EFFECT OF ADDTION OF POLYPROPYLENE FIBRE ON THE PHYSICAL AND MECHANICAL PROPERTIES OF SELF COMPACTING CONCRETE

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Abstract - *Self-compacting concrete is a unique type of concrete that can be compacted under its own weight without the use of vibrations while remaining cohesive enough to be handled without segregation or bleeding. With the use of a water-reducing additive, it has a substantially higher cement concentration. Self-compacting concrete allows for a faster rate of concrete laying, as well as easier flow around congested reinforcing.*

SCC's fluidity and segregation resistance enable a high level of homogeneity, little concrete voids, and uniform concrete strength in situ, allowing for a superior level of finish and structural endurance.

It has a higher level of stability than traditional concrete. The effect of adding polypropylene fibre to self-compacting concrete is the focus of this project. Changes in bulk density, apparent porosity, and water absorption were used to study the impact on physical qualities, while changes in compressive strength were used to quantify the impact on mechanical attributes.

Key Words: *Self Compacting concrete, admixture, segregation resistance,filling ability, passing ability, Polypropylene Fibre, Compressive Strength, Apparent Porosity, Water Absorption, Bulk Density*

1. INTRODUCTION

It was developed in the 1980s in Japan as a high-strength concrete. Skilled personnel were required for efficient compaction of typical concrete, but the fall in the number of skilled workers in Japan resulted in a reduction in the quality of construction in the long-term durability of concrete structures. As a result, the invention of self-compacting concrete, which can be compressed into every corner of formwork without the need of compaction machinery, became necessary. This form of concrete was first proposed by Okamura in 1986. Ozawa and Maekawa of Tokyo University conducted research on self-compacting concrete on the basis of workability. In terms of the following features, high performance concrete was designed as a prototype for self-compacting concrete. Hardening shrinkage, hydration heat, hardening density, and so on.

Prof Aitcin classified it as a highly durable concrete with a low water cement ratio. Okamura altered the planned name from High Performance Concrete to Self Compaction Concrete since "high performance" was misinterpreted as "high durability."

Ozawa and Maekawa of the University of Tokyo have been working on developing self-compacting concrete, including a fundamental study on concrete's workability (Ozawa 1989, Okamura 1993 & Maekawa 1999).

In 1988, a prototype of self-compacting concrete was constructed using commercially available materials. In terms of drying and hardening shrinkage, heat of hydration, density after hardening, and other parameters, the prototype performed well.

“High Performance Concrete” was the name given to the concrete. In the three concrete stages the following definition was given

(1) Fresh: self-compactable

(2) Early age: avoidance of initial defects

(3) After hardening: protection against external factors

The current building scenario in India is characterised by a growth in the construction of huge and complicated structures, which frequently results in difficult concreting circumstances. In addition to auditory stress, vibrating concrete in busy areas may pose a risk to workers. There are always concerns concerning the robustness and long-term viability of such structures. As a result, if at all possible, vibration should be avoided in practise. SCC expertise has progressed from research to application in countries such as Japan, Sweden, Thailand, and the United Kingdom. However, in India, this knowledge is expected to be widely disseminated.

Fibre incorporation into the cementitious matrix can improve flexural characteristics and control fracture propagation and widening under various mechanical loading and shrinkage conditions.

The compressive strength and workability of fibre reinforced concrete are influenced by the proportions and properties of the constituent materials that make the composite .Polypropylene (PP) fibres have gained popularity in recent years for use in concrete, mainly owing to their low price and excellent characterisation in improving the physical and mechanical properties.

1.1 Self Compactability Mechanism

Fresh concrete's self-compactability is mostly determined by its ability to flow through obstacles[18]. When the concrete flows through the constrained zone of reinforcing bars, the method for creating self-compactability includes not only high deformability of the paste or mortar, but also resistance to segregation between coarse aggregate and mortar.Okamura and Ozawa have employed the following methods to achieve self-compactability:

(1) Limited aggregate content

(2) Low water-powder ratio

(3) Use of superplasticizer.

When concrete runs through an impediment, a highly viscous paste is required to prevent coarse material from becoming stuck. When concrete is distorted, a paste with a high viscosity avoids localised increases in internal stress caused by coarse aggregate particles approaching the surface. Only by using a superplasticizer and keeping the water-powder ratio at a very low value can high deformability be attained. Superplasticizers of the poly-carboxylate type are appropriate for SCC (Self Compaction Concrete)

Cement particles in conventional concrete are electrostatically charged, and they tend to clamp together, trapping water in the mix and increasing friction, i.e. they don't flow easily against each other.

By adding waterreducing admixture that a chemically sort of negatively charged molecules which bond themselves onto the cement particles, neutralize the charge and basically allows you to do the same job, the same amount of flowability without adding excess water. If excess water is added then more of excess water is left drying out and one has less cement in the mix leading to a lower strength and worse visual concrete.

With reference to the various research on (Ref:*Strengths and Failure Characteristics of Self-Compacting Concrete Containing Recycled Waste Glass Aggregate* -Rahman Khaleel AL-Bawi, Ihsan Taha Kadhim,and Osamah AL-Kerttani) studies show that it is possible to use self compacting concrete as a recycle medium for disposal of coloured green glass at a 30 % replacement rate. According to their research several ongoing studies and investigations is being carried out on determining the effect of waste glass cullet as a effective replacement for aggregate.

The author`s result concluded that there was no remarkable reduction in strength of self compaction concrete if coloured Waste Glass used at 30% replacement rate.[13]

2. EXPERIMENTAL PROCEDURE

2.1 Materials Preparation

The quantity of water binder used in the preparation of the specimen is 0.38. On a micro flow table, the flow diameter of the new paste was measured, and the sample was then cast into a (50 X 50 X 50)mm steel cast that had been agitated for 30 seconds to remove any trapped air. After vibration, the specimens were stored at room temperature for 4 hours before being placed in an oven and cured for 48 hours at 85°C. On the 28th day, the test was conducted. The investigation is based on the specimen's workability.

Table -1: Recron Reinforcement Fibre -Admixture%

Sample Designation	%Fly-Ash	%GGBS	Type Of Admixture	% Admixture
1% recron fibre reinforced	70	30	Polycarboxylic Ether	1%
2% recron fibre reinforced	70	30	Polycarboxylic Ether	1%
3% recron fibre reinforced	70	30	Polycarboxylic Ether	1%

Recron 3S fibres(Polymeric Synthetic fibres) have been used. The fibres are having length between 6 to 48mm, effective diameter of 10 micron to 1mm and a specific gravity of more than 1.0.the dosage suggested is in between 0.6 to 2kg/cumec which is 0.23 to 0.6% by weight of cement in the mixture. Use regulations as specified in IRC- 44/456 or any other specialised literature was followed. Fibre has a water absorption of less than 0.45%. Generally the aspect ratio varies from 200 to 300.One of the characteristic of synthetic fibre is that these fibres offer good resistance to alkali and UV light.

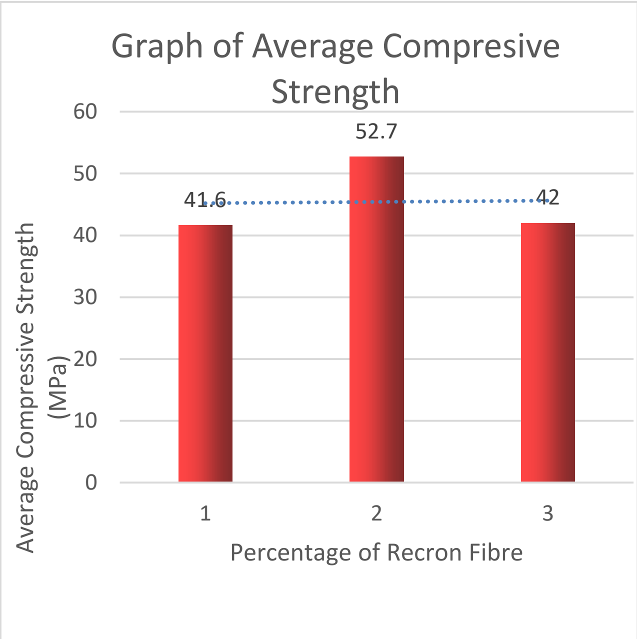
3. Results and Discussion

3.1 Compressive Strength

Four samples of concrete cube have been reinforced using 2% and 3% recron fibre and three samples of concrete cube were reinforced with 1% recron fibre. The cubes were cured for 28 days and then tested using compressive testing machine of 1000kN. Compressive load acts gradually till failure occurs. The average compressive strength of 2% specimen was found to be 26.68% more than 1% specimen and 20.30% more than 3% specimen . Incorporation of prolypropylene fibre increased porosity which in turn has a negative eggect on the compressive strength. This is supported by Kroehong et al .

Table-2: % Recron Reinforcement Fibre---Average Compressive Strength(in MPa)

% of Recron Fibre	Average Compressive Strength(MPa)
1	41.6
2	52.7
3	42



Graph-1: Average Compressive Strength(MPa) -- % Recron Fibres

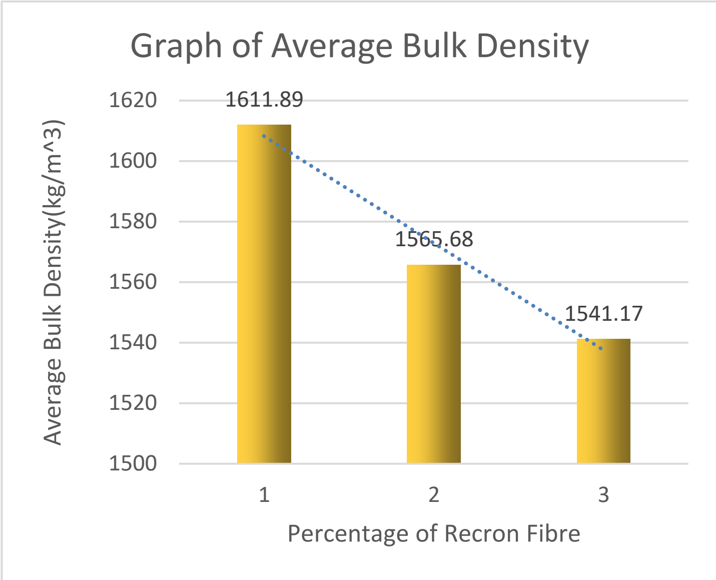
3.2 Bulk Density

Three sample each of concrete cube were reinforced with 1%, 2% and 3% recron fibre for finding out the bulk density, apparent porosity and water absorption.

Graph- 2 illustrates outcome of reinforcement of recron fibre on the bulk density of the specimen. Minimum average bulk density is observed for 3% recron fibre reinforcement which increases by 1.56% for 2% recron fibre reinforcement which further increases by 2.68% for 1% recron fibre reinforcement and as the maximum bulk density is observed for the 1% reinforced sample. The results point out that as the amount of polypropylene fibre reinforced in the paste increase the value of bulk density drops down or decreases. The decrease in bulk density can be attributed to the supplementation of porous natural fibres, which has a density less than that of the paste.

Table-3: % Recron Reinforcement Fibre--Average Bulk Density(in kg/m^3)

Percentage of Recron Fibre	Average Bulk Density(kg/m^3)
1	1611.89
2	1565.68
3	1541.17



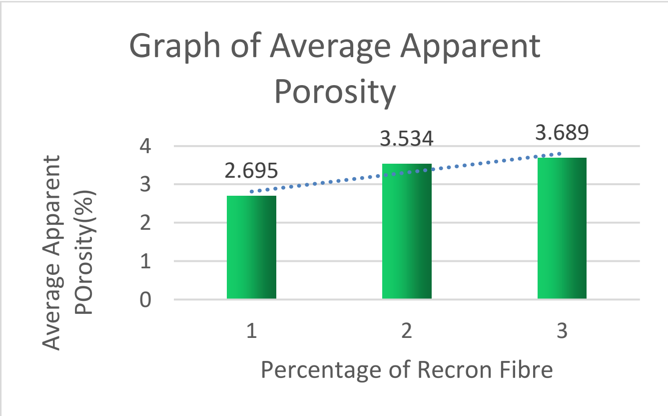
Graph-2: Average Bulk Density (kg/m^3) -- % Recron Fibres

3.3 Apparent Porosity

Graph 3 and Table 4 illustrates consequence of the reinforcement of recron fibre on the concrete cube. Average apparent porosity of 2% reinforcement is 31.13% more than 1 reinforcement whereas that of 3% reinforced sample is 4.38% more than the 2% reinforced sample. The difference in average apparent porosity between 1% and 2% reinforced sample is quite more as compared to that between 2% and 3% reinforced sample. The results suggest that the increase in fibre content increased the total porosity. This is due to the fact that the fibre has a cellular porous structure.

Table-4: % Recron Reinforcement Fibre--Average Apparent Porosity(in %)

Percentage of Recron Fibre	Average Apparent Porosity (%)
1	2.695
2	3.534
3	3.689



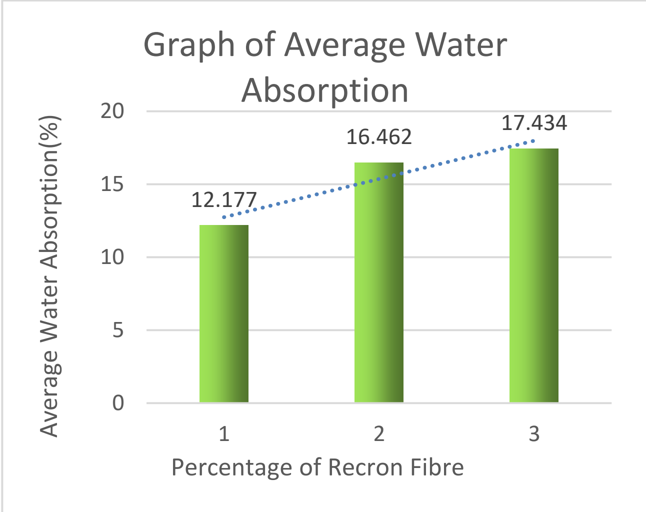
Graph-3: Average Apparent Porosity % -- % Recron Fibres

3.3 Water Absorption

Table 5 and Graph 4 illustrates the result of the reinforcement of recron fibre on the water absorption of concrete cube. Average water absorption of 2% reinforcement is 35.18% more than 1 reinforcement whereas that of 3% reinforced sample is 5.90% more than the 2% reinforced sample. The difference in average water absorption between 1% and 2% reinforced sample is quite more as compared to that between 2% and 3% reinforced sample. As suggested by T. Alomayri and I.M. Low [11] due to the greater interfacial area between the matrix and the fibre and the natural fibre being hydrophilic in nature the water absorption increases.

Table-5: % Recron Reinforcement Fibre--Average Water Absorption (in %)

Percentage of Recron Fibre	Average Water Absorption(%)
1	12.177
2	16.462
3	17.434



Graph-4: Average Water Absorption % -- % Recron Fibres

4. CONCLUSIONS

1) The compressive strength increased from 1% reinforcement to 2% reinforcement but then decreased from 2% reinforcement to 3% reinforcement of recron fibre in geopolymer concrete cube.

2) The bulk density decreased from 1% reinforcement to the 3% reinforcement with maximum bulk density being observed for 1% reinforcement and minimum bulk density being observed for 3% reinforcement of recron fibre in the geopolymer concrete cube.

3) The apparent porosity increased from 1% reinforcement to the 3% reinforcement with maximum bulk density being observed for 3% reinforcement and minimum bulk density being observed for 1% reinforcement of recron fibre in the geopolymer concrete cube.

4) The water absorption increased from 1% reinforcement to the 3% reinforcement with maximum bulk density being observed for 3% reinforcement and minimum bulk density being observed for 1% reinforcement of recron fibre in the geopolymer concrete cube.

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