

Experimental Studies on Durability Studies of Concrete with Partial Replacement of Cement by Water Hyacinth Ash

V.Muruges^{*1}, Dr. N. Balasundaram² and Dr. T. Senthil Vadivel³

¹Research scholar, Department of Civil Engineering, Karpagam Academy of Higher Education, Coimbatore-641021, Tamilnadu.

²Professor and HOD, Department of Civil Engineering, Karpagam Academy of Higher Education, Coimbatore-641021, Tamilnadu.

³Professor & Head, Department of Civil Engineering, School of Engineering & Technology, Adamas University, Kolkata – 700126. West

*Email.id: muruges.v@jct.ac.in

Abstract

Cement is the main constituent ingredient in concrete. Now days many investigations undergone for substitute of cement due to green houses effect and global warming .Many new products like rice husk ash, egg shell powder, baggage ash, etc are used as an effluent replacement material for cement. The new and Practical material for substitute of cement is water hyacinth ash .Water hyacinth ash (WHA), is used as an effectual replacement of partial cement, and it has been proved in several characteristics of concrete. The main important parameters in concrete are strength, durability and workability. In this paper, 10 % of cement replaced by water hyacinth ash to investigate the effects of WHA on durability and Strength in concretes. On this basis, specimens were engrossed in water and acid to study the absorption property, acid attack and compared to conventional concrete. The test results show that replacement of cement by WHA in concrete has improved the parameters of concrete.

Keywords : Water Hyacinth Ash, Compression Strength, Acid Resistance, Water Absorption

1. Introduction

Concrete is the main constituents materials considered in the construction industry all over the world. The main important criteria for design of reinforced concrete structures are Durability and strength. At present environment, concrete structures are affected by different pollutants which contains chloride, sulphate, carbonation of concrete. In the world, 40 % of investment are spent for maintenance of building. A good deal of research undergoes for a innovative material for the replacement of cement which should not affect the environment. Water hyacinth ash is new alternative material for cement. It can be easily visible on lakes and ponds . Then it is dried, powdered and heated upto 600°c for 6 hours at oven. Water hyacinth ash are replaced in cement and tested earlier for some mechanical characteristics of concrete. The results show 10 percent of water hyacinth ash is the optimum replacement for cement in concrete. Durability is the property of resistance of concrete against chemical attack, and environmental pollutants. Cement is replaced by 10 % of WHA to found the water absorption property, loss of mass in chlorine resistance attack and also strength aspects. The results are compared with conventional concrete M30.

2. Objectives

- To evaluate the strength property of WHA replacement concrete and conventional concrete.
- To study the durability property of WHA replacement concrete and conventional concrete.

- To analyze the water absorption property of WHA replacement concrete and conventional concrete.

3. Materials

The materials used in the experiment are:

- Cement
- Water Hyacinth Ash (WHA)
- Fine aggregate
- Coarse aggregate
- Water

4. Experimental Work

4.1. Saturated water absorption test

The main important parameters for durability of concrete are water absorption which tends to corrode the reinforcement bars in the concrete structures. Cubes are cast and de -mould after 28 days .then the cubes were dried at oven for 24 hours at 105°c. The cubes are kept at open atmosphere and noted the dry weight of specimens .A dried sample is immersed in water for 24 hours. Then the specimens are taken out and noted the wet weight of specimens.

$$\text{Water absorption} = [(W1 - W2)/W2] \times 100\%.$$

Where W1- Wet Weight ; W2- Dry Weight



Figure 4.1: curing of cubes in normal water

Mix	Wet Weight W ₁	Dry Weight W ₂	% Water Absorption	Average % Water Absorption 24 Hrs
	8.32	8.20	1.463	
CC	8.25	8.12	1.600	1.583
	8.44	8.30	1.686	
10%	8.38	8.30	0.960	
Replaced	8.10	8.00	1.250	0.943
Concrete	8.15	8.10	0.620	

Table 4.1: Results of Saturated Water Absorption Test

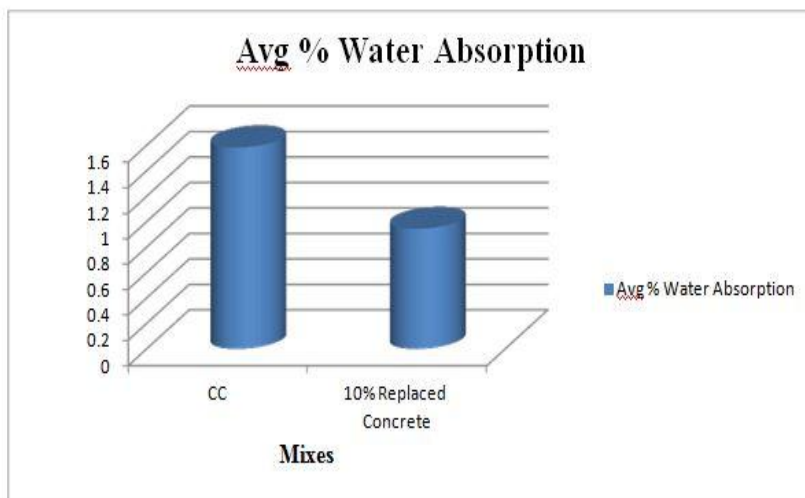


Figure 4.2: Water absorption of Conventional and 10% replaced concrete

Fig 4.2 explains 10 % replacement concrete by WHA attains less absorption property when compared to the conventional concrete. It shows that Voids in WHA replacement concrete is less when compared to conventional concrete. So, 10 % of replacement of cement by WHA prevents concrete from water absorption properties and prevents the corrosion mechanism on concrete structures.

4.2. Chloride resistance test

Concrete cubes of size 150x150x150mm were cast and cured for 28 days. After 28 days of curing the cubes were taken out and dried. Initial dry weight of the cubes was found. The chloride solution has been prepared by adding 3.5 % sodium chloride (NaCl) in distilled water and stirred well. The salts get dissolved into the solution. Specimens were engrossed for 28 days in a chloride solution. Then the cubes are taken out from solution and dried at a room temperature. Weight of the specimens are noted as final dry weight. The differences between initial and final dry weight of the specimen were found. Percentage loss of mass = $[(W1 - W2)/W2] \times 100\%$

where W1-Weight Before Immersion
W2-Weight After Immersion



Figure 4.3: curing of cubes in chloride solution

Table 4.2: Results of Percentage Loss of Mass In Specimens

Mix	Weight Before Immersion W1	Weight After Immersion W2	Loss % In Mass	Average Loss % In Mass
	8.20	8.11	1.098	
CC	8.12	8.01	1.355	1.279
	8.30	8.18	1.446	
10% Replaced concrete	8.30	8.24	0.723	0.862
	8.00	7.93	0.875	
	8.10	8.02	0.988	

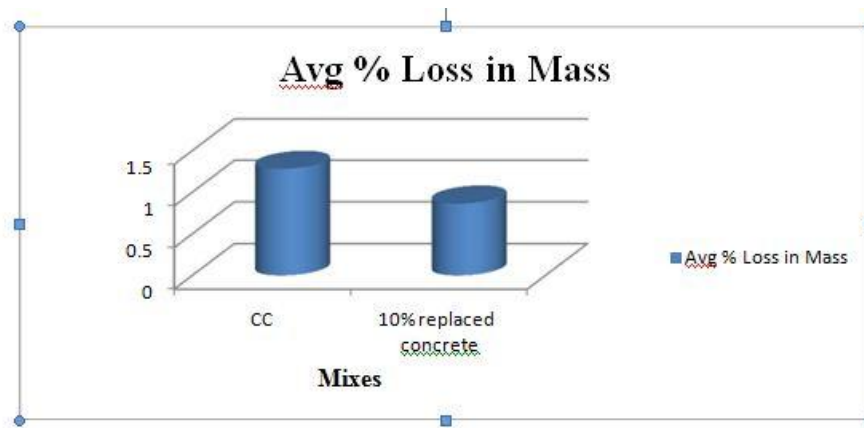


Figure 4.4: Percentage mass loss of concrete

Fig 4.4 explains the loss percentage of mass in conventional concrete and 10 % replacement concrete by WHA .it shows that loss percentage of mass in conventional concrete is higher than 10 % replacement concrete. The results indicate sodium chloride affects the bond strength in low range when compared to conventional concrete.

Table 4.3:Results of Percentage Loss of Compression Strength

Mix	Wet Weight	Dry Weight	% Water	Average % Water
	W_1	W_2	Absorption	Absorption
				24 Hrs
	32.31	30.45	5.757	

CC				5.308
	32.89	31.22	5.078	
	32.62	30.96	5.089	
10%	35.96	34.31	4.588	
Replaced				3.523
Concrete	36.09	35.53	1.522	
	36.81	35.18	4.428	

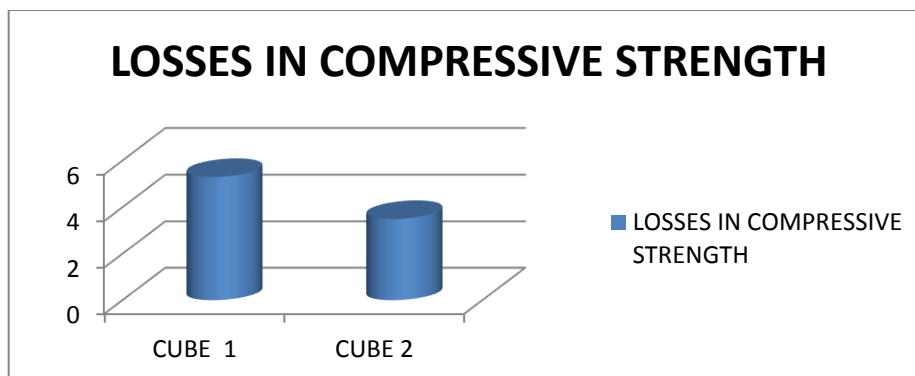


Figure 4.5: Losses in Compressive Strength

Fig 4.5 explains Compression loss of strength is less in 10% of replacement by WHA than conventional concrete. The results shows water hyacinth ash is the best suited alternative material for cement on concrete.

5. Conclusion

Saturated water absorption test indicates that water absorption is less for 10% replaced concrete which shows the better durability compared to CC.

The Chloride resistance test results indicates that 10% replaced concrete subjected to excellent chloride resistance in 3.5% chloride solution is the best because the mass loss and strength loss were very less compared to CC.

Compare to the normal concrete of M30 grade the 28 days strength is good and the required curing is normal.

The optimum dosage for partial replacement of cement by WHA is 10%.

After 28 days, the compression resistance strength of cube with WHA is better than normal conventional concrete.

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