of Research in Applied Science and Engineering Technology (IJRASET), Volume 5, issue 4, ISSN-2321-9653,* June 2017.

[10]. B K Varun1, Harish B A, Effect of Addition of Fly ash and GGBS on Cement Concrete in Fresh and Hardened State, *International Journal of Advance Engineering and Research Development, e-ISSN (O): 2348-447 , Volume 5, Issue 02*, February -2018.