An Experimental Study on Concrete With Partial Replacement of Cement By Water Hyacinth Ash And Fine Aggregate By Quarry Dust

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Abstract- *Water hyacinth is known as most productive aquatic plant, which can spread over a whole river in small amount of time. Environment contamination of aquatic environment, by toxic metal is a serious problem. Unlike organic pollutants toxic metals are non-biodegradable by chemical or biological process. Ideally these contaminants should be remediated by possible reuse. The study has been done to evaluate the water hyacinth ash in replacement of cement and quarry dust in replacement of fine aggregate. This project reveals about different proportions of water hyacinth ash replacing cement by 0%,10%,15%,20% and partial replacement of fine aggregate by 50% quarry dust, which will affect the workability, compression, flexural strength and split tensile strength of the concrete. The tested results will be compared with conventional concrete to check whether water hyacinth and quarry dust can be effectively replaced in concrete.*

Keywords- Concrete, Water hyacinth ash (WHA), Quarry dust, River sand, Compressive strength.

I. INTRODUCTION

Concrete is considerably the world's largely adaptable and well-liked material produced each year in the construction. Concrete is nothing but a combination of aggregates both fine and coarse, Cement and water. Comparing to all other ingredients in concrete, cement is considered to be the expensive material. This is because cement is manufactured using energy intensive process. Cement is one of the major producers of carbon dioxide, which is the main cause of global warming. During the manufacturing process of cement, the formation of clinker can be achieved only by heating the cement at very high temperature. This leads to the release of enormous amounts of carbon in the atmosphere. This was one among the major problems identified for climatic changes. Various research works has been carried out for the cost reduction in construction with some of the locally available materials as the partial or full replacement material for cement. Over the last few decades, supplementary materials like fly ash, rice husk, silica fume, egg shell, groundnut shell, etc. are used as a replacing material. These supplementary materials have proven to be successful in meeting the needs of the concrete in construction. Water hyacinth is a free floating aquatic plant that grows in ponds or slow moving fresh water bodies. Water Hyacinth produces a large biomass by rapidly growing and doubles its population within two weeks. Many problems are caused by the water hyacinth. Some of them are loss of bio diversity, affects water quality, water loss, agricultural implications, damage to infrastructure and it affects health and safety of humans as well as some aquatic species. Hence, the bio – admixture extracted from the water hyacinth can be used as the replacement material for cement and it is cost effective. In this research work, bio waste is utilized as a substitute of cement in concrete.

water hyacinth

II. CONCRETE MATERIALS AND THEIR PROPERTIES

Coarse aggregate of 20mm maximum size is used in Reinforced cement concrete work of all types of structures. This is obtained by crushing the stone boulders of size 100 to 150mm in the stone crushers. Then it is sieved and the particles passing through 20 mm and retained on 10mm sieve known as course aggregate.The particles passing through 4.75mm sieve are called as quarry dust The quarry dust is used to sprinkle over Various physical properties of the concrete materials are tabulated inTable 1.

Table1: Properties of the materials

Material	Properties
Crushed granite stone	Maximum size : 20mm Specific gravity : 2.98 Fineness modulus : 6.36 Density : 1.58gm/cc
River sand	Specific gravity : 2.53 Fineness modulus : 3.08 Density : 1.63gm/cc Void ratio : 0.55
Quarry dust	Specific gravity : 2.57 Fineness modulus : 2.41 Density : 1.85gm/cc Void ratio : 0.42
Ordinary Portland cement	Specific gravity : 3.05 Initial setting time : 30 min. Final setting time : 220 min Fineness residue on IS 90 micron sieve : 8 %
Water hyacinth ash	Specific gravity : 2.57 Fineness modulus : 2.41 Water absorption : 0
Water	PH : 7 Density : 1gm/cc

III. EXPERIMENTAL INVESTIGATION

A. Preparation of mould

The compressive strength of concrete is determined by casting cube of dimension 150mm x 150mm x 150mm. The split tensile strength of concrete is determined by casing cylinder of diameter 150mm and height 300mm. The flexural strength of concrete is determined by casting prism of dimension 500mm x 100 mm x 100mm. The moulds must be properly oiled before pouring concrete.

B. Batching and mixing of concrete

Batching of concrete is done accurately. It is desirable to take 15% more materials during mixing. Proper mixing must be done to get the uniform colour of concrete. Sufficient amount of water is added to ensure the strength of concrete. If water added is less, the mixture won't mix properly. If water is added more, it is reducing the strength of concrete. So, optimum quantity of water must be added. First dry ingredients are mix thoroughly and water is added to the mix and mixed properly.

C. Compaction of concrete

Compaction of concrete is the process adopted for expelling the entrapped air from concrete. In the process of mixing, transporting and placing of concrete air is likely to get entrapped in the concrete. So, minimize it compaction is done. Hand compaction is done by tamping, rodding and ramming. Rodding is done bycompacting each layer with not less than 25 strokes per layer using a tamping rod (steel bar 16mm diameter and 60cm long, bullet pointed at lower end) and levelling the top surface and smoothen it with a trowel.

D. Demoulding of specimens

The moulded specimens are demoulding after 24 hours of time. Demoulding is done carefully without the specimen getting damaged. Because the damage may cause reduction in strength. So, Care must be taken while this process.

E. Curing of specimens

Concrete derives its strength by the hydration of cement particles. The hydration of cement is not a momentary action but a process continuing for a long time. Curing can be described by keeping the concrete moist and warm enough so that the hydration of cement can continue. More elaborately, it can be described as the process of maintaining a satisfactory moisture content and a favourable temperature in concrete during the period immediately following placement, so that hydration of cement may continue until desired properties are developed to a sufficient degree to meet the requirement. Here, water curing is done by immersing the specimens into water.

IV. TESTING PROCEDURE

A. Fresh concrete workability

To determine consistency of concrete, Slump test was conducted with varying water content and a particular water cement ratio (w/c) which gives the slump of 60mm was selected from graph. The various w/c for different proportions of sand, quarry dust and water hyacinth ash was presented in Table 2.

Table 2: Workability of concrete (slump 60mm)

Cement replaced with water hyacinth ash	water cement ratio (w/c) M20
0%	0.45
10%	0.43
15%	0.41
20%	0.40

B. Compression test

The cube specimens were tested for compressive strength at the end of 7 days and 28 days. The specimens were tested after surface of the specimen dried. The load was applied on the smooth sides without shock and increased continuously until the failure of the specimen. The maximum load withstand by the specimens is noted, mean compressive strength is determined and presented in Table 3.

Table 3: Mean Compressive strength of concrete in (kN/mm^2)

Cement replaced with water hyacinth ash	28 days M20
0%	1.48
10%	1.49
15%	0.94
20%	0.83

C. Split tensile test

The cylinder specimens were tested for split tensile strength at the end of 28 days. The specimens were tested after surface of the specimen dried. The load was applied on the smooth sides without shock and increased continuously until the failure of the specimen. The maximum load withstand by the specimens is noted, mean split tensile strength is determined and presented in Table 4.

Table 4: Mean split tensile strength of concrete (in kN/mm^2)

Cement replaced with water hyacinth ash	28 days M20
0%	1.48
10%	1.49
15%	0.94
20%	0.83

D. Flexural test

The prism specimens were tested for split tensile strength at the end of 28 days. The specimens were tested after surface of the specimen dried. The load was applied on the smooth sides without shock and increased continuously until the failure of the specimen. The maximum load withstand by the specimens is noted, mean flexural strength is determined and presented in Table 5.

Table 5: Flexural strength of concrete (in kN/mm^2)

Cement replaced with water hyacinth ash	28 days M20
0%	2.56
10%	4.29
15%	2.30
20%	1.47

V. ANALYSIS OF TEST RESULTS

A. Compressive strength

From table 3 it is observed that the maximum compressive strength is attained at 10% of water hyacinth ash as replacement of cement and further addition of water hyacinth results in decrease in compressive strength.The variation in compressive strength is represented in Figure 5.1 and 5.2.

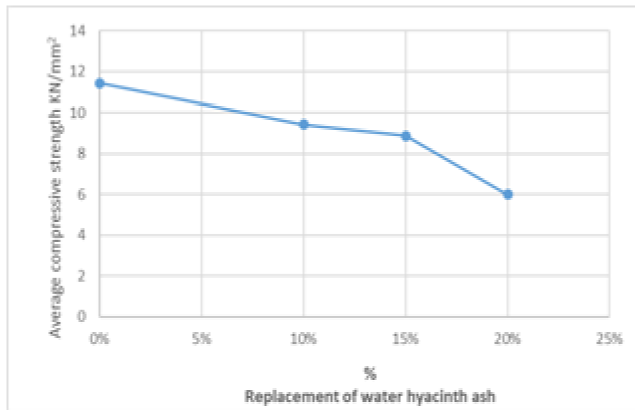

Figure: 5.1 Compressive strength of concrete at the age of 7 days

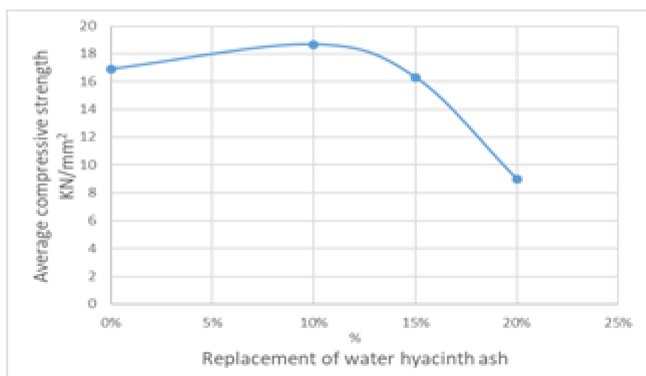

Figure: 5.2 Compressive strength of concrete at the age of 28 days

B. Split tensile strength

From table 4 it is observed that the maximum split tensile strength is attained at 10% of water hyacinth ash as replacement of cement and further addition of water hyacinth results in decrease in split tensile strength. The variation in split tensile is represented in Figure 5.3

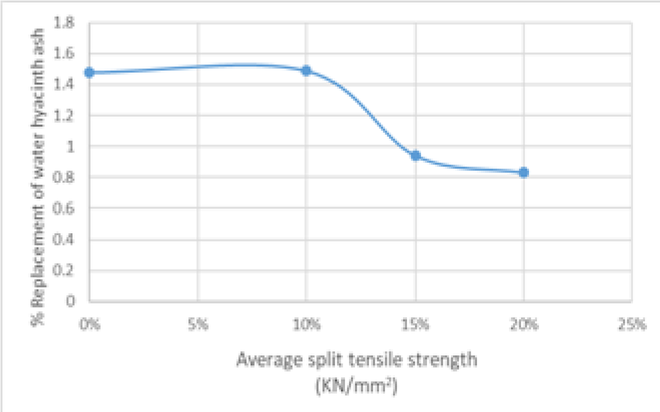

Figure: 5.3 Split tensile strength of concrete at the age of 28 days

B. Flexural strength

From table 5 it is observed that the maximum split tensile strength is attained at 10% of water hyacinth ash as replacement of cement and further addition of water hyacinth results in decrease in split tensile strength. The variation in split tensil is represented in Figure 5.4

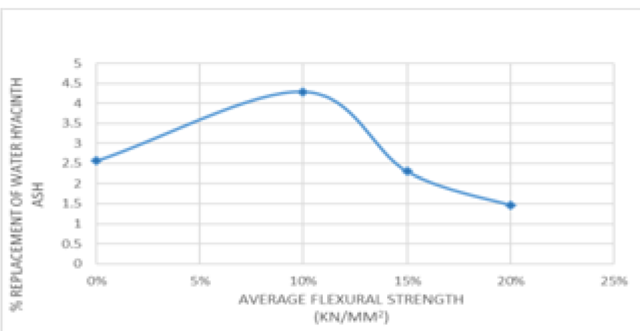

Figure: 5.4 Compressive strength of concrete at the age of 28 days

VI. CONCLUSION

Based on above discussions, following conclusions are drawn;

1. Concrete acquires maximum increase in compressive strength at 10% water hyacinth replacement and 50% quarry dust. The percentage of increase in strength with respect to nominal concrete is 10.53 %
2. Split tensile strength is maximum at 10% water hyacinth replacement and 50% quarry dust. The percentage of increase in strength with respect to nominal concrete is 0.67 %
3. Maximum flexural strength is at 10% water hyacinth replacement and 50% quarry dust. The percentage of increase in strength with respect to nominal concrete is 67.57 %

REFERENCES

[1] G.Balamurugan and Dr.P.Perumal, Experimental study on the thermal and thermoshock effects on the concrete strength due to the use of quarry dust for replacing sand, European journal of scientific Research, (Dec-2012) pp113-119.

[2] G.Balamurugan and Dr.P.Perumal, Use of quarry dust to replace sand in concrete Experimental study, Internationaljournal of scientific and Research Publications, (Dec-2013) pp1-4.

[3] G.Balamurugan and Dr.P.Perumal, Behaviour of concrete on the use of quarry dust to replace sand – An Experimental study Engineering, Science and Technology:An International Journal (ESTIJ) (Dec-2013) pp776-780.

[4] Neelu das and Shashikant singh, evaluation of water hyacinth stem ash as pozzolanic material for use in blended cement Journal of Civil Engineering, Science and Technology (Dec 2015) pp1-8.

[5] Juby Mariam Boban , Parvathy V Nair, Shinoy T Shiji and Sneha Elsa cherian, - Incorporation of water hyacinth in concrete International Journal of Engineering Research & Technology (IJERT) (May 2017) pp540-544.

[6] V. Murugesh and Dr. N. Balasundaram, Experimental Investigation On Water Hyacinth Ash As The Partial Replacement Of Cement In Concrete International Journal of Civil Engineering and Technology (IJCIET) (Sept-2017) pp1013-1018.

[7] G.D.O.Okwadha and D.M. Makomele, Evaluation of water hyacinth extract as an admixture in concrete production Journal of Building Engineering (jan 2018) pp129-133.