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A Study On Self Compacting Fibre Reinforced Concrete

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Abstract:
Fibre-reinforced self-compacting concrete is a new building material that combines positive characteristics of workability of self-compacting concrete (SCC) with enhanced characteristics of hardened concrete due to fibre addition. In literature, metallic and synthetic fibres are used as the SCC reinforcement. From the literature it may be established that workability properties of SCC are more adversely affected by the use of metallic fibres. Also, metallic fibres are more effective than synthetic fibres in increasing the mechanical properties of SCC.

1. Introduction

Concrete's performances have continuously risen in order to accomplish society's needs. Recently, many studies focused on using additives and superplasticizers in Concrete to pass the frontier of minimum water content for good workability of Concrete. As a result of this, high-performance Concretes developed, having superior durability. Furthermore, a self-compacting Concrete (SCC) can be placed in the form and can go through obstructions by its weight without the need for vibration. Since its first development in Japan in 1988, SCC has gained broader acceptance in Japan, Europe, and the USA due to its inherent distinct advantages. The significant advantages of SCC technology are that it offers the opportunity to minimize or eliminate Concrete placement problems under challenging conditions.

The many advantages SCC offers in the construction industry are as follows:
• Low noise level in the plants and construction sites.
• Eliminated problems associated with vibration.
• Less labour involved.
• Faster construction.
• Improved quality and durability.
• Higher strength.
• Easier placing.

2. Objective

The primary aim of this study is to observe the fractural and fatigue performance of SCC. A study is conducted about mixing the proportion of municipal solid waste ash and tire chips by replacing cement content in Concrete which implements the fractural performance of self-compacting fiber-reinforced Concrete.

3. Materials Used

The different materials used in this investigation study are:

- Fly Ash
- Municipal Solid Waste Ash
- Rice Husk Ash
- Tire Chips
- Meta-kaolin
- Wood Ash

4. Test Methods

In this we will study various results for workability, compressive strength and flexural strength of SCC.

Mix Design For SCC:-

Initial study in which mix design was carried out at coarse aggregate content of 45 % by volume of Concrete and fine aggregate content of 45 % by volume of mortar in Concrete. Trial mixes were designed with superplasticizer content of 0% and then 1.15 % by cement weight for all further trails. A Polycarboxylic ether-based superplasticizer complying with ASTM C-494 Type F was used.

Table 3.5: Mix Proportions

MIX NO.	Cement (kg/m3)	MSWA (kg/m3)	F.A (kg/m3)	C.A (kg/m3)	Water (kg/m3)	Tire (%)	S.P (%)	W/C Ratio
M1	550	0	801	693	198	0	0	0.36
M2	495	55	801	693	197	0.25	1.15	0.39
M3	495	55	801	693	204	0.5	1.15	0.41
M4	495	55	801	693	213	1	1.15	0.43
M5	495	55	801	693	224	1.25	1.15	0.45
M6	495	55	801	693	248	1.5	1.15	0.50
M7	440	110	890	616	198	0.25	1.15	0.45
M8	440	110	890	616	207	0.5	1.15	0.47
M9	440	110	890	616	217	1	1.15	0.49
M10	440	110	890	616	229	1.25	1.15	0.52
M11	440	110	890	616	243	1.5	1.15	0.55
M12	385	165	979	539	197	0.25	1.15	0.51
M13	385	165	979	539	205	0.5	1.15	0.53
M14	385	165	979	539	214	1	1.15	0.55
M15	385	165	979	539	221	1.25	1.15	0.57
M16	385	165	979	539	230	1.5	1.15	0.59

TESTS PERFORMED:-

Various combinations for test performed for Compressive Strength:

S. No.	Combination for tests performed for Compressive strength
1	100 % OPC + 0% MSW ash + 0% Tire chips
2	89.75 % OPC + 10% MSW ash + 0.25 % Tire chips
3	89.5 % OPC + 10% MSW ash + 0.5% Tire chips
4	89 % OPC + 10% MSW ash + 1.0% Tire chips
5	88.75 % OPC + 10% MSW ash + 1.25% Tire chips
6	88.5 % OPC + 10% MSW ash + 1.5 % Tire chips
7	79.75 % OPC + 20% MSW ash + 0.25 % Tire chips
8	79.75 % OPC + 20% MSW ash + 0.5 % Tire chips
9	79.75 % OPC + 20% MSW ash + 1.5 % Tire chips

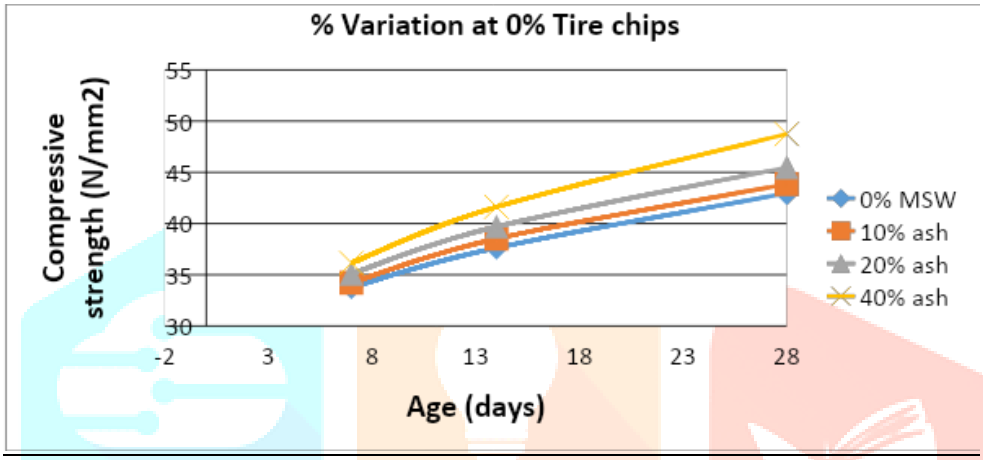
5. Test Results and Discussion:

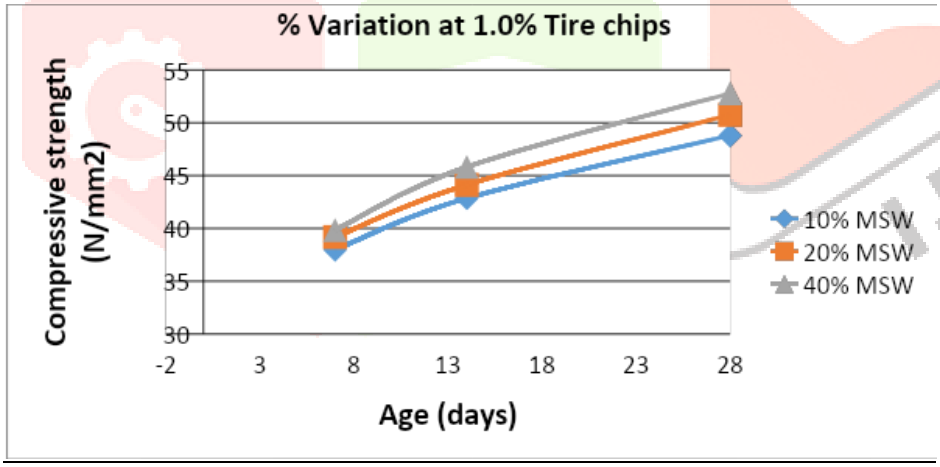
Workability of SCC

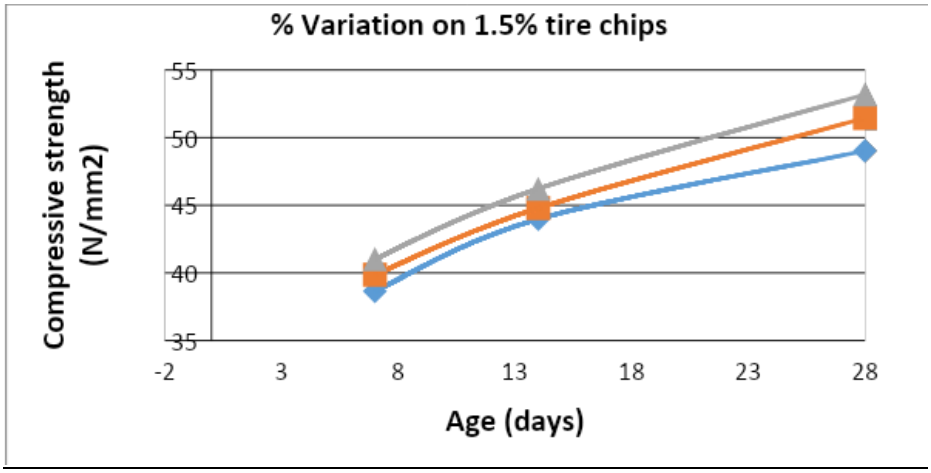
In the prepared Concrete at mix ratio 1:2:4 and at w/c ratio 0.4, a shear slump with a slump value of 90 mm is obtained. With the addition of 40% of Municipal solid waste ash at 0% tire chips in mix proportion then, the slump value increases from 90 to 93 mm And with the addition of 40% Municipal solid waste ash at 1.25 % tire chips in mix proportion then, the slump value increases from 90 to 96 mm. The reason is due to the adhesion of fiber in Ordinary Portland Cement (OPC). But, the decrease in value is further justified by increment on Municipal waste ash and Tire chips in mixed proportion with OPC.

Compressive Strength of SCC

The Compressive strength of Concrete follows an interesting trend when mixed with municipal solid waste ash and tire chips. With the addition of 40% of Municipal solid waste ash at 0% tire chips in Ordinary Portland cement (OPC) then, the compressive strength increases by 13.5%. And with the addition of 40% Municipal solid waste ash at 1.25 % tire chips in OPC then, the compressive strength increases by 26.5%. The reason is due to the adhesion of fiber in Ordinary Portland Cement (OPC). But, the decrease in value is further justified by increment on Municipal waste ash and Tire chips in mixed proportion with OPC.

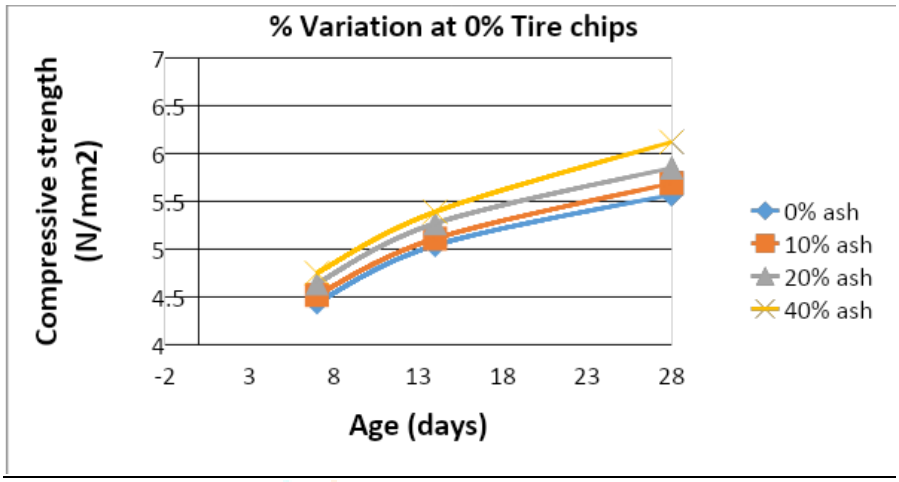


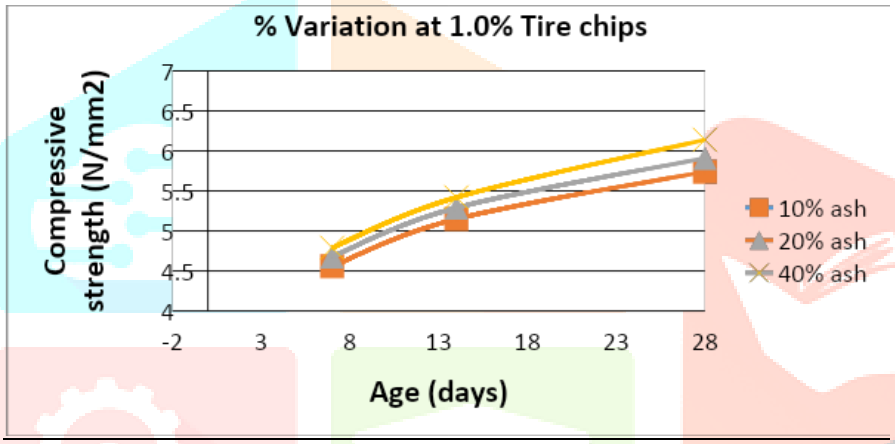


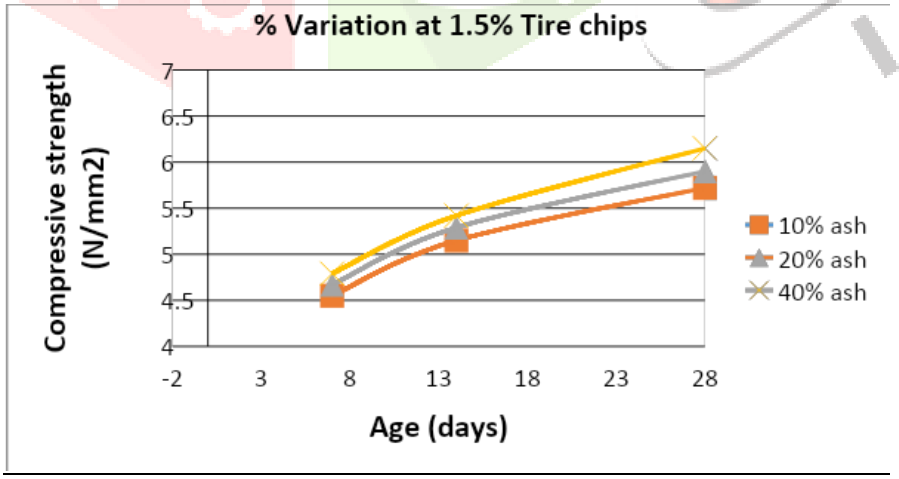


FLEXURAL STRENGTH OF SCC

The Flexural Strength of Concrete follows an interesting trend when mixed with municipal solid waste ash and tire chips. With the addition of 40% of Municipal solid waste ash at 0% tire chips in Ordinary Portland cement (OPC) then, the flexural strength increases by 11.8%. And with the addition of 40% Municipal solid waste ash at 1.25 % tire chips in OPC then, the flexural strength increases by 13.5%. The reason is due to the adhesion of fiber in Ordinary Portland Cement (OPC). But, the decrease in value is further justified by increment on Municipal waste ash and Tire chips in mixed proportion with OPC.







6. Conculsions

Based on the study performed following conclusion can be drawn:

The strength properties of the Concrete can be improved significantly by the addition of MSW Ash and tire chips.

According to the design mix proportion, we obtain drastic increments and decrements in the strength properties of Concrete.

The workability of mix increases with an increase in ash content at optimum mix proportion.

The slump value first increases with the addition of MSW Ash up to 3.3% at a w/c ratio of 0.4 and decreases with a further increase on w/c ratio.

The slump value is maximum at 40% of municipal waste ash and 1.25 % of the tire.

The compressive strength shows maximum increment up to 26.5 % at 40% MSW ash and 1.25% tire chips.

The compressive strength decreases further as the content of MSW ash and tire chips increases.

Similarly, the flexural strength we obtained shows a maximum increment of up to 13.5% at 40% MSW ash and 1.25 % tire chips.

The flexural strength also shows a decrease in strength as the content of MSW ash and tire chips increases.
Thus, we can say that at optimum mix proportion of Concrete with fiber, we can achieve self-compacting Concrete.

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