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A STUDY ON IMPROVIZATION OF CONCRETE PROPERTIES WITH PARTIAL REPLACEMENT OF CEMENT WITH SILICA FUME AND ADDITION OF KENAF FIBRE

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Abstract: The aim of this research focuses on preparation of high performance and high strength concrete by employing industrial waste to preserve the naturally raw ingredients of concrete. Due to increases in demand of cement with large scale production, resulting in creating a environmental problem. In this regard, an attempt was made to investigate the combined effects of incorporating mechanical properties of concrete specimens produced by using addition kenaf fibres and partially replacing of cement with silica fume on concrete specimens. The aspect ratio of kenaf fibre used in this study is 100. The parameter investigated in this project is M-30 concrete and cement were partially replaced with silica fume by the percentages of 5%, 10%, 15% and 20% by total weight of cement also, kenaf fibres were added in ratio of 0.5%, 1.0% and 1.5%. Test was carried out on standard specimens casted by composite mixes. Slump test carried out in all mix before casting test specimens to ascertain workability of fresh concrete. It was obtained that tensile strength of kenaf fibre increased with the increase in percentage of SF replacement. In this regard, silica fume in concrete decreases the quantity of cement in the construction purpose and addition of kenaf fibre in concrete and leads to better performance of high strength concrete and reduction in environmental problem.

Key Words: Cement, Silica Fume , Kenaf Fibre , Compressive Strength, Split Tensile Strength, Flexural Strength.

INTRODUCTION

Wastes are generated in many industries are used to obtain new materials or it can be used as an admixtures. There are many methods available to reduce the usage of waste. Waste admixtures are also used in construction practices to increases the strength. The projects starts from building of residential house to the large infrastructure platforms like construction of dams, high rise buildings etc. The materials used in forming of concrete is cement, aggregate (fine and coarse) and ordinary potable water. The role of constituents contained in concrete is to obtain optimal strength of concrete after the curing period. The manufacturing of cement, leads to emission of green house gases in atmosphere Here, there is a need to find some efficient methods to minimize the consumption of cement used in concrete. Hence, there is an attempt to utilise the admixture silica fume along with natural fibre to produce efficient concrete.

The main research of the paper is ,

- To investigate the material properties contains in concrete.
- To identify the optimum content of partially replacing of cement with Silica Fume and addition of Kenaf Fibre.

INGREDIENTS

Cement : Ordinary Portland Cement (OPC) 53grade	
Admixtures :	Silica Fume
Fine aggregate :	Manufactured sand
Fibre :	Kenaf Fibre
(aspect ratio 100)	
Ordinary	potable water

Silica Fume

Silica fume is a waste mineral admixtures obtained from the by product of silicon metal or ferrosilicon alloys. The beneficial uses of silica fume in concrete, it contains high cementitious material and it is used as a replacement of cement in concrete structures in different percentage and the maximum compressive strength, splitting tensile strength, flexural strength of concrete have been evaluated. The property of silica fume is a very reactively high pozzolanic material.

Fig 1 Silica Fume Powder Table 1

Silica Fume Properties

Properties	Test Results
Specific Gravity	2.2
Particle size (diameter)	150 nm
Consistency	38 %

Table 2 Chemical Composition of Silica Fume

Chemical composition	Test values
SiO_2	96.00
Fe_2O_3	0.5
Al_2O_3	0.25
CaO	0.25
MgO	0.56
K_2O	0.56
Na_2O	0.25
SO_3	0.12

Kenaf Fibre

Kenaf fibre is a naturally available fibre which is obtained from the stem of Hibiscus cannabinus family and it is placed in the concrete to increases the strength and ductility nature. The concrete containing kenaf fibre is used for arresting the minor cracks.

Fig 2 Kenaf Fibre

Table 3 Properties of Kenaf Fibre

Properties	Test values
Diameter	0.5 mm
Length	50 mm
Aspect ratio	100 mm
Water absorption	220
Density	750 kg/m^3

MIX DESIGNATIONS

Table 4 Mix Designations

Mix Designation	Description
MS1	95 % of total volume of Cement and 5 % Silica fume
MS2	90 % of total volume of Cement and 10 % Silica fume
MS3	85 % of total volume of Cement and 15 % Silica fume
MS4	80 % of total volume of Cement and 20 % of Silica fume
MK1	0.5 % of Kenaf fiber
MK2	1.0 % of Kenaf Fiber
MK3	1.5 % of Kenaf fiber
MK4	2.0 % of Kenaf Fiber

Table 5 Mix Designations for Optimum Mix

Mix Designation	Description
MS & MK	15 % of Silica fume and 0.5 % of Kenaf fibre
	15 % of Silica fume and 1.0 % of Kenaf fibre
	15 % of Silica fume and 1.5 % of Kenaf fibre
	15 % of Silica fume and 2.0 % of Kenaf fibre

RESULTS AND DISCUSSION

Compressive Strength on Silica Fume Concrete

The cubes were tested in compression testing machines with varying proportions of silica fume (5%, 10%, 15%, 20%) and the cube are kept in 28 days of curing in ordinary portable water. The test values has been tabulated 6.

Table 6 Test values for Silica Fume Concrete

Mixes	Load (KN)	Average Compressive Strength @ 28 Days (N/mm^2)
MS1	631	28.00
MS2	675	30.00
MS3	764	34.00
MS4	715	31.00

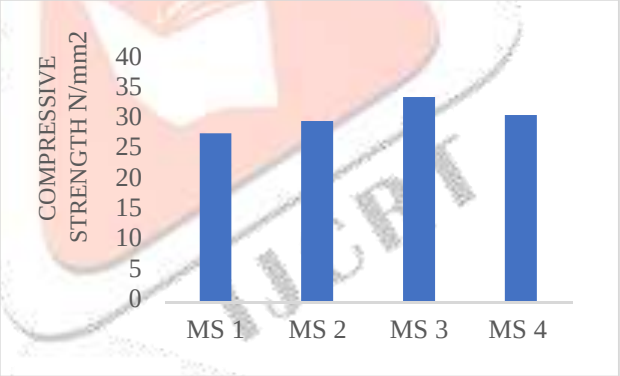

Fig 3 Test results for Silica Fume Concrete

Split Tensile Strength on Silica Fume Concrete

The test values of Split tensile strength of specimens with varying proportions of silica fume (5%, 10%, 15%, 20%) and the Table 7 and Fig 4 shows the Tensile Strength of Silica fume in concrete.

Split Tensile Strength on Kenaf Fiber Concrete

For, split tensile test, 150mm x 300mm cylinder were used. All cylinder were tested in unsaturated condition, after wiping tout the surface moisture. Test result for Kenaf Fibre Concrete are shown 9

Table 7 Test results for Silica Fume Concrete

Mixes	Load (KN)	Average Split Tensile Strength @ 28 Days (N/mm^2)
MS1	116	1.61
MS2	130	1.8
MS3	155	2.17
MS4	137	1.9

Table 9 Test result for Kenaf Fibre Concrete

Mixes	Load (KN)	Average Split Tensile Strength @ 28 Days (N/mm^2)
MK1	140	1.89
MK2	156	2.11
MK3	164	2.22
MK4	144	1.94

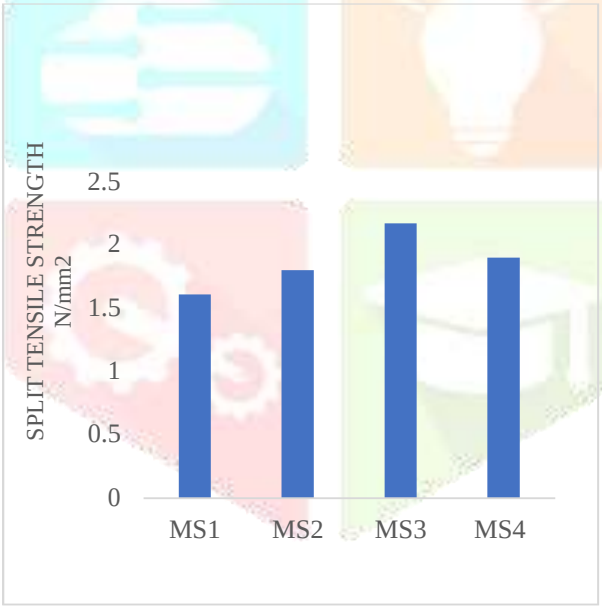

Fig 4 Test result for Silica Fume Concrete

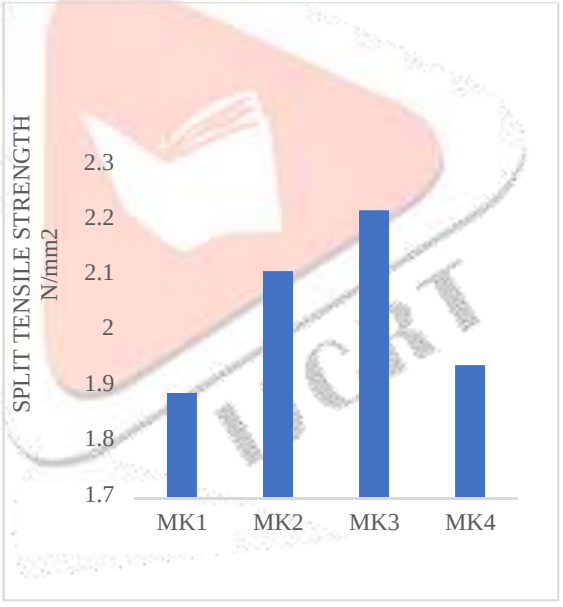

Fig 6 Test result for Kenaf Fibre Concrete

Flexural strength on Kenaf Fibre Concrete

For, Flexural strength test, 100mm x 100mm x 50mm prism were used. All prism were tested in unsaturated condition, after wiping tout the surface moisture. Test result for flexural strength of Kenaf Fibre concrete are described in Table 10

Table 10 Test results for Kenaf Fibre Concrete

Mixes	Load (KN)	Average Flexural Strength @ 28 Days (N/mm^2)
MK1	2.8	1.40
MK2	3.7	2.25
MK3	7.06	3.53
MK4	6.13	3.07

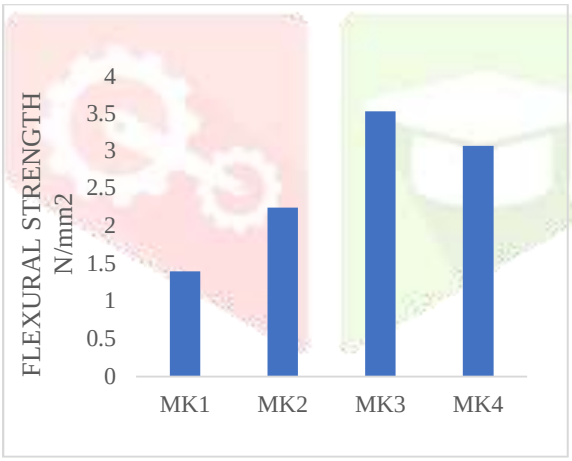

Fig 7 Test results for Kenaf Fibre Concrete

COMPARISON STUDY ON MS & MK

Compressive strength

For compression test, 150mm x 150mm x 150mm cubes were used. All cubes were tested in saturated condition, after wiping tout the surface moisture. Test result for compressive strength are described in table 11.

Table 11 Test result for Compressive strength of MS & MK

Mixes	Load (KN)	Average Compressive Strength @ 28 Days (N/mm^2)
MS & MK	682	31.01
	739	32.3
	782	35
	744	33.4

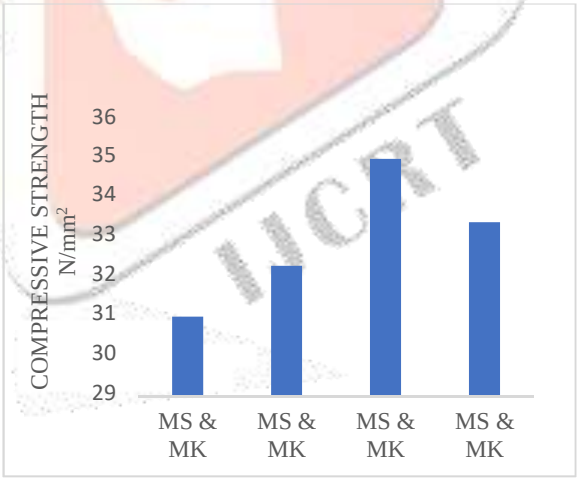

Fig 8 Test result for Compressive Strength of MS & MK

Split Tensile Strength

The values of Split tensile strength of mixes with optimum mix proportions of silica fume (15%) and addition of varying mix proportion of kenaf fibre (0.5%, 1.0%, 1.5%, 2.0%) are mentioned in Table 12 and Fig 9

Table 12 Test result for Flexural Strength of MS & MK

xes	Load (KN)	Average Split Tensile Strength @ 28 Days (N/mm^2)
	148	2.05
MS & MK	160	2.218
176		2.44
165		2.27

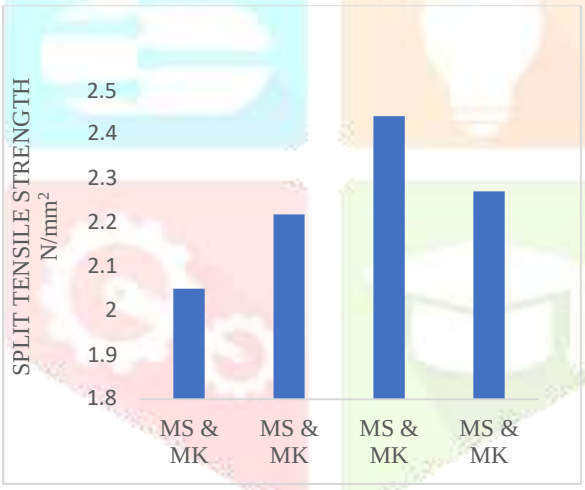

Fig 9 Test result for Split Tensile Strength of MS & MK

Flexural strength

The values of Flexural strength of mixes with optimum mix proportions of silica fume (15%) and addition of varying mix proportion of kenaf fibre (0.5%, 1.0%, 1.5%, 2.0 %) are shown in Table 13 and Fig 10

Table 13 Test result for Flexural Strength of MS & MK

Mixes	Load (KN)	Average Flexural Strength @ 28 Days (N/mm^2)
	3.29	1.65
MS & MK	4.5	2.25
7.97		3.98
7.01		3.51

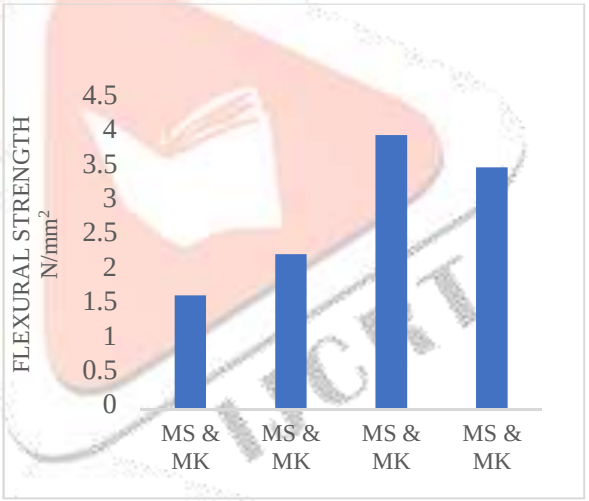

Fig 10 Test results for Flexural Strength of MS & MK

CONCLUSION

1. This research reveals the partial replacement of cement by Silica Fume and addition of Kenaf Fibre in harden concrete. Thus the optimel percentage of partially replacing cement with Silica Fume in concrete is proved to be 15% and addition of Kenaf Fibre in concrete is proved to be 1.5 %.
2. While partially replacing of cement, it decreases the consumption of cement in concrete and emission of green house gases get minimized and reduces the cost of construction.
3. Based on above test results, it was found to be addition of admixtures and addition of eco-friendly available fibre produces the economical concrete by adding silica fume and kenaf fibre.

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