Impact of Coconut Fibre & Polypropelene Woven Fibre including Admixture on Concrete Mix

Dr. Shubha Khatri

Abstract— In this paper an attempt has been made to check the compressive strength of concrete cubes for M-20 and M-40 grade concrete mix design by doing an experimental study by using Coconut Fibre and Polypropelene Woven Fibre (PPWF) incuding Admixture in the form of Super-plasticizer as CONPLAST (G-8) 410. Results show that compressive strength of concrete cube increases with Admixture. Another study with Coconut fibre and PPWF including Admixture also proves that compressive strength of concrete cubes increases much more as compared to with and without admixture-concrete cubes.

Index Terms— Admixture, Coconut Fibre, Compressive Strength, Concrete Mix, Polypropelene Woven Fibre, Super-plasticizer

1 Introduction

NOW-a-days in the field of Civil Engineering it's a great challenge to make such construction in which quality control of a product can be included. Cement, sand and aggregates are the basic materials for any type of construction and these are so costly with increasing demands of infrastructures day by day. But strength of structure is required any how and it's mandatory. In this regard it is generally considerable to use such type of wastage material like coconut fibre and polypropylene woven fibre (PPWF) which are usually dumb in to the ground and also create hazardous issue for environment. From literature it has been proved that compressive strength of concrete improves by using such wastage materials. By adding 1% or 2% content of coconut fibre in concrete mix flexural strength and compressive strength of concrete cubes increases. Similarly by using 1% or 1.5% polypropelene woven fibre on concrete mix design compressive strength of concrete cubes increases. Admixtures also impart the strength of materials and have been used in contruction work in the form of plasticizer or super-plasticizer.

Various research workers have been worked on Adimixture and without admixture mixed concrete [Khaled et al. 2011], [Prajapati at al. 2011]. Few studies have been carried out on coconut fiber mixed concrete and PPWF mixed concrete [Saandeepani et al 2013], [Mounir at al. 2013], [Arkan et al. 2013], [Mehul et al. 2013]. But no study has been carried out till now with all these wastage materials including Admixture to increase the compressive strength of concrete cubes.

In this regard an experimental study has been carried out in laboratory at OPJIT, Raigarh (C.G.). In this experimental work a comparison study has been conducted with M-20 and M-40 grade of concrete cubes by adding coconut fibre and polypropelene wooven fibre including admixture at 7, 14 and 28 days respectively.

2 Proposed Methodology

Out of many test applied to concrete, compressive strength of concrete cubes is most important test which gives an idea about various characteristics of concrete like concreting is done properly or not. Before conducting experimental study a methodology has been prepared and here it is shown in steps.

2.1 Concrete Mix Design by Standard Mix

Standard mixed concrete with reference to Grade of concrete has been prepared i.e. M-20 and M-40 respectively according to Indian Standard Code: 456-2000.

2.2 Required Materials

Cement, Sand and Aggregates are the basic requirements for mix design but in this paper main emphasis is given on impact of Coconut fiber and PPWF on concrete mix design. In this regard brown fibre of coconut is used here. Fig. 1 shows this brown coconut fibre in dry form and length of is not of great importance so it is kept as original natural length but each and every fibre should be separate. Fig. 2 shows polypropelene woven fibre which is generally used in cement bag is taken in dry and small pieces form cut by cutting machine and used in experimental study. Admixture in form of Super-plasticizer as CONPLAST (G-8) 410 has been used in combination with above required materials including required quantity of water for mixing with reference to Grade of concrete.

2.3 Preparation of Cubes

For cube casting size of mould is taken 15 cm×15 cm×15 cm. Reruired materials as per concrete garde i.e. M-20 and M-40 under concrete mix design are thoroughly mixed in dry form in batch mixer and then required quantity of water is added until the concrete appears to be homogeneous and desired consistency. Quantity of water is taken as 40 % of cement. 1 to 2% of polypropelene woven fibre and 1 to 2% of coconut brown fibre including admixture in the form of super-plasticizer of cement have been used in experimental study. Then moulding, curing and finishing has been carried out.

2.4 Calculations and Observations

These specimens are tested by compressive testing machine after 7, 14 and 28 days curing respectively with different concrete grades. The load is applied gradually at a rate of 140 kg/ cm^2 till the specimen fails.

3 Experimental Program

For doing an experimental analysis in laboratory, first of all cement, sand, aggregates, admixtures, coconut brown fibre,

polypropelene woven fibre (PPWF) have been taken with reference to concrete grade. After batching of required materials by following the proposed methodology work has been brought in the form. Few steps are as follows which have been used in experimental study:

1. Quantity of admixture is taken with respect to cement. Since for one cubic meter concrete mix 350 kg cement is required and for that admixture quantity is taken as 1.5 litres. So casting of 3 cubes or more than 3 quantity of admixture is taken accordingly.
2. For M-20 grade concrete mix 1:2:4 ratios of materials have been used. Cubes for M-20 garde concrete with coconut fibre including admixture have been prepared for 7, 14 and 28 days respectively by increasing the quantity of materials with standard ratio since 1:2:4 is basic standard ratio as per 1 cubic meter and that is not sufficient for casting more than 1 cube. Length of coconut fibre is kept constant as 15 mm and used in dry form only. These fibres are spread out in concrete mix in 5 layers layer and 25 blows of compaction is carried out
3. Similarly, for M-20 grade ratio 1:2:4 concrete cubes with PPWF including admixture have been prepared for 7, 14 and 28 days respectively by increasing the quantity of materials with standard ratio. These PPWF are used in cutting form i.e. small and uniform size i.e. 5 mm. PPWF are spread out in 5 layers and after each layers 25 blows are given. These moulds are also kept on vibrating machine for better compation.
4. These cubes are then kept for curing in clear and fresh water after 24 hrs for 7, 14 and 28 days respectively. After curing and finishing these cubes are tested in compressive testing machine.
5. Similarly, other cubes are prepared for M-40 grade concrete with coconut brown fibre and PPWF including admixture in the form of Super-plasticizer as CONPLAST (G-8) 410. Then curing and finishing has been done and these cubes are put for testing in compressive testing machine till the failure occurs. Readings are recorded and graphs of comparison are plotted.

4 Observation and Calculation

Because standard ratio for M-20 Gr. (1:2:4) Concrete mix design for casting 6 cubes cannot be accurate hence we increased materials ratio in the form of standard ratio as (10kg+24kg+ 34kg.) i.e. cement, sand and aggregates for casting 6 cubes for checking the compressive strength at 7 and 14 days only with admixture as shown in Table 1.

Similarly, Table 2 shows the material ratio for M-20 with PPWF & coconut fibre including admixture. This quantity is for casting 6 cubes at 7 and 14 days with PPWF including admixture and then 6 cubes at 7 and 14 days with coconut fibre including admixture. Quantity of PPWF is taken as 2% of cement as per grade and similarly, coconut fibre is taken as 2% of cement as per grade and these are used separately one by one but including admixture also.

Table 3 shows material quantities for M-40 grdae concrete. Because standard ratio for M-40 Gr. (1:1.5:3) Concrete mix design for casting 6 cubes cannot be accurate hence we increased materials ratio in the form of standard ratio as (20kg+30kg+ 60kg.) i.e. cement, sand and aggregates for casting 6 cubes for checking the compressive strength at 7 and 14 days respectively. Table 4 shows material quantity for M-40 grade with PPWF as 2% and coconut fibre as 2% including admixture.

TABLE 1

MATERIALS REQUIREMENT FOR M-20 FOR 6 CUBES INCLUDING ADMIXTURE ONLY

S. No	Material	Quantity	Unit
1.	Cement	10	Kg
2.	Sand	24	Kg
3.	Aggregate	34	Kg
4.	Admixture	21	ml
5.	Water	3.2	lt

TABLE 2

MATERIALS REQUIREMENT FOR M-20 FOR 6 CUBES WITH PPWF AND COCONUT FIBRE INCLUDING ADMIXTURE

S.No	Material	Quantity	Unit
1.	Cement	10	Kg
2.	Sand	24	Kg
3.	Aggregate	34	Kg
4.	Admixture	21	ml
5.	Water	3.2	lt
6.	PPWF	200	Grams
7.	Coconut Fibre	200	Grams

TABLE 3

MATERIALS REQUIREMENT FOR M-40 FOR 6 CUBES INCLUDING ADMIXTURE ONLY

S.No	Material	Quantity	Unit
1.	Cement	20	Kg
2.	Sand	30	Kg
3.	Aggregate	60	Kg
4.	Admixture	86	ml
5.	Water	6.4	lt

TABLE 4

MATERIALS REQUIREMENT FOR M-40 FOR 6 CUBES WITH PPWF AND COCONUT FIBRE INCLUDING ADMIXTURE

S.No	Material	Quantity	Unit
1.	Cement	20	Kg
2.	Sand	30	Kg
3.	Aggregate	60	Kg
4.	Admixture	86	ml
5.	Water	6.4	lt
6.	PPWF	400	Grams
7.	Coconut Fiber	400	Grams

5 RESULTS

This section gives details of compressive strengths of concrete cubes. Table 5 shows the detail of compressive strength of concrete cubes including admixture and without admixture. Table 6 shows the result with PPWF & COCONUT FIBER including admixture for M-20 grade concrete.

TABLE 5

DETAILS OF COMPRESSIVE STRENGTH OF CONCRETE CUBES WITH AND WITHOUT ADMIXTURE FOR M-20

No. of Days	Mean Strength/Compressive Strength of Concrete Cubes(N/mm²)	
	With Admixture	Without Admixture
7	17.5	13.5
14	28.7	20

TABLE 6

DETAILS OF COMPRESSIVE STRENGTH OF CONCRETE CUBES WITH PPWF AND COCONUT FIBRE INCLUDING ADMIXTURE FOR M-20

No. of Days	Mean Strength/Compressive Strength of Concrete Cubes(N/mm²)	
	PPWF +Admixture	Coconut Fibre + Admixture
7	20.05	22.68
14	32.99	37.4

Similarly, Table 7 and 8 show the results for cubic strength of concrete cubes for M-40 grade with and without admixture and with PPWF and Coconut fibre including admixture at 7 and 14 days respectively.

TABLE 7

DETAILS OF COMPRESSIVE STRENGTH OF CONCRETE CUBES WITH AND WITHOUT ADMIXTURE FOR M-40

No. of Days	Mean Strength/Compressive Strength of Concrete Cubes(N/mm²)	
	With Admixture	Without Admixture
7	37.37	27.29
14	45.6	33.68

TABLE 8

DETAILS OF COMPRESSIVE STRENGTH OF CONCRETE CUBES WITH PPWF AND COCONUT FIBRE INCLUDING ADMIXTURE FOR M-40

No. of Days	Mean Strength/Compressive Strength of Concrete Cubes(N/mm²)	
	PPWF +Admixture	Coconut Fibre + Admixture
7	42.9	50.8
14	55.6	68.4

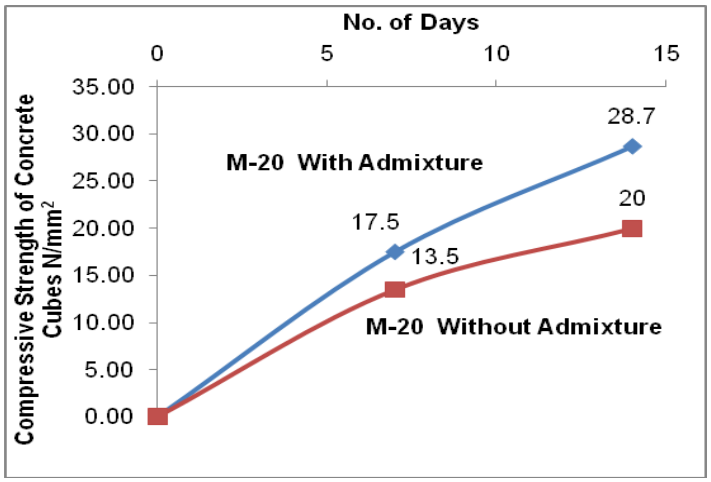

Fig 1. Comparison study between compressive strength of concrete cubes for M-20 mix with & without admixture

Figure 1 shows the difference between compressive strength of concrete cubes for M-20 mix with and without using of admixture according to Table No. 5. An experimental study is also carried out for M-20 mix with inclusion of admixture and it is concluded that by using admixture in the form of superplasticizer at 7 days compressive strength of concrete cubes increases 22.85% and at 14 days it increases as 30.31% as compared to using only admixture.

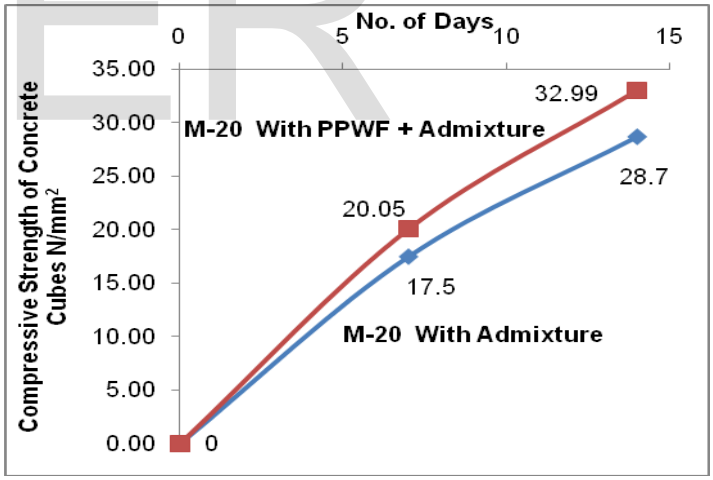

Fig. 2. Comparison study between compressive strength of concrete cubes for M-20 mix with poltproprlene woven fibre includingadmixture with admixture only

According to Table No. 6, Figure 2 shows the comparison study of compressive strength of concrete cubes for M-20 mix with polypropelene wovwn fibre (PPWF) including admixture with only admixture cubes and it is observed that by inclusion of PPWF and admixture strength increases as 12.75 % at 7 days and 13 % at 14 days as compared to compressive strength of cubes with only admixture as 17.5 N/ mm² and 28.7 N/ mm²at 7 and 14 days respectively.

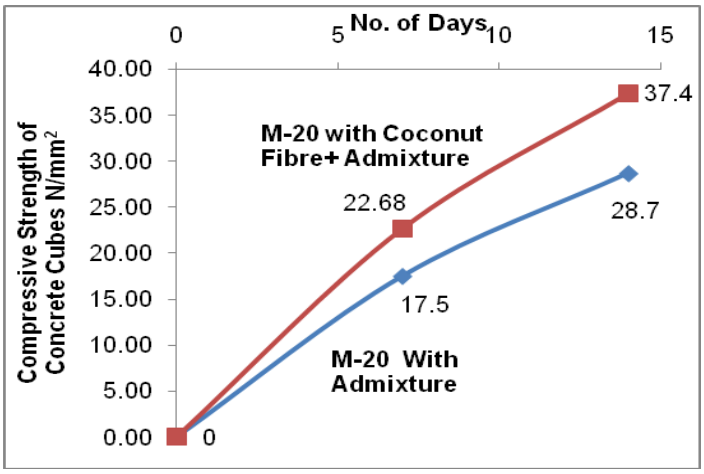

Fig. 3. Comparison study between compressive strength of concrete cubes for M-20 mix with coconut fibre including admixture and with admixture only

Figure 3 shows the comparative study between compressive strength of concrete cubes for M-20 mix with coconut fibre including admixture with only admixture according to Table No. 6. It is observed that by using of admixture at 7 and 14 days compressive strength of concrete cubes increases but when it is compaired by using coconut fibre including admixture, compressive strength increases as 22.83% at 7 days and 25.29% at 14 days respectively. It is also observed that compressive strength with coconut fibre including admixture is much more than compressive strength with polypropelene woven fibre.

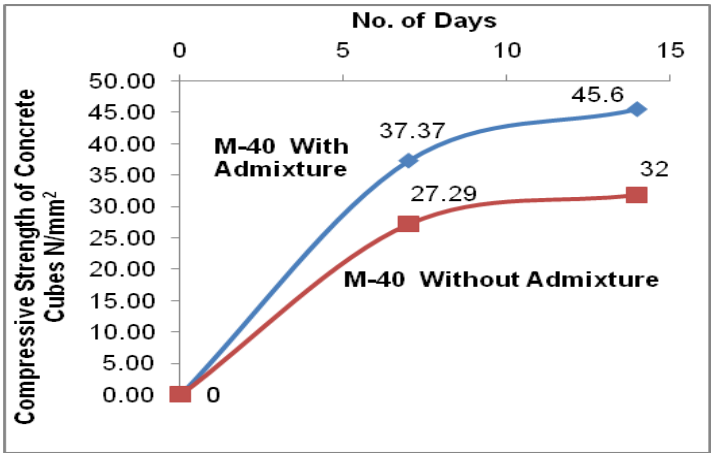

Fig. 4. Comparison study between compressive strength of concrete cubes for M-40 mix with and without admixture

Figure 4 shows the difference between compressive strength of concrete cubes for M-40 mix with and without using of admixture according to Table No. 7. An experimental study is also conducted for M-40 mix with inclusion of admixture and it is concluded that by using admixture in the form of super-plasticizer compressive strength of concrete cubes increases 26.97 % at 7 days and at 14 days it increases as 29.82 % as compared to compressive strength of concrete cubes without admixture. Final value of compressive strength of concrete cubes for M-40 mix at 7 and 14 days are 27.29 N/mm2 and 32 N/mm2 respectively.

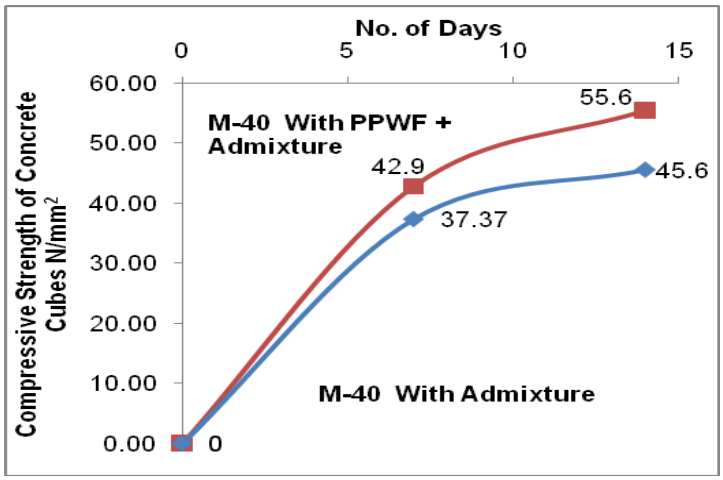

Fig. 5. Comparison study between compressive strength of concrete cubes for M-40 mix with polypropelene woven fibre (PPWF) including admixture and with M-40 mix including admixture only

Figure 5 shows the result of compressive strength of concrete cubes for M-40 grade mix with polypropelene woven fibre including admixture and with only admixture. It is shown in figure that compressive strength of concrete cubes increases as 12.89% at 7 days and 18% at 14 days as copmpared to by using only admixture in M-40 mix.

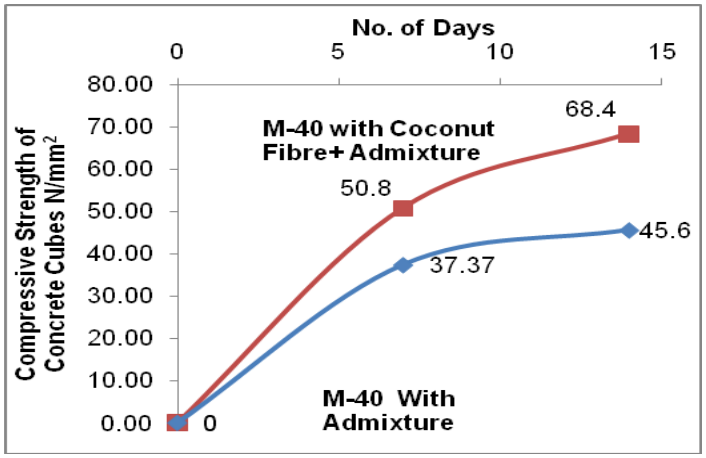

Fig. 6. Comparison study between compressive strength of concrete cubes for M-40 mix with coconut fibre including admixture and with M-40 mix including admixture only

Figure 6 shows the result of compressive strength of concrete cubes of M-40 grade mix with coconut fibre including admixture and with only admixture. It clearly shows the percentage difference between coconut fibre including admixture & with only admixtyre at 7 and 14 days. Compressive strength of concrete cubes with coconut fibre including admixture in the form of super-plasticizer increases as 26.43% at 7 days and 33.33 %

at 14 days as compared to M-40 mix with only admixture.

Fig. 7. Comparison study between compressive strength of concrete cubes for M-20 mix with coconut fibre including admixture and polypropelene woven fibre including admixture at 7 and 14 days respectively

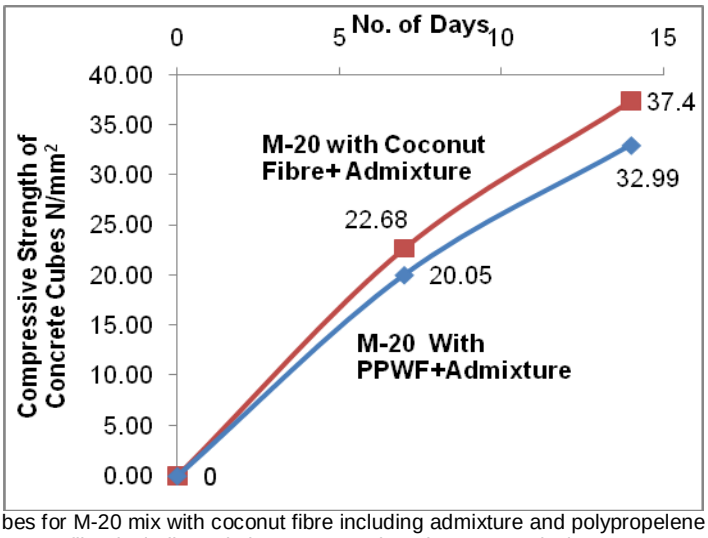

Figure 7 shows the comparative study between PPWF including admixture and Coconut fibre including admixture for M-20 mix. Figure shows the results of compressine strength of concrete cubes at 7 and 14 days. For M-20 grade with coconut fibre including admixture graph shows the result of compressive strength increases as 22.68 N/mm² and 37.4 N/mm² at 7 and 14 days respectively as compared to using of PPWF including admixture.

Fig. 8. Comparison study between compressive strength of concrete cubes for M-40 mix with coconut fibre including admixture and polypropelene woven fibre (PPWF) including admixture at 7 and 14 days respectively

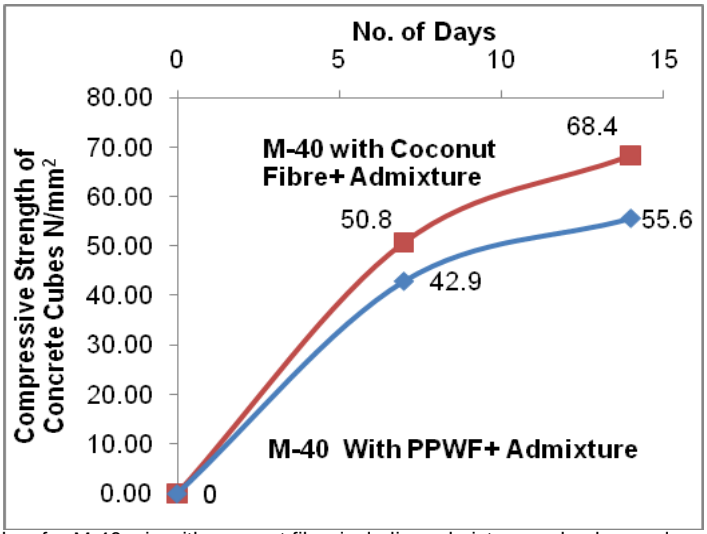

Figure 8 shows the comparative study between PPWF including admixture and Coconut fibre including admixture for M-40 mix. Figure shows the results of compressine strength of concrete cubes at 7 and 14 days. For M-40 grade with coconut fibre including admixture graph shows the result that compressive strength increases as 50.8 N/mm² and 68.4 N/mm² at 7 and 14 days respectively as compared to using of PPWF including admixture. This graph indicates the percentage difference also between coconut fibre including admixture and PPWF including admixture. Compressive strength of concrete cubes increases as 15.5% and 18.71 % by using cocnut fibre including admixture for M-40 grade at 7 and 14 days respectively as compared to using PPWF including admixture.

6 Conclusion

In this section all the results are suuarized such that each result gives a specific reason for being corrected by itself. Highlighted results are concluded as follows:

1. By doing an experimental study in laboratory with wastage materials i.e. POLYPROPELENE WOVEN FIBRE and COCONUT FIBRE which are usally dumped in to ground or below the earth surface and create hazardous issues for Environment, proves that by using these materials in concrete mix design, compressive strength of concrete cubes increases. SO, quality control comes in to picture.
2. It is concluded that compressive strength of concrete cubes increases more for M-20 grade mix design by using super-plasticizer as a admixture i.e. 22.85% at 7 days and 30.31% at 14 days as compared to without superplasticer.
3. It is concluded that admixture in the form of Superplasticizer with polypropelene woven fibre for M-20 grade mix design, gives higher compressive strength as compared to using only admixture in concrete mix design. Its increasing percentage is observed as 12.75% at 7 days and 13% at 14 days.
4. By using of coconut fibre including admixture for M-20 mix design compressive strength of concrete cubes increases as 22.83% at 7 days and 25.29% at 14 days as compared to using only admixture in concrete mix design.
5. For M-40 grade mix design it is observed that by using admixture compressive strength of concrete cubes is increased as 26.97% at 7 days and 29.82% at 14 days as compared to without admixture mixed design.
6. It is found out that with polypropelene woven fibre including admixture for M-40 mix design, compressive strength of concrete cubes is increased as 12.89% at 7 days and 18% at 14 days as compared to with only admixture mixed design.
7. It is observed that by incorporating coconut fibre including ad mixture for M-40 mix design as compared to using only admixture mixed design compressive strength of concrete cubes is increased as 26.43% at 7 days and 33.33% at 14 days.
8. It is concluded that for M-20 mixed design compressive strength of concrete cubes increases by incorporating coconut fibre as compared to polypropelene woven fibre approximately 12 % is found there.
9. It is observed and concluded that for M-40 grade

mixed design compressive strength of concrete cubes increases by using coconut fibre as compared to polypropelene woven fibre and percentage increment noted as 15.5% at 7 days and 18.71% at 14 days.

10. It is finally concluded by this experimental analysis that coconut fibre is having more flexural strength as compared to polypropelene woven fibre so compressive strength increases much more with coconut fibre. It is also concluded that with combination of amixture in mixed design with these materials like polypropelene woven fibre and coconut fibre, compressive strength is increased continuously by increasing concrete grade.

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