IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

STUDY ON DURABILITY OF CONCRETE USING NATURAL FIBER

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Abstract: The Concrete is the most widely used building material in the world, due to its strength, durability and low cost. However, there is always a demand for improving the durability properties of concrete, especially in the face of the ever-increasing demand for sustainable construction materials. This study aims to investigate the durability properties of concrete when jute fibres are used as a reinforcing material.Jute fibres are obtained from the stem of the jute plant, which is a fast-growing crop that requires minimal fertilizer and pesticide input. Jute fibres are also biodegradable and renewable, making them an attractive option for sustainable construction materials. The use of jute fibres in concrete has been found to enhance the mechanical properties of concrete and reduce shrinkage.In this study, the effect of jute fibres on the durability properties of concrete is investigated. The durability properties considered in this study are the water absorption, acid resistance and sulphate resistance of concrete. The jute fibres were added to the concrete at varying percentages of 0.5%,1%, and 2% by weight of cement.

Index Terms – durability, jute fiber, mechanical properties

I. INTRODUCTION

The construction industry is developing with the invention of different materials to make tasks efficient; reduce time and cost; improve durability, quality and performance of structures during their life time. This leads to the development of special concrete such as polymer concrete for high durability, fiber reinforced concrete for preventing cracks in concrete, high and ultra- strength concrete for applications in tall buildings and bridges, light weight concrete for reducing foundation loads and high performance concrete for special performance requirements. Internal micro cracks are inherently present in the concrete. It has poor tensile strength due to the propagation of such micro cracks leading to brittle fracture of the concrete and the conventional steel reinforcement makes the reinforced cement concrete structure heavy and due to water or moisture diffusion through micro cracks developed, steel starts corroding leading to failure of concrete. Durability is an important property of concrete, as it determines the ability of concrete to resist degradation over time due to exposure to various environmental factors, such as moisture, freeze-thaw cycles, and chemical attack. Thus the objective of the present investigation is to study the mechanical properties of jute fiber reinforced concrete focusing on its durability behaviour.

II. LITERATURE REVIEW

Nasir (2009), The fibers in the concrete changes post-elastic property that range from subtle to substantial depending on number of factors, including matrix strength, fiber types, fiber modulus, and fiber aspect ratio, fiber strength, fiber surface bonding characteristics, fiber content, fiber orientation and aggregate size effects. The fiber does not increase the ultimate tensile strength appreciably but increase the tensile strains at rupture do. The matrix first-crack strength is not increased but the most significant enhancement is the post-cracking composite response.

Mohammad, Mashud, Md.Mozammel, Abduland Mohammad, (2015) adding larger fiber content and larger length resulted the easy failure of the concrete. Mixing of concrete low cut lengths jute fiber can move easily and causes the even spreading of fiber and create the better reinforcement on composites. However the higher porosity and uneven distribution of reinforcing material causes the heavy reduction of bending strength. Moreover, the inclusion of more jute of larger length results to the discontinuity of concrete mixing and improper arrangement of the concrete constituents that highly affects the strength against bending of a prism specimen.

Rahul, Vikas, Mansi, Chetan C., Roshan, Chetan N. and Sanyogita (2016),studied about use and development of jute fiber and provided an improvement of tensile strength using quantity of jute being chemically treated. It was observed that when the jute is chemically treated then its degradation decreases.

T. Sai and B. Manoj, (2016) Several approaches were proposed to improve the durability of vegetable fibre–cement composites. These included carbonation of the matrix in a CO2-rich environment; the immersion of fibres in slurried silica fume prior to incorporation in ordinary Portland cement matrix; partial replacement of ordinary Portland cement by undensified silicafume or blast furnace slag

III. EXPERIMENTAL STUDY

The study is to produce jute fiber reinforced concrete made with locally available jute fiber then to characterize its mechanical properties and durability properties of concrete. A trial mix proportions were used for mix of conventional concrete to achieve M30. The jute fiber was added on the basis of percentage to cement content of conventional concrete. The high strength of M30 concrete grade was produced using two mix series besides the control mix; one incorporating 0.5%, 1.0% and 2% enclosed with fiber length of 5mm each and the other with length of 5mm, 15mm and 25mm incorporated with 0.5% volume each. The mix ratio of conventional concrete is 1:1.07:2.96 and 0.45 water cement ratio. Slump test, compressive strength test, split tensile strength test, flexural strength test are conducted to determine the fresh and hardened properties of concrete. Water absorption test, acid resistance, sulphate resistance test are conducted to determine the durability properties of concrete.

Compressive strength test: The 14 days compressive strength were determined with the measurement of deformation with load. The test is carried out on 150x150x150mm size cubes.

Water absorption test: To assess the water absorption properties of composites reinforced with jute fibers, the procedure outlined in ASTMD570 was followed. The composites amples were submerged in water for a period of up to 15 days, maintaining a room temperature environment.

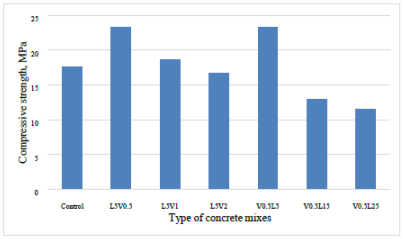
Acid resistance: Acid resistance was tested on 150x150x150 mm size cube specimens at the age of 28 days of curing. The cube specimens were weighed and immersed in water diluted with five percent by weight of sulphuric acid (H2SO4) for 28days. Then, the specimens were taken out from the acid water and the surfaces of the cubes were cleaned. Then, the compressive strength of the specimens was found out and the average percentages of loss of compressive strength were calculated.

Sulpate resistance: The sulphate attack testing procedure was conducted by immersing concrete specimens of the size 150 mm over the specified initial curing in a water tank. Then, they were cured in 5% Sodium sulphate (Na2SO4) solution.

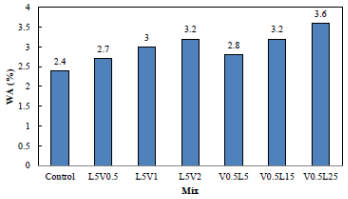
IV. RESULTS AND DISCUSSIONS

The results of compressive strength test and the durability properties of jute fibre reinforced concrete was compared with the conventional concrete. The compressive strength test, water absorption test, acid resistance, sulphate resistance were conducted to investigate the durability properties and hardened properties of concrete. It gives brief description about the work done. The addition of JF in concrete and WA are directly related; the absorption of water increases with the rise in JF content.The JF concretes were less susceptible against sulphate attack in terms of strength loss percentage and compressive strength deterioration. On the other hand it was high susceptible against acid attack.

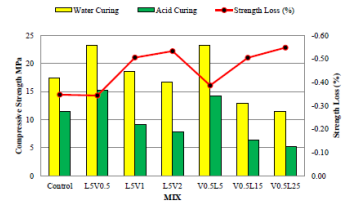
However, less information is available durability aspects of concrete with jute fibers.



Compressive strength values of mix series I and II



WA of concrete blended with Jute Fiber



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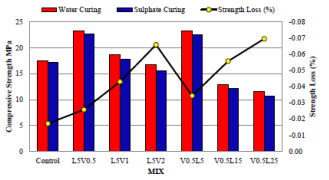

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