



STUDY ON FLEXURAL BEHAVIOR OF R.C BEAM USING DIFFERENT STARCHES AS AN ADMIXTURE

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Abstract

Admixtures are basically used to modify the concrete properties. During or immediately before mixing of concrete admixtures are introduced. There are enormous benefits obtainable through the usage of admixtures like increasing concrete strength, improving quality, improving workability, acceleration or retardation in setting time etc. The effects of admixtures are generally varied with the types of cement, mix proportions and dosages. Starches can be used as admixture in concrete. Starch effects on the setting time of concrete. In this study, starches used are Cassava (CA) and Corn (CO). Different sample of starches measured in percentile (0, 0.6, 1.2, 1.8) by mass of cement were separately mixed to the existing concrete to prepare the required material and the curing was done for 7 and 28 days. With the addition of the starches the workability and setting time of concrete get increased. The starches such as corn and cassava can be replaced by the use of chemical admixtures. It

reduces the extra cost of the use of synthetic admixtures. The result shows 0.6 % CO and 1.2% CA increases in split tensile strength. For checking durability Rapid Chloride Permeability Test has been conducted. In this study flexural behavior of R.C beams (conventional vs optimize percentages of starches) is compared.

Key Words: Cassava Starch (CA), Corn Starch (CO), Admixture, Conventional Concrete, Compressive Strength, Split Tensile Strength, Rapid Chloride Permeability Test, Flexural Test

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1 INTRODUCTION

This project presents the flexural behavior of R.C beam using different starches as an admixture. Concrete is a shapeable and strong construction material. The cement and water binds FA and CA in the form of paste. The initial setting starts within a few hours. After taking some weeks concrete achieve full hardness and strength. Concrete continues to harden and reach strength over many years. A particular kind of matter with uniform properties added to concrete mixes to modify one or more properties of the concrete to make them good for specific motive are called as admixtures. Some of the admixtures are able to modify one or more than one properties of the concrete. For a special intention an admixture can also be initiated in a mix.

A.A.Akindahunsi, S.E. Iyuke (2014) [1] in this study concrete is modified by the starches and used as a repair material. The starch used in this project is corn. Its changes concrete properties (with 0, 2.5 and 5% addition of starch by weight of cement) such as compressive strength, permeability and sorptivity. Tests had been done - compressive test, oxygen permeability test, sorptivity test. The result showed 9 and 3% expand in concentration for 2.5 and 5% starch additions separately compared to the regulate afterwards 56 days of curing, although the sorptivity and permeability tests as compared carefully with the regulate. At definite magnitude, corn starch added cement and concrete showcase less slump and speeded up setting time.

A.A.Akindahunsi, S.E. Iyuke & H.C. Uzoegbo, (2014) [2] in the

analysis starches which were use in this project corn, cassava. Cubes were casted near the various percentages (0, 0.5, 1.0, 1.5 and 2%) by weight of the cement utilized in the mix. Tests had been done-creep and shrinkage test, heat of hydration, compressive test. It is likewise came upon that one extension of no more than 1% starch in concrete mix appear to grant maximum bring about association to beat strength show although as much as 2 % addition of starch grants excellent ensue corresponding creep and shrinkage.

A.A.Akindahunsi, and H.C.Uzoegbo (2015) [3] this paper inspect concrete durability and strength with starch admixtures. Starches mainly used cassava (CA) and maize (MS). Compressive test and oxygen permeability test transmit out afterwards curing of 3, 7, 14, 21, 28, 56, 90, 180, 270, 360 days. Strength increased after 1 year for cassava 0.5 and 1.0 were 2.7 and 3.8 respectively; whereas maize 0.5, 1.0 gave 1.5% extend under control.

Abalaka, A. E. (2011) [4] studied comparative effects of sugar and cassava starches in cement mortar concrete. Simple white sugar and cassava starch added in concrete with the concentration of 0 to 1% by total weight measuring of cement in the mix and curing had done for 3, 7, 14, 28 days. Compressive strength for cassava with 0.05% concentration after 28 days curing reduced initial setting time, similarly 0.06% concentration of sugar increased the setting time. The paper concludes that cassava is good substitute of sugar.

George Rowland Otoko (2014)[5] the paper represented minimize the outcome of concrete in hot weather by the uses of cassava starch. In hot weather increase the temperature of fresh concrete that is why it needs more water to maintain its slump value and set rapidly in hot weather. Laboratory results proved that cassava as retarder slow down its setting time and enhance its workability.

ShiluKurian Joseph, Annie Sonia Xavier (2016)[6] the study represented the properties of fresh and harden concrete effected by starch admixtures. The starches are tapioca (0, 0.5, 1.0, 1.5, 2.0 and 2.5%) and maize (1.5%) used combined in the mix by the total weight of the cement. As result it had been found out that 2% tapioca and 1.5% maize provides good results in flexure, split tensile and compression if maize content increases its reduces the strengths.

Suhad M Abd, Qassim Y Hamood, Alaa S Khamees and Zainab H Ali (2016) [7] this study only showcase the effect of concrete properties by using corn starch. Corn starch had been taken in

account of 0, 1, 3, 5% concentration by weight of the cement. 1% concentration gives good compressive result, increases the density of concrete specimen.

The uses of starches are eco-friendly concept. These starches are best to use in hot weather concreting. The corn and cassava are abundantly available and by using this will reduce the cost as compare to the other admixtures. Using the starch admixture provides good strength in concrete. These starches are easily available. Using starches are more economical as compare to chemical admixtures.

2 EXPERIMENTAL INVESTIGATION

2.1 Materials used

2.1.1 Cement

Cements used Penna Cement OPC with 53 grades conforming from the specification as per IS: 12269-1987 [8]. Cement properties shown in Table 1.

Table 1: Properties of cement

SL NO	Property of cement	Value
1	Fineness of cement	3.7%
2	Standard consistency	31.20%
3	Initial setting time	33min
4	Specific gravity	3.12

2.1.2 Aggregates (Fine Aggregates and Coarse Aggregate)

As per code IS383:1970 [9]. Maximum size of CA is 22mm. Properties of CA and FA is shown in Table 2.

Table 2: Properties of FA and CA

Fine Aggregate	Sieve Analysis	Zone II
	Specific Gravity	2.35
Coarse Aggregate	Sieve Analysis	Zone III
	Specific Gravity	2.86

2.1.3 Corn and Cassava Starches

The starches measured in percentile (0, 0.6, 1.2, and 1.8 %) by mass of cement which was separately mixed to the existing concrete to prepare the required material for various tests. Some pictures of CO and CA shown in Fig. 1.



Fig. 1. (a) Corn Starch & (b) Cassava Starch

2.2 PREPARATION OF TEST SPECIMENS

The size of concrete cube is 150 mm $\times$ 150 mm $\times$ 150 mm and cylinder is 150 mm diameter, 300 mm height. The mix design of concrete carried out as per IS-10262:2009 [10] for M40 grade. The ratio of mix is 1: 1.25: 2.70 with w/c ratio 0.40. Corn and Cassava were added by total weight of cement used in concrete as 0.6%, 1.2%, 1.8% concentration separately. The concrete cubes, cylinders with and without starches were casted and cured for 7 and 28 days. Cylinders are casted for RCPT and the size of the specimen is 100 mm diameter and 200 mm height. Beams are casted for Flexure Test; the size of the beam is 210 $\times$ 250 $\times$ 1500 mm which is shown in Fig. 2. Reinforcement detailing is shown in Table 3.

Table 3: Reinforcement detailing of R.C Beam

Specimen No.	Longitudinal reinforcement		Transverse reinforcement		Description
	Top (mm)	Bottom (mm)	Size (mm)	Spacing (mm)	
1	2 - 10 Φ	2 - 10 Φ	8 Φ	150	Conventional
2	2 - 10 Φ	2 - 10 Φ	8 Φ	150	0.6% Corn
3	2 - 10 Φ	2 - 10 Φ	8 Φ	150	1.2% Cassava

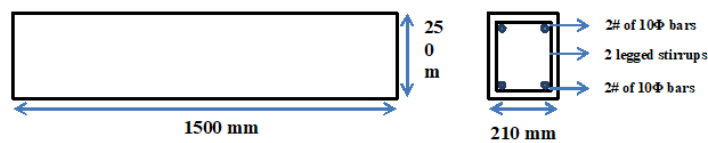


Fig. 2. Dimensions of beam specimen

3 RESULTS

3.1 Compressive Strength Test

After curing the specimens, the specimens are taken out removed of surface dust and tested. The sample cubes are then subjected to compression where a particular amount of mass is placed on them and the sample is subjected to compression at the given rate. This process continues till the particular sample cube with weight on it can withstand the strength. Calculate and report the compressive strength by using Compressive testing machine and the test results are summarized in Table 4. Fig. 3(a) and (b) shows the graphical representation of compressive test result.

Table 4: Comparison of Compressive Strength results cubes made with and without starches

Sl No.	Name of the materials	Percentage of starches	7 days (N/mm ²)	28 days (N/mm ²)
1	Conventional	0	37.94	52.33
2	Corn	0.6	37.89	50.73
		1.2	38.71	46.28
		1.8	40.68	58.28
3	Cassava	0.6	40.44	46.26
		1.2	38.07	43.7
		1.8	31.80	51.24

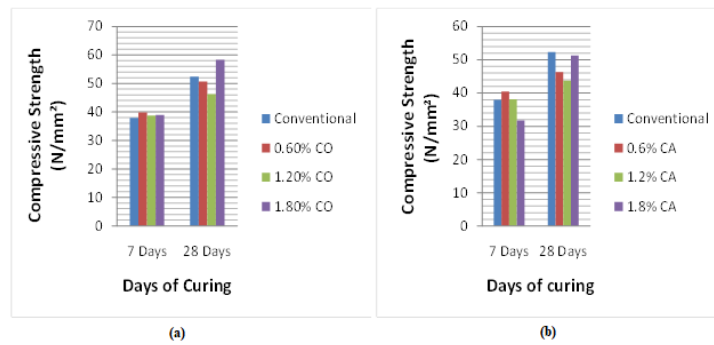


Fig.3. (a) Comparison of Compressive Strength for Corn (CO) Starch (b) Comparison of Compressive Strength for Cassava (CA) Starch

3.2 Split Tensile Strength Test

After curing the specimens are taken out removed of surface dust and tested. Weight is applied to a cylinder which is placed in a horizontal way and the compression process continues till it fails to withstand it. In this study Corn and Cassava starches added in different percentage like 0.6%, 1.2% and 1.8% to concrete and the results are summarized in Table 5. Fig. 4(a) and (b) shows the graphical representation of split tensile test result.

Table 5: Split tensile strength result of cylinder with and without starches

Sl.No.	Name of the materials	Percentages of starches	7 days (N/mm ²)	28 days (N/mm ²)
1	Conventional	0	3.12	3.58
2	Corn	0.6	3.23	3.83
		1.2	3.01	3.58
		1.8	2.85	3.75
3	Cassava	0.6	2.13	4.11
		1.2	3.15	4.38
		1.8	3.35	3.93

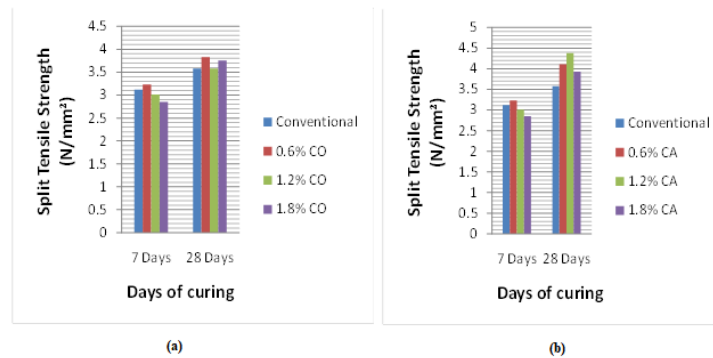


Fig.4. (a) Split Tensile Strength for Corn Starch (b) Split Tensile Strength for Cassava Starch

3.3 Rapid Chloride Permeability Test

As per uniform check procedures are AASHTO T277-83 [11] and ASTM C1202[12]. The check approach comes to obtaining a 100 mm diameter cylinder sample of the concrete being tested and 50 mm thickness cut from the cylinder. The radial section of the cylinder is glued and then the particular glued area is dried by placing it in an area which is void of any substance and it is then kept for 180 mins. The sample is soaked for an hour and then bathing process takes place for next 18 hrs.. It is after which fixed within the test equipment. The left-hand part -Ve of one's test cell is full of 3% NaCl solution. The right-hand part +Ve of one's assess cell is full of 0.3MNaOH solution which is shown in Fig. 5. The process is after which hooked up in addition to a 60 V ability is obtain 6 hours. Readings are taken each half-hour. At the tip of 6 hours the sample is far away from the cell and in the interest of coulombs passed through the model is calculated. The results are shown in Table 6. The test has been conducted by the use of optimized percentage (0.6% CO & 1.2% CA) of starches.

Table 6: RCPT result

Type of specimen	Charge Passing (Coulombs)	Chloride Permeability
Conventional	2401.2	Moderate
0.6% Corn	2002.5	Moderate
1.2% Cassava	1924.2	Low



Fig.5.Rapid Chloride Permeability Test

3.4 Flexural Test

In this particular test a beam is placed on a simply supported condition, the beam is subjected to two point load shown in Fig.6. The frame which surrounds the beam can withstand a weight of 100 T. Plum bob is used to measure the accuracy level. When load is repeatedly placed the deflection increases at constant rate until the capacity of the beam is accomplished.

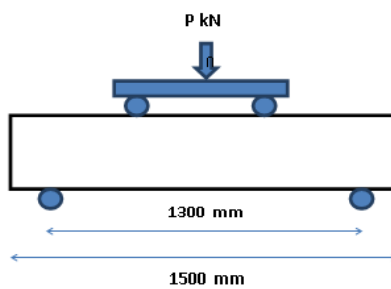


Fig. 6. Experimental setup

For checking the flexural behavior various types beams are casted and cured for 28 days. The types of beams are conventional, 0.6% CO and 1.2% CA. The starches are added in concrete by the total weight of the cement. From the test result Fig. 7 found the stiffness values for conventional, 0.6% CO and 1.2% CA are 12.93 kN/mm, 14.51 kN/mm and 17.24 kN/mm respectively.

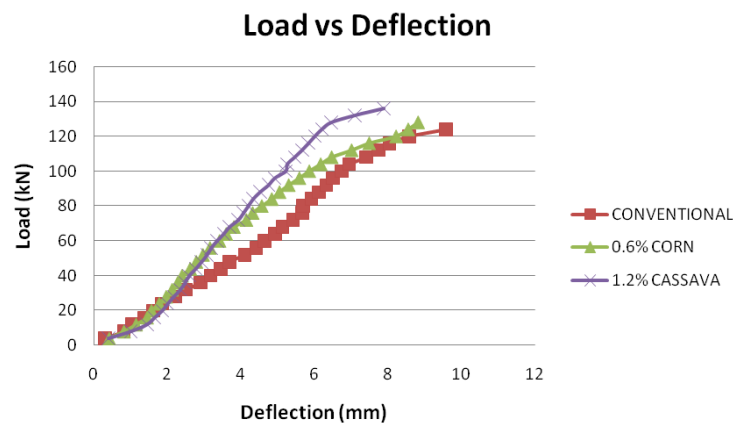


Fig. 7. Load-Deflection graph

4 Conclusion

1. From the experimental investigation its found that the compressive, split tensile and durability of concrete has been enhanced by addition of starches. The starches should be added in concrete optimize percentages further addition it reduces its strength. In the aforementioned one learn about 1.8% CO habituated just right brings about compression test and 0.6% CO, 1.2% CA inured excellent leads to split tensile strength.

2. Durability checks (RCPT) 0.6% CO and 1.2% CA have it good produce as correlate to ordinary concrete. 0.6% CO is 1.2 times less permeable and 1.2% CA is 1.24 times less permeable than conventional concrete.

3. Flexural test result provides 0.6% CO is 1.12 times and 1.2% CA is 1.33 times greater than conventional R.C beam.

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