

Experimental Study of Different Admixtures on the Workability and Compressive Strength of Concrete

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ABSTRACT

In this study different type of admixtures (jaggary water, sugarcane water) were used for M30 grade of concrete to improve the properties of fresh and harden Concrete such as:

- Increase the workability
- Increase the compressive strength by adoption of admixtures which increase the workability and hence the strength is increased through the reduction of water content.

The experimental work was divided into two phases:

1. Tests on basic materials (cement, aggregate, sand, water) and the effect of recommended dose of admixture on the properties of fresh and hardened concrete.

The results of tests for the basic materials were carried to ensure that their results conforming to their standards and can be used.

2. In 2nd phase use admixture and studied the effect on.

- Workability of M30 grade concrete by adding admixtures (2.5% ,5%): Slump for jaggary water. Slump for sugarcane water.
- Study on compressive strength of M30 grade concrete by adding admixtures (2.5%,5%)

Compressive strength for jaggary water. Compressive strength for sugarcane water.

INTRODUCTION

Concrete is any product or mass made by the use of cementing medium. Generally, this medium is formed by the reaction of cement and water. Concrete is made with several types of cement and also containing pozzolana, fly ash, blast furnace slag, etc. The major components of concrete are a mixture of cement, water, aggregate (fine and coarse) and

sometimes admixtures.

The interrelation between the constituent of this mixture:

Firstly, one can view the cementing medium as the essential building material, with the aggregate fulfilling the role of cheap, Or cheaper diluting.

Secondly, one can view the coarse aggregate as assort of mini- masonry which is joined together by mortar i.e., by a mixture of hydrated cement and fine aggregate.

Thirdly, is to recognize that, concrete consist of two phases hydrated cement paste and aggregate, and, as a result, the properties of concrete are controlled by the properties of the two phases and also by the presence of bond between them.

In its hardened state concrete is a rock like materials with a high compressive strength, by virtue of the ease with which fresh concrete in its plastic state may remolded into virtually any shape it may be used advantages architecturally or solely decorated purposes.

Concrete is composed mainly of three materials, namely Cement, water, and aggregate and an additional material, known as admixture, is sometimes added to enhance certain of its properties.

Concrete has the following advantages:

1. Concrete is economical as compared to other engineering materials, except cement, it can be made from locally available coarse and fine aggregate.
2. Concrete has high compressive strength, and the corrosive and weathering effects are insignificant. When prepared accurately its strength is equal to a hard-natural stone.
3. The green concrete can be easily handling and molded into any shape or size according to specification.
4. It is strong in compression and has infinite structural applications in combination with steel reinforcement, the concrete and steel have almost equal coefficients of thermal expansion. The concrete is widely used in the construction of foundations, walls roads, airfields, buildings, water retaining structures, docks and harbors, dams' bridges, silos, etc.
5. Concrete can even be sprayed on and filled into fine cracks for repairs by the geniting process.

6. Since the concrete can be pushed therefore it can be laid in the difficult positions also.
7. It is durable and fire resistance and requires less maintenance.

The disadvantages of concrete are as follows:

1. Concrete has low tensile strength therefore cracks easily. That's why it has to be reinforced with the steel bars.
2. Fresh concrete shrink on drying, and hardened concrete expands on wetting.
3. Concrete under uninterrupted loading undergoes creep resulting in reduction of prestress of the prestressed concrete construction.
4. Concrete is likely to break by alkali and sulphate attack.
5. The lack of ductility inherent in concrete is disadvantages with respect to earthquake resistance.

ADMIXTURE:

In this work Slump cone test and compression test for different combinations of concrete and natural admixtures. In the research work, natural admixtures used are sugarcane water and jaggery water with 2.5% and 5% concentration. Concrete used was M30 grade.

Admixtures are used to change the properties of concrete. Admixtures are substances mixed into a batch of concrete, during or immediately before its mixing. There are numerous benefits available through the use of admixtures such as: improved quality, coloring, greater concrete strength, increased flow for the same water- cement ratio, enhanced frost and sulphate resistance, improved fire resistance, cracking control, acceleration or retardation in setting time, lower density and improved workability. The effects of an admixture generally change with the type of cement, mix proportion and dosage.

FOLLOWING ADMIXTURES USED IN MIX:

A. Sugarcane water:

Sugarcane is a carbohydrate, a substance made of carbon, oxygen and hydrogen. It can be useful when concrete used in hot weather, when the normal setting time of concrete is shortened by the higher surrounding temperature such as Gujarat, Rajasthan etc.

Very small dosage of the order of 0.06 percent of sugarcane can delay initial setting time by about 45 minutes 45seconds. It acts as retarder, which increase setting time of concrete.

Sugarcane water was used in the concrete production. A white crystalline solid easily soluble in water and easily available in market and used in the experimental works. Sugarcane water was added in concrete mix with three different dosages as 2.5 and 5% by weight of cement.

B. Jaggary water:

A solid form of Jaggary available in market and effortlessly soluble in water was used as admixture. jaggary was added in concrete composition with three different dosages as 2.5 and 5% by weight of cement.

MIX PROPORTION:

Nominal proportions chosen for the concrete mix of M30 grade as per IS 10262-1982 and it was 1:1.875:2.890 (Cement: sand: aggregate) by weight. For better workability, graded aggregates were used as 60 % of 20 mm and 40 % of 12.5mm and fine aggregate (local sand) of zone II was used in the concrete preparation.

OBJECTIVES OF THIS STUDY:

The objective of this research is to study the effect of using admixtures to improve concrete properties both in its fresh and hardened stages.

This can be attained through experimental work on:

- study of admixture on workability of M30 mix.
- study of admixture on compressive strength of M30 mix.
- Study of M30 mix by Reducing water content.

LITRATURE REVIEW

Gap of study

On the basis of survey of available literature following gaps in the research are being identified. There is very limited research which focuses on comparison of admixtures; and There is almost nil research available which focuses on natural admixtures.

Concluding Remarks

Present chapter tells about the details of research contributions and investigated gaps in the research work. Details of solution methodology and implementation of research tools to the case problem are presented in upcoming chapters.

Objectives of the Research Work

Following are the objectives of research work.

- Evaluation of performance of concrete using natural admixtures;
- Evaluation of performance of natural admixtures; Ranking of different natural admixtures.

EXPERIMENTAL WORK

Where the main requirement is to:

1. Improve workability
2. Increase strength.

Concrete mix:

A concrete mix design or trial mixes should be made with normal concrete mix design. In this study two admixtures are used are to be used to check the property of concrete:

1. Jaggery water
2. Sugarcane water

Materials test

1. Test of base materials, i.e. cement, gravel, water and admixture
2. the effect of recommended doses of admixture on the properties of fresh and hardened concrete, i.e. (workability & strengths)

Testing program Grade M30

1. Ordinary reference mix (RM).

(12 cubes)

- 3 cubes will be tested on 7 days
- 3 cubes will be tested on 14 days
- 3 cubes will be tested on 28 days
- 2. Reference mix admixture to increase workability
- 3. Mix with admixture to increase workability and strength.
- 4. Mix with admixture to reduce water content and check its strength and workability.

Notice

- All specimens will be cured on room temperature up to the date of test.
- Pozzolana Portland cement will be used.
- Medium workability.
- Crushed stone aggregate will be used so as to get the strength 40N/mm²easily.

Workability

Slump test have been used as a measure of workability for the M30 concrete.

Table 1 average alternative results of admix concrete property

S No.	Alternative	Results		Overall Ranking (for workability)
		Slump Cone Test	Compression Test (N/mm ²)	
1	Jaggery	23.75	25.55	2
2	Sugarcane	23	28.88	1
3	M30	25	27.33	3

For the two admixtures the observation on slump are as follow:

From Table 1 one can find that sugarcane scores highest on criteria, slump cone test with the score 23, which leads to this type of ranking, while conventional M30 concrete scores rank 2 with scores 25 for slump cone test and jaggery obtained the rank 3 with scores 23.75, on slump cone test.

Compressive strength:

Compressive strength results for the two admixtures (jaggery water, sugarcane) were obtained from the average of three cubes under the normal laboratory temperature and same curing conditions for 7, 14, 28 days.

From Table 1 one can find that Sugarcane scores highest in compression test, with the score 28.773, which leads to this type of ranking, while conventional M30 concrete scores rank 2 with score 27.33 for slump cone and jaggery obtained the rank 3 with score 25.55 on compression test.

The higher rate of increased strength was in sugarcane admix concrete which is the main scope of the research.

water reduction (6%) + admixtures:

from table 3.2 For the two admixtures of concrete mix (jaggery water, sugarcane water) water content was reduced up to 6% and then sugarcane admix concrete obtained highest slump with scores 23 and, jaggery admix concrete have 2nd with score 23.75.

Table 2

Variation of admixtures	Height of slump for jaggery water	Height of slump for sugarcane water
2.5	28	29
5	19.5	17

Table 2 slump value after reduction water content for different admix concrete

Avg. slump for jaggery = $28+19.5+2 = 23.75$ Avg. slump for sugarcane = $29+17/2 = 23$

RESULTS AND DISCUSSION

Table 3: Slump Cone Test Results

S.No	Particulars	Height (cms)
1	M30+ 2.5% Jaggery water	28
2	M30+ 5% Jaggery water	19.5
3	M30+ 2.5% sugarcane	27
4	M30+ 5% sugarcane	17
5	M30	25

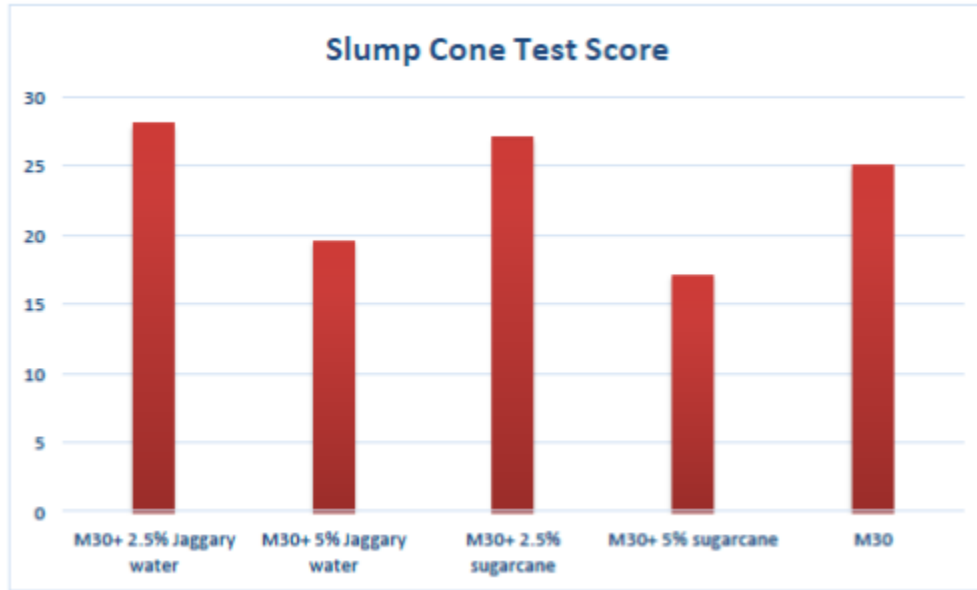


Figure 1 shows the graphical version of above-mentioned results.

Table 4: Compressive Strength Test Results

S.No	Particulars	Compressive Strength (N/mm ²)
1	M30+ 2.5% Jaggary water	11.66
2	M30+ 5% Jaggary water	12.33
3	M30+ 2.5% sugarcane	11.77
4	M30+ 5% sugarcane	12.66
5	M30	13.11

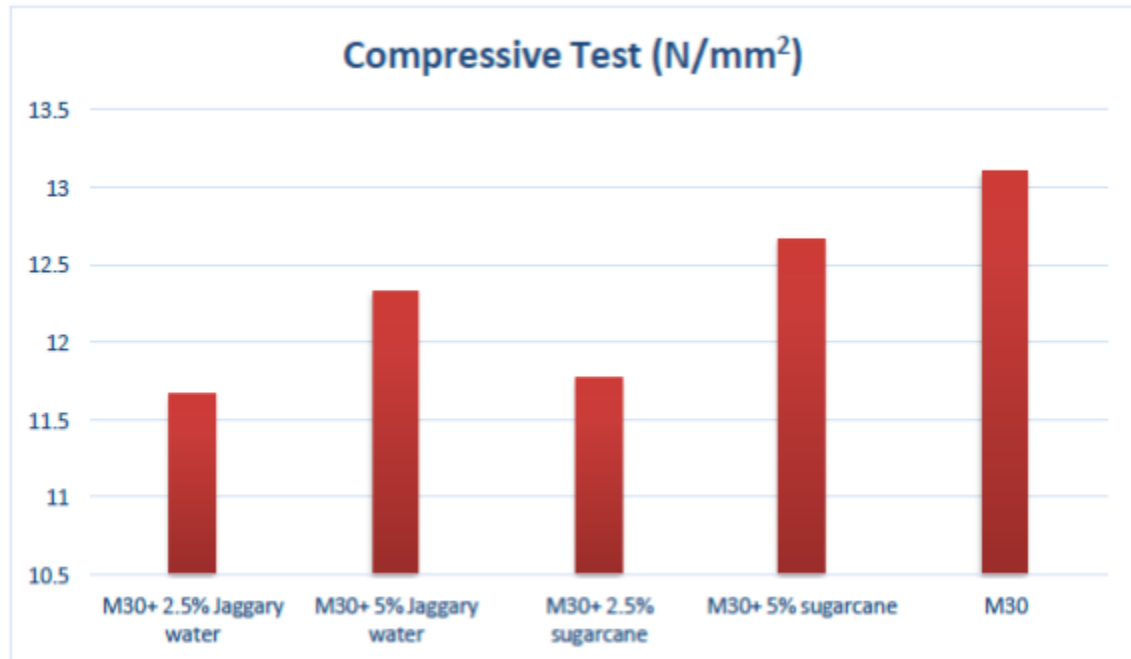


Figure 2 shows the graphical version of above-mentioned results.

Table 5: Compression Test Results (14 Days Test)

S.No	Particulars	Compressive Strength (N/mm ²)
1	M30+ 2.5% Jaggary water	15.55
2	M30+ 5% Jaggary water	17.77
3	M30+ 2.5% sugarcane	20.11
4	M30+ 5% sugarcane	22
5	M30	21.33

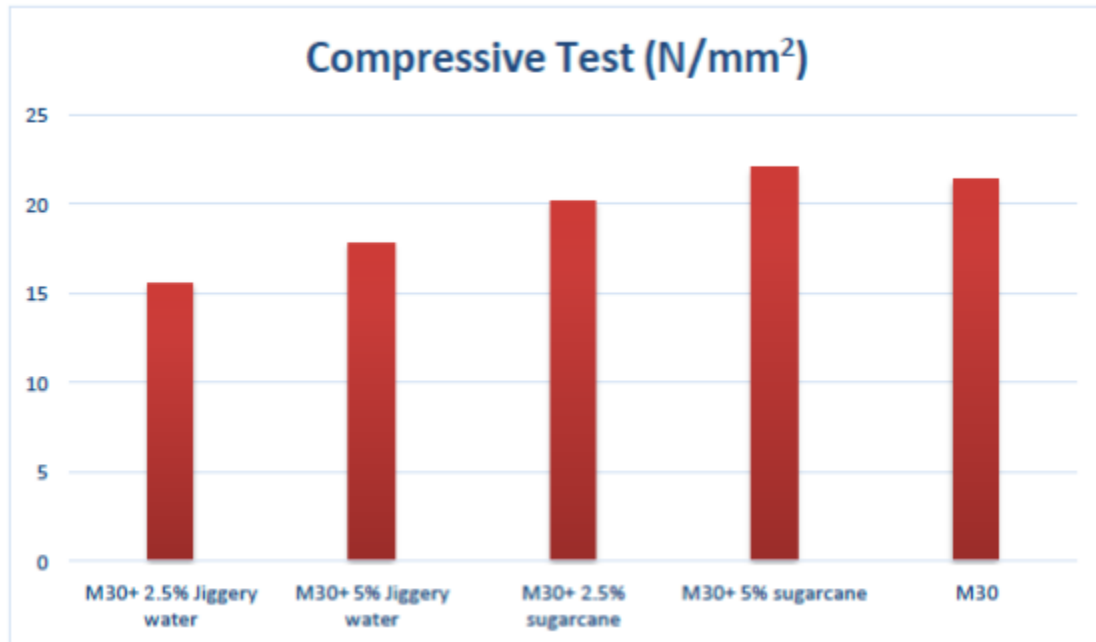


Figure 3 shows the graphical version of above-mentioned results.

Table 6: Compression Test Results (28 Days Test)

S.No	Particulars	Compressive Strength (N/mm2)
1	M30+ 2.5% Jaggary water	22.22
2	M30+ 5% Jaggary water	25.55
3	M30+ 2.5% sugarcane	23
4	M30+ 5% sugarcane	28.88
5	M30	27.33

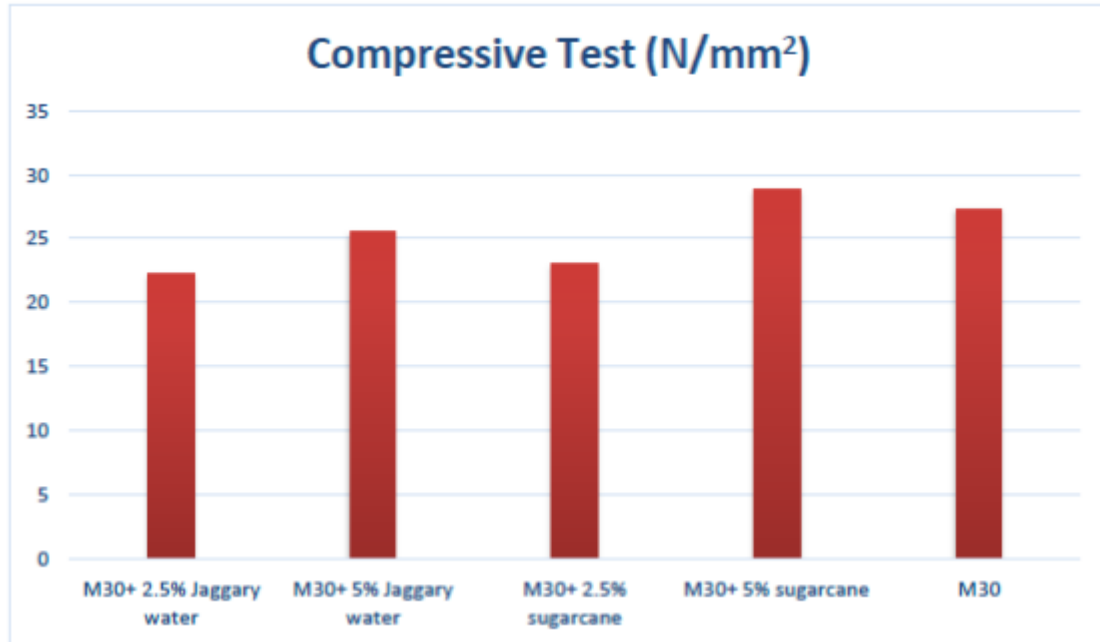


Figure 4. shows the graphical version of above-mentioned results.

Discussion

Table 7 shows the summary of results obtained from the research work, based on average values.

Table 7: Summary of Result Obtained

S. No	Alternative	Slump Cone Test Result (cm)	Compression Test Result (N/mm ²)		
			7 Days	14 Days	28 Days
1	M30+ 2.5% Jaggary water	28	11.66	15.55	22.22
2	M30+ 5% Jaggary water	19.5	12.33	17.77	25.55
3	M30+ 2.5% sugarcane	27	11.77	20.11	23
4	M30+ 5% sugarcane	17	12.66	22	28.88
5	M30	25	13.11	21.33	27.33

On the basis of above table rankings of different admixtures along with the conventional concrete can be obtained, for which again average values of the alternatives are investigated, the details of which are presented as follows.

Table 8: Average scores of alternatives for different tests

S.No	Alternative	Results	
		Slump Cone test (cm)	Compression test (N/mm ²)
1	Jaggary Water	23.75	23.885
2	Sugarcane	22	25.94
3	M30	25	27.33

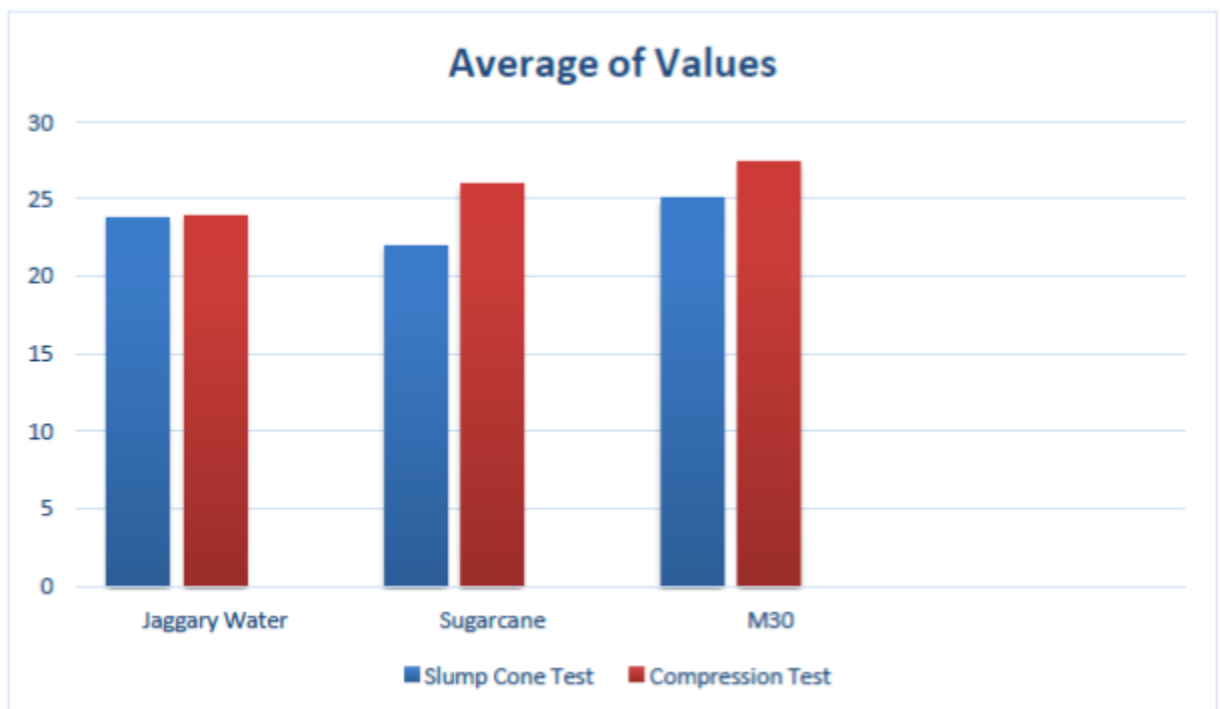


Figure 5 Average Values of Alternates for Different test

Compression test result graph and slump test graph

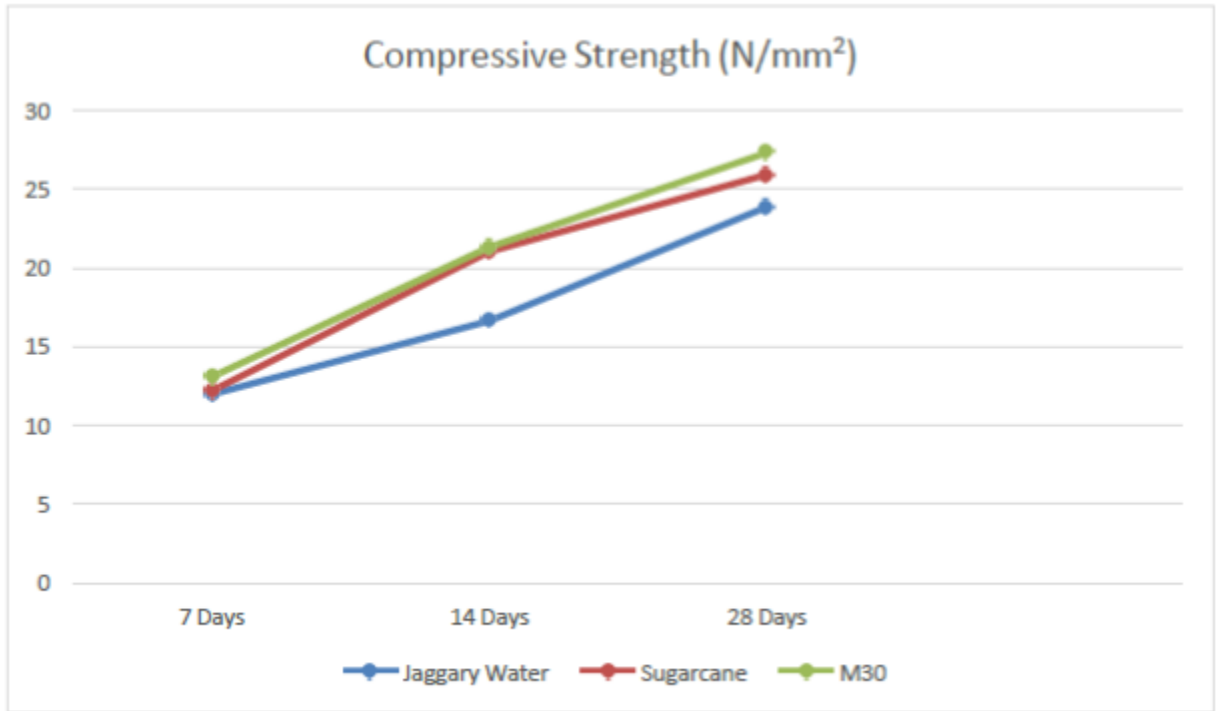


Figure 6: Comparison of Compressive Strength

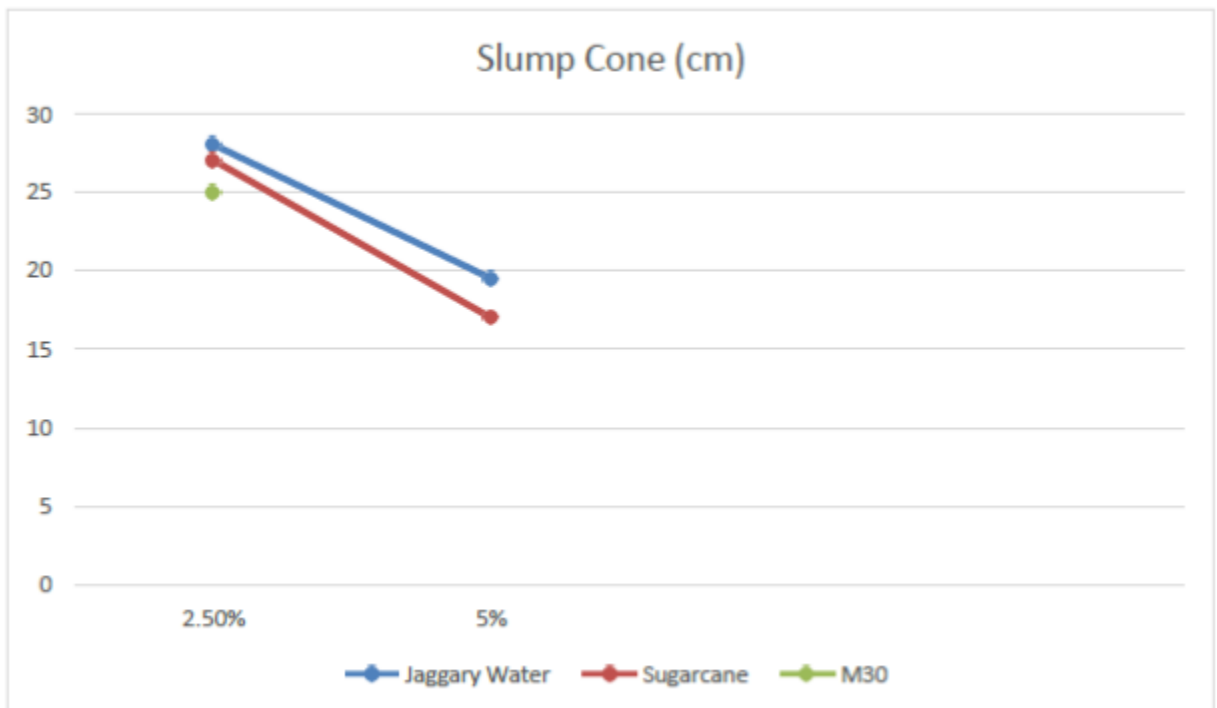


Figure 7: Comparison of Slump Cone Test

Table 9 slump values due to reduction in water content

Variation of admixtures %	Height of slump for Jaggary water	Height of slump for sugarcane	M30
2.5	28	27	25
5	19.5	17	

Conclusion

This research work is based on effect of natural admixtures on the concrete. For this purpose, a M30 concrete was prepared in association of different admixtures, Jaggary and Sugarcane, and different tests, Slump cone test and Compression test (7 days, 14 days and 28 days) were performed on the samples along with the sample of M30, and finally rankings of admixtures were carried out.

Table 10

S.No	Particulars	Result			
		Slump cone test result (cm)	7days Compressive Strength (N/mm2)	14 days Compressive Strength (N/mm2)	28 days Compressive Strength (N/mm2)
1	M30+ 2.5% Jaggary water	28	11.66	15.55	22.22
2	M30+ 5% Jaggary water	19.5	12.33	17.77	25.55
3	M30+ 2.5% sugarcane	27	11.77	20.11	23
4	M30+ 5% sugarcane	17	12.66	22	28.88
5	M30	25	13.11	21.33	27.33

Following are the results obtained.

- sugarcane secured rank 1 in slump test and rank 1 in compressive test;
- jaggary secured rank 2 in slump test and rank 3 in compressive test;

So, sugarcane admixture increases workability and compressive strength more than other admixtures and jaggary admixture increase workability more than consecutive M30 concrete.

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