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EXPERIMENTAL STUDIES ON THE PROPERTIES OF CEMENT CONCRETE WITH WATER HYACINTH FIBRES

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Abstract:

Concrete, the most abundantly used material all over the world, suffers several drawbacks such as low tensile strength, permeability to liquids and consequent corrosion of reinforcement, etc. Several admixtures have been used since ancient times to change and improve the properties and performance of the concrete. Water hyacinth is a free floating aquatic plant that infests rivers, dams, lakes and irrigation channels. It affects water flow, blocks sunlight and oxygen and completely destroys the aquatic life cycle. If these plants could be harvested for some beneficial uses, the menace could be reduced to a large extent. In this paper, the feasibility of using the water hyacinth fibres to improve the properties of cement concrete has been studied.

Keywords: Water hyacinth, compressive strength, flexural strength, split tensile strength

1. Introduction:

Fibre reinforced concrete is a concrete containing fibrous material which increases its structural integrity. It contains short discrete fibre that are uniformly distributed and randomly oriented. Different materials are used as fibres in the concrete and each of them lend varying properties to the concrete. In addition, the character of fibre reinforced concrete changes with varying concrete, fibre materials, geometrics, distribution, orientation and densities. Water hyacinth (Eichhornia crassipes) a free floating aquatic plant is known to cause major ecological and socio-economic changes [1]. With broad, thick, glossy, ovate leaves, water hyacinth may rise above the surface of the water as much as 1 meter in height. One of the fastest growing plants known, water hyacinth reproduces primarily by the way of runners or stolons, which eventually forms daughter plants. Each plant can produce thousands of seeds each year and these seeds can remain viable for more than 28 years [2]. Although, a number of beneficial uses have been identified, this plant still poses a potential threat to water bodies. In the study made by Sathya et al. [3], it was found that the compressive strength and setting time of cement were influenced by the bio admixture hydro extract and bio fine powder of water hyacinth. The setting time was found to be delayed with increase in replacement percentage of bio admixture whereas, the compressive strength and workability increased with increasing concentration of bio mixture. Investigations carried out by Ahmed Shaban Abdel-Hay and Yasser Abdel Ghany Fawzy [4] revealed that introducing water hyacinth in concrete mix up to 2% by mass of cement does not affect the slump whereas 5% water hyacinth decreased the slump. Studies made by Suchanya Viwatsakpol [5] indicated that the mortar mixed with 1% by weight gave the best result when compared with 3% and 9% reinforced mixed with mortar gave higher compressive strength for cube mortar and also gave higher bending strength for the tile mortar. This paper deals with the feasibility study on the utilization of water hyacinth fibres in cement concrete and to ascertain the properties of cement concrete for various proportions of water hyacinth fibres.

2. Materials and Methods:

Water hyacinth plants were collected from the Kurichi and Ukkadam lakes. The collected plants were washed with clean water to remove the muddy debris and impurities (Figure 1). The stalks of the plant were cut and sun dried (Figure 2). The dried stalks were further cut to pieces of 5cm length and fibres were extracted. As the fibres are organic in nature, they were treated with 15% sodium hydroxide solution to prevent degradation (Figure 3 and Figure 4). The fibres were further dried to remove the moisture content. The treated fibres were then added in proportions of 2%, 4%, 6% and 8% by weight of cement.

Figure 1: Washed water hyacinth plant

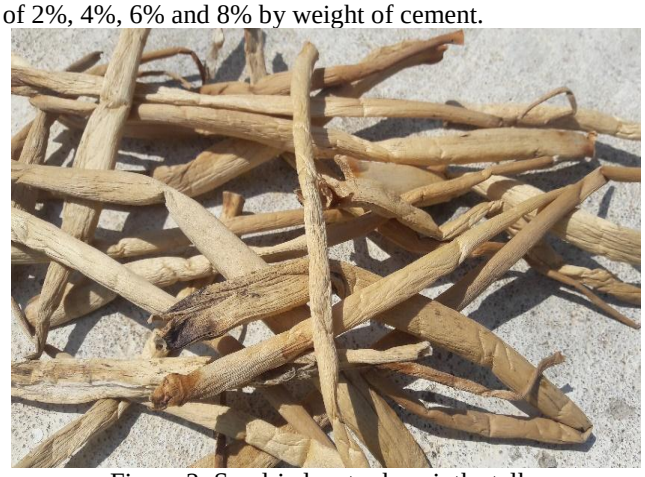

Figure 2: Sundried water hyacinth stalks

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Figure 3: Treated water hyacinth pieces

Figure 4: Extraction of fibres

OPC 53grade cement was used for the study. The normal consistency test, setting time test and the soundness test were performed on the cement used for the study. Fine aggregate and coarse aggregate were tested for moisture content, specific gravity and particle size distribution. Water used was tested for pH, chlorides, sulphates and total dissolved solids (TDS). Investigation was carried out for M25 grade concrete. Mix design was made in accordance with IS456 and IS10262. Cube specimens of size 150mm x 150mm x 150mm for compressive strength, prism specimens of size 100mm x 100mm x 500mm for flexural strength and cylinder specimens of size 100mm x 200mm for split tensile strength were cast. The test specimens were de-moulded after 24 hours and subjected to water curing. Compressive strength, flexural strength and split tensile strength was determined at the end of 14 days and 28 days.

3. Results and Discussion:

Studies were carried out on the properties of cement concrete with water hyacinth fibres. Table 1 presents the compressive strength of cement concrete for varying percentages of water hyacinth fibres added. The compressive strength was found to increase with the increase in the amount of water hyacinth fibres upto 4% and then decreased with further increase of water hyacinth fibres.

Table 1: Compressive strength of cement concrete with different proportions of water hyacinth fibres

No. of days	Compressive Strength N/mm^2				
	0%	2%	4%	6%	8%
14	21.6	15.78	17.33	16	14.22
28	24	24.8	26.66	25.77	22.66

Table 2 presents the results of flexure test conducted at the end of 14 and 28 days. The flexural strength was also found to increase with the increase in water hyacinth fibres upto 4%. With further increase of water hyacinth fibres, the flexural strength dropped.

Table 2: Flexural strength of cement concrete with water hyacinth fibres in different proportions

No. of days	Flexural Strength N/mm^2				
	0%	2%	4%	6%	8%
14	2	2.25	2.5	1.5	1.1
28	2.5	2.35	2.7	1.7	1.3

Table 3: Tensile strength of cement concrete with different proportions of water hyacinth fibres

No. of days	Split Tensile Strength N/mm^2				
	0%	2%	4%	6%	8%
14	2.7	2.23	2.7	1.33	0.98
28	3	3.02	3.66	1.36	0.95

4. Conclusion:

Investigation was made to study the properties of cement concrete with the addition of water hyacinth fibres in varying percentages by weight of cement. The compressive, flexural and tensile strengths were determined at the end of 14 days and 28 days. M25 grade cement concrete was used. The compressive strength, flexural strength and split tensile strength of cement concrete was found to increase with the increase in water hyacinth fibres content upto 4% by weight of cement. Further addition of water hyacinth fibres resulted in decreased values for compressive, flexural and tensile strengths.

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