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A comparative study on compressive strengthof natural fibre reinforced concrete with micro silica

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Abstract: This paper deals with an experimental study on the properties of concrete containing micro silica and natural fibres (i.e. Jute and sisal fibre). Short discrete vegetable fibres namely jute and sisal have been examined for their suitability for incorporation in cement concrete. The physical properties of these fibres show no deterioration in the concrete medium. The comparative study is madefor the compressive strength properties of conventional concrete with jute and sisal fibre reinforced concrete with micro silica as partial replacement of cement. Micro silica content used was 0%, 5%, 10% and 15% and fibre content used was 0.5% of mass basis. Present work has been undertaken to study the effect of jute and sisal fibre addition into micro silica concrete of M_{25} grade on the basis of its compressive strength.

Keywords: Natural fibres, Jute fibre, Sisal Fibre, Micro silica

I. INTRODUCTION

Concrete is the most versatile building material. Concrete has a relatively low tensilestrength (compared to other building materials) and low ductility. And also it is susceptible to cracking.Theproduction of concrete leads to lot of environmental issues associated with the significant release of CO_2 and other greenhouse gases.Therefore, it is necessary to look for sustainable solutions for future concrete construction.The fusion of concrete with micro silica & natural fibres is a conventional technique. Natural fibres have the potential to be used as reinforcement to overcome theinherent deficiencies in concrete material composites. These fibres have always been considered promising as reinforcement of cement based matrices because of their availability and low consumption of energy. Fibrere inforcement in concrete, mortar and cement paste can enhance many of the engineering properties of the basic materials, such as fracture toughness, flexural strength and resistance to fatigue, impact, thermal shock and spalling. The physical properties of sisal & jute fibre have shown no deterioration in a concrete medium.More over the application of these natural fibres is beneficial for consuming less energy, releasing less greenhouse gases into the atmosphere, and costing less to build and to maintain over time.

Micro silica also known as silica fume is one of the waste materials that is being produced from alloy industries in tones of industrial waste per year in our country. It is a byproduct of producing silicon metal or ferrosilicon alloys.It consists of spherical particles with mean size of about 100 nm which is about 100 times finer than Portland cement.One of the most beneficial uses of micro silica is in concrete. Because of its chemical and physical properties; it is a very reactive pozzolanic material. Concrete containing micro silica has very high strength and is very durable.

Using waste product as an ingredient in concrete not only proves to be economical but also may improve the mechanical properties of concrete and decrease the pollution load.

II. OBJECTIVE

The objectives of this research project are as follows:

- To safeguard the environment by the utilization waste properly.
- To provide an economical construction material.
- To usethe mostsustainable type of fibre which can be used in concrete with the least harmful effects on nature.
- To find the optimum percentage of micro silica replacement with cement for the constant percentage of fibre parameter.

III. SCOPE

The scope of this work are as follows:

- The project deals with two modified concretes.
- To study the effect of combined application of jute fibre reinforced concrete with micro silica as partial replacement of cement on compressive strength.
- To study the effect of combined application of sisal fibre reinforced concrete with micro silica as partial replacement of cement on compressive strength.
- Comparison of the test results of conventional concrete with those of two modified concretes.

IV. INGREDIENTS AND PROPERTIES

The ingredients used for this research project work are: Ordinary Portland cement of 53 grade, coarse aggregate, fine aggregate, water, super plasticizer, micro silica and natural fibrous material like jute fibre and sisal fibre.

A. Portland cement

Dalmia cement of Ordinary Portland Cement of 53 grade was used which satisfies the requirements of IS: 12269-1987. The properties of cement are shown in Table 1.

TABLE 1.PROPERTIES OF CEMENT

SNo.	Property	Average value of OPC used in present investigation	Standard value for OPC
1	Specific Gravity	3.15	-
2	Consistency (%)	29	-
3	Initial Setting Time (min)	40	>30
4	Final Setting Time (min)	251	<600
5	Fineness (%)	1.33	<10
6	Compressive strength of cement at 28 days (MPa)	54.8	>53

B. Aggregate

Various properties of aggregate govern the strength of concrete properties such as particle shape, particle size distribution, mechanical properties of aggregate and possible chemical reaction between aggregate and paste which affects the bond as well as grading of aggregate.

1) Coarse aggregate: The coarse aggregate in our project is 20mm to 25mm in size, crushed angular shape and free from dust.

2) Fine aggregate:M-Sand was used as fine aggregate due to the unavailability of river sand.The size of fine aggregate is less than 4.75mm. The most important function of fine aggregate is to assist in producing workability and uniformity.

TABLE 2.PROPERTIES OF AGGREGATE

SNo	Property	Fine Aggregate	Coarse Aggregate
1	Fineness modulus	2.60	6.93
2	Specific gravity	2.36	2.69
3	Bulk Density(kg/m^3)	1.574	1.47

C. Water

It is a famous saying, "Water fit for drinking is also safe for making concrete". The water used in this work in making concrete was free from oils, acids, alkalis, and other organic and inorganic properties.

D. Admixtures

Admixtures are generally used to modify or improve the various properties of concrete such as workability, non-segregation, anti-cracking, mechanical and durability.

1) Micro silica: Micro silica affects both the fresh and hardened properties of concrete. The effects on concrete are a result of the physical and chemical properties of micro silica.

TABLE3.PROPERTIES OF MICRO SILICA

S No	Property	Results
1	Form	Ultrafine amorphous powder
2	Colour	White
3	Specific gravity	2.63
4	Pack Density	0.76 gm/cc
5	Specific surface	20 m^2/g
6	Particle size	15μ
7	SiO_2	99.87%

2) Jute Fibre: Jute is one of the cheapest natural fibres with large production volume. Jute fibers are composed mainly of the plant materials cellulose and lignin.Jute fibre delays the hardening of concrete and improves the resistance of concrete against cracking.

3) Sisal Fibre: Sisal fibre is obtained from the leaves of the plants. Leaves are crushed between the rollers and the mechanically scraped. Sisal fibre is coarse and inflexible, and is valued because of its strength, durability, ability to stretch and resistance to deterioration in saltwater.

E. Super plasticizer

Ceraplast 300 was used as super plasticizer for M_{25} Grade of concrete.It is developed by Cera-ChemPvt Ltd, Chennai. It is high efficient plasticizer, water proofing compound and high performance retarding super plasticizer.The super plasticizer was added at the rate of 4ml by weight for 1kg of cement to all mixes.

V. EXPERIMENTAL WORK

A. Batching

Weigh batching was preferred in this experimental work for a higher degree of accuracy. So the chosen method of weigh batching to batch materials like cement, fine aggregate, coarse aggregate, micro silica, jute and sisal fibre were done. Water is measured in terms of litre.

B. Mixing

Coarse aggregate, fine aggregate, cement, and micro silica were mixed manually. The natural fibres were manually distributed to overcome the problem of uniform distribution of fibre in concrete. Then the water is added and mixing is to be continued till a homogenous mix was obtained.

C. Filling of mould

Once the concrete was mixed thoroughly it was placed in a large rigid pan where the quality of concrete was observed and then poured in the moulds of cubes of standard size 150x150x150mm.The inner surfaces of the moulds were coated with oil before pouring so that they can be easily demoulded after 24 hours. Each layer was tamped 25 times with tamping rod and then vibrated using a needle vibrator for sufficient time. The top surface was levelled with a trowel and finished properly.

D. Curing

The cube specimens were demoulded after 24 hours of casting and then immersed in a curing tank containing water at normal temperature for the required time period.

VI. TESTING OF SPECIMENS

After 7 days, 14 days and 28 days of curing period, the specimens were allowed to dry the surface for about one to two hours. Then they were tested in compression testing machine for studying the properties compressive strength of hardened concrete.

Fig. 1. Compression test on cube specimen.

Fig. 2. Cube resistance to cracking due to binding of fibres.

VII. RESULTS AND DISCUSSIONS

A. Plain Cement Concrete (PCC)

1) Compression Test

TABLE 4.COMPRESSIVE STRENGTH OF PCC

S No.	Curing Period	Avg. Compressive Strength (MPa)
1	7 Days	24.53
2	14 Days	25.26
3	28 Days	29.88

B. Concrete with 0%,5%,10% & 15% Micro silica and 0.5% Jute fibre

Comparison of the results of modified concrete with conventional concrete were done after testing the samples from 7, 14 and 28 days. Table 5, shows the observations on compressive strength with addition of 0.5% jute fibre and partially replacing cement with micro silica up to 0%,5%. 10% & 15%.

1) Compression Test

TABLE 5.COMPRESSIVE STRENGTH OF CONCRETE WITH 0%,5% 10% & 15% OF MICRO SILICA&0.5% OF JUTE FIBRE

Curing Period	Jute Fibre (%)	Micro Silica (%)	Avg. Compressive Strength of Modified Concrete (MPa)	Avg. Compressive Strength of Normal Concrete (MPa)
7 Days	0.5	0	25.77	24.53
		5	30.66	
		10	28.88	
		15	27.55	
14 Days	0.5	0	28.44	25.26
		5	31.11	
		10	30.22	
		15	28.00	
28 Days	0.5	0	29.12	29.88
		5	32.00	
		10	30.66	
		15	29.55	

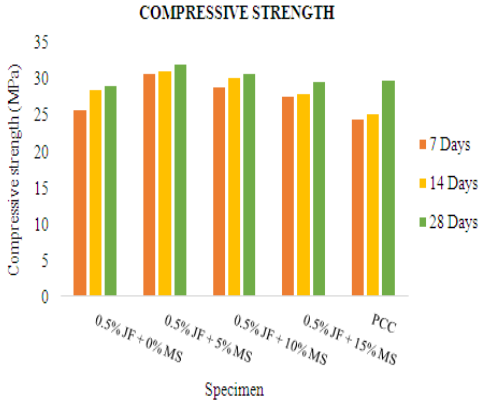

Fig. 3. Comparison of compressive strength of conventional concrete (PCC)& modified concrete with 0%,5%,10% & 15% of Micro Silica (MS)and 0.5% Jute Fibre (JF).

C. Concrete with 0%,5%,10% &15% Micro silica and 0.5% Sisal fibre

Comparison of the results of modified concrete with conventional concrete were done after testing the samples from 7, 14 and 28 days. Table 6, shows the observations on compressive strength with addition of 0.5% sisalfibre and partially replacing cement with micro silica up to 0%, 5%. 10% & 15%.

1) Compression Test

TABLE 6. COMPRESSIVE STRENGTH OF CONCRETE WITH 0%,5%,10%& 15% OF MICRO SILICA & 0.5% OF SISAL FIBRE

Curing Period	Sisal fibre (%)	Micro silica (%)	Avg. Compressive Strength of Modified Concrete (MPa)	Avg. Compressive Strength of Normal Concrete (MPa)
7 Days	0.5	0	24.44	24.53
		5	24.88	
		10	24.66	
		15	21.12	
14 Days	0.5	0	28.36	25.26
		5	31.33	
		10	28.66	
		15	24.66	
28 Days	0.5	0	36.88	29.88
		5	37.77	
		10	34.88	
		15	30.22	

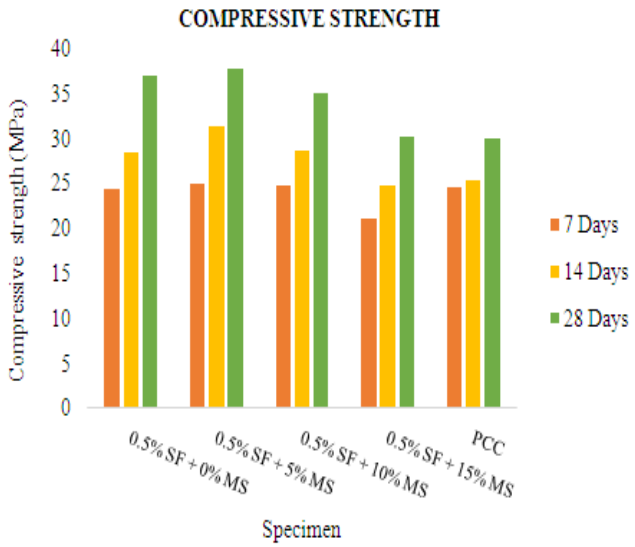

Fig. 4. Comparison of compressive strength of conventional concrete (PCC) & modified concrete with 0%,5%,10% & 15% of Micro Silica (MS)and 0.5% Sisal Fibre (SF).

VIII. CONCLUSIONS

In this experimental program, the compressive strength developments of two modified concretes and conventional concrete were investigated.

Based on the present experimental investigation, the following conclusions are made.

- The two proposed modified concretes show better compressive strength properties than those of conventional concrete.
- Cement replacement with 5% micro silica and 0.5% natural fibre shows optimum compressive strength.
- For M_{25} grade concrete with micro silica 5% and 0.5% jute fibre, the percentage increase in compressive strength is 7.1%.
- For M_{25} grade concretewith micro silica 5% and 0.5% sisal fibre, the percentage increase in compressive strength is 26.4%.
- Sisal fibre reinforced concrete with micro silica shows better compressive strength properties than jute fibre reinforced concrete with micro silica.
- The addition of natural fibres to the concrete not only modifies the compressive strength properties of concrete but also enhances the binding properties and micro cracking control.

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REFERENCES

[1]. Rahul Dogra, "Effect of silica fume on various properties of fibre reinforced concrete", International Journal of Civil Engineering and Technology (IJCIET), Volume 7, Issue 4, July-August2016.

[2]. Thallapaka Vishnu Vardhan Reddy, K. Rajasekhar and Seelanani Janardhana, "Study and performance of high strength concrete using with nano silica and silica fume", International Journal of Civil Engineering and Technology (IJCIET), Volume 6, Issue 11, November 2015.

[3]. Jaspal singh Manmeet Kaur and Manpreet Kaur "Sustainable concrete using natural fibre a review", Journal of International Academic Research for Multidisciplinary, Volume 3, Issue 9, October 2015.

[4]. N.Midhuna, Dr. P. Chandrasekeran "Mechanical and Durability Properties of Micro Silica Concrete with Sisal Fibers" International Journal of Science and Engineering Research (IJ0SER), Volume 3, Issue 4, April 2015.

[5]. S. Tanveer Hussain1, K. V. S. Gopala Krishna Sastry, "Study of strength properties of concrete by using micro silica and nano silica", International Journal of Research in Engineering and Technology (IJRET), Volume 3, Issue 10, October 2014.

[6]. Saandeepani Vajje, Dr. N. R. Krishna Murthy "Study on addition of the natural fibre's into concrete" International Journal of Scientific & Technology Research, Volume 2, Issue 11, November 2013.