EXPERIMENTAL ANALYSIS OF STEEL FIBER REINFORCED CONCRETE WITH CARBON RUBBER AS PARTIAL REPLACEMENT FOR FINE AGGREGATE

A. Alton[1], C. Prasanna Kumar[2], J.J. Shajan Rose[3], S. Sri Harikara Jaswanth[4], M. Yoheshwaran[5]

Department of Civil Engineering

Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala Engineering College

Email: altonregi90@gmail.com

ABSTRACT

Carbon rubber (subtypes are acetylene black, channel black, furnace black, lamp black and thermal black) is a material produced by the incomplete combustion of heavy petroleum products such as FCC tar, coal tar, or ethylene cracking tar. Carbon black is a form of procrystalline carbon that has a high surface-area-to-volume ratio, albeit lower than that of activated carbon. It is dissimilar to soot in its much higher surface-area-to-volume ratio and significantly lower (negligible and non-bioavailable) polycyclic aromatic hydrocarbon (PAH) content. However, carbon black is widely used as a model compound for diesel soot for diesel oxidation experiments. Carbon black is mainly used as a reinforcing filler in tires and other rubber products. Using carbon rubber as a substitute of sand in construction materials would resolve the environmental problems caused by large scale depletion of natural resources of rivers and mining sands. This paper reports the experimental study undertaken to investigate the influence of partial replacement of fine aggregate with carbon rubber in Steel Fiber Reinforced Concrete (SFRC). Carbon rubber was replaced in proportions of 20%, 30% & 40% for fine aggregate in SFRC. The optimum percentage of steel fibers used was 1%. The investigations include the testing of compressive strength, split tensile strength & the flexural strength of hardened concrete. The concrete was tested on 7, 14 and 28days and the results were discussed and concluded. In the present investigation, an experimental study is made to use Carbon rubber as a partial replacement to fine aggregate in Concrete, and an attempt has been made to investigate the strength parameters of concrete (Compressive Flexural and Split Tensile). For control concrete, IS method of mix design is adopted and considering this a basis, mix design for replacement method has been made. Three different replacement levels namely 20%, 30% and 40% are chosen for the experimental study concern to replacement method. Large range of curing periods starting from, 7days, 14days and 28days are considered in the present study.

KEY WORDS: Carbon rubber, Cement, Concrete, Carbon rubber and Steel fibers.

1. INTRODUCTION:

In India, there is a great demand for aggregates mainly from civil engineering industry for road and concrete constructions. But nowadays it is a

very difficult problem for available of fine aggregates. So, researchers developed waste management strategies to apply for replacement of fine aggregates for specific need. Natural resources are depleting worldwide while at the same time the generated wastes from industry are increasing substantially.[1] With the increased strength of high-strength, lightweight concrete, this has been used widely as major construction materials, but problems, such as low tensile/compressive strength ratio, low flexural strength, low fracture toughness, high brittleness and larger shrinkage, prevented its use in concrete structure. The addition of steel fiber to high-strength, light-weight concrete has important effects on the improvement on properties of high-strength, light-weight concrete, especially for improving tensile/compressive ratio, behavior of earthquake resistance, resistance to cracking and fracture toughness.[2] In compression, similar to the tensile response, steel fibers incorporation primarily augments the toughness and post-peak ductility . The fibers can act most effectively if aligned in the direction of the largest tensile stress. Fibers are the most beneficial when large strains occur in the cement matrix. Carbon rubber (subtypes are acetylene black, channel black, furnace black, lamp black and thermal black) is a material produced by the incomplete combustion of heavy petroleum products such as FCC tar, coal tar, or ethylene cracking tar. Carbon black is a form of procrystalline carbon that has a high surface-area-to-volume ratio, albeit lower than that of activated carbon.[5] Researchers suggest that rubberized concrete (RC) is more flexible than standard concrete pavement, which allows it to conform to the frost action induced by subgrade movements. By absorbing freeze-thaw induced movements, the rigid pavement behaves similarly to that of flexible pavement and conforms to ground movement, which minimizes potential development of voids. However, regardless of the nature, size, and composition of used tire rubbers, increasing the amount of rubber content in the mixture results in a considerable decrease in the compressive and flexural strength of the concrete.

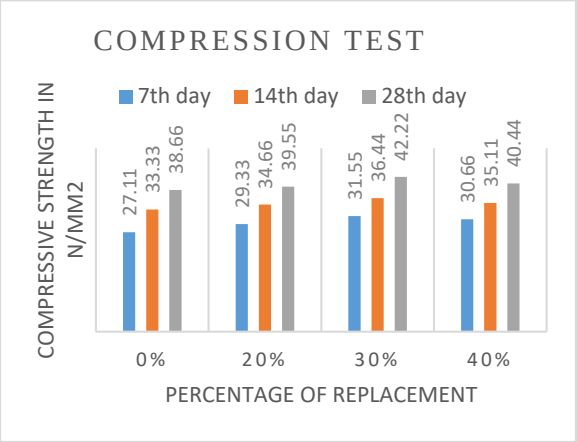
2. MATERIAL AND METHODS

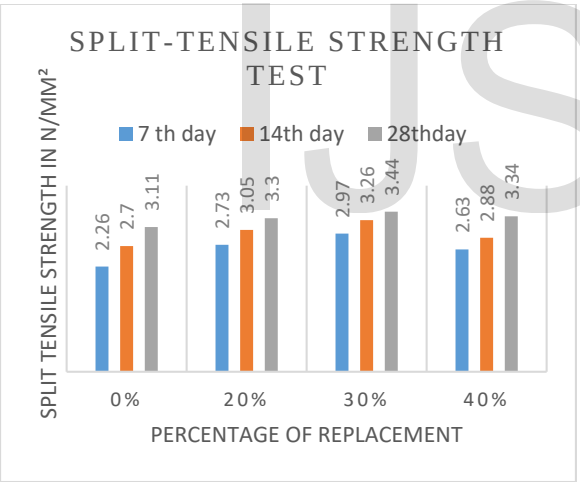
Carbon rubber (subtypes are acetylene black, channel black, furnace black, lamp black and thermal black) is a material produced by the incomplete combustion of heavy petroleum products such as FCC tar, coal tar, or ethylene cracking tar. Carbon black is a form of procrystalline carbon that has a high surface-area-to-volume ratio, albeit lower than that of activated carbon. It is dissimilar to soot in its much higher surface-area-to-volume ratio and significantly lower (negligible and non-bioavailable) polycyclic aromatic hydrocarbon (PAH) content. However, carbon black is widely used as a model compound for diesel soot for diesel oxidation experiments. Carbon black is mainly used as a reinforcing filler in tires and other rubber products. Using carbon rubber as a substitute of sand in construction materials would resolve the environmental problems caused by large scale depletion of natural resources of rivers and mining sands.

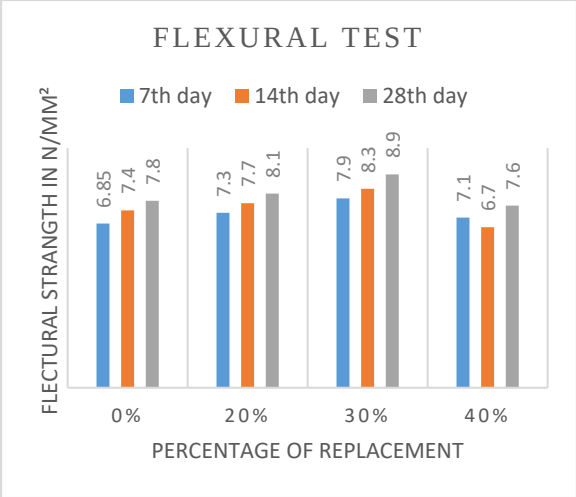
3. RESULT AND DISCUSSION

In order to assess the performance of the Carbon Rubber Steel Fiber Reinforced Concrete compression test, flexural strength and split tensile test was conducted in the sample members casted with 20%, 30% and 40% of Carbon

Rubber replacing the fine aggregate. Here the members are cast into Cubes, Prisms and Cylinders for compression, flexural and split tensile tests respectively. The results of the test are given below.







4. CONCLUSION:

Based on the 7, 14 & 28 days test results, the following conclusions were made:

The partial replacement of fine aggregate by carbon rubber increases the strength of SFRC concrete mix. The optimum replacement of fine aggregate by marble powder was found to be 30%. At 30% replacement the compressive strength of concrete was found to be increased by 12% when compared to conventional SFRC.The Split-Tensile Strength was found to increase by 10%. The Flexural Strength was increased by 2%.

5. REFERENCES:

[1] Kai Wu, Feng Chen, Chuyang Chen, Huiming Zheng, Jianan Xu "Load-transfer Mechanism And Bond-stress Components In Steel And Steel Fiber–reinforced Concrete Structure" © 2019 American Society of Civil Engineers. PP 0733-9445.

[2] Joshua A. Mcmahon And Anna C. Birely, M.asce" Experimental Performance Of Steel

Fiber Reinforced Concrete Bridge Deck" © 2018 American Society of Civil Engineers. PP 1084-0702.

[3] Ramadoss Perumal "Correlation of Compressive Strength and Other Engineering Properties of High-Performance Steel Fiber–Reinforced Concrete" © 2014 American Society of Civil Engineers. PP 0899-1561.

[4] Hai H. Dinh, Gustavo J. Parra-Montesinos, M.ASCE, James K. Wight, ASCE "Shear Strength Model for Steel Fiber Reinforced Concrete Beams without Stirrup Reinforcement" © 2011 American Society of Civil Engineers. PP 1039-1051.

[5] Muhammad Usman, Syed Hassan Farooq, Mohammad Umair, Asad Hanif "Axial Compressive Behavior Of Confined Steel Fiber Reinforced High Strength Concrete" 2019 Elsevier Ltd. All rights reserved. PP 0950-0618.

[6] Hongmei Zhang,Ying Zhang, Xilin Lu, Yuanfeng Duan, Hanshu Zhang "Influence of Axial Load Ratio on the Seismic Behavior of Steel Fiber–Reinforced Concrete Composite Shear Walls"© 2019 American Society of Civil Engineers. PP 0733-9445.

[7] Jianming Gao,Wei Suqa, Keiji Morino "Mechanical Properties of Steel Fiber-reinforced, High-strength, Lightweight Concrete" 1997 Elsevier Science Ltd. PP 307-313.

[8] Cheng Yuana, Wensu Chena, Thong M. Phama, Hong Haoa "Bond Behavior Between Basalt Fibres Reinforced Polymer Sheets And Steel Fibres Reinforced Concrete" © 2018 Elsevier Ltd. All rights reserved. PP 0141-0296.

[9] Sallal R. Abid, Munther L. Abdul-Hussein, Nadheer S. Ayoob, Sajjad H. Ali, Ahmed L. Kadhum "Repeated Drop-weight Impact Tests On Self-compacting Concrete Reinforced With Micro-steel Fiber" 2020 The Authors. Published by Elsevier Ltd. PP 2405-8440.

[10] Osama A. Abaza, A.M.ASCE and Zaid S. Hussein, M.ASCE "Flexural Behavior of Flat-End Steel-Fiber-Reinforced Concrete" © 2014 American Society of Civil Engineers. PP 899-1561.