© 2017 IJSRSET | Volume 3 | Issue 8 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section : Engineering and Technology

An Experimental Analysis on Mechanical Properties of Concrete with Polypropylene Woven Fibre Including Admixture with Fly Ash as a Partial Replacement of Cement

Anshul Jain*, Dr. Shubha Khatri
Department of Civil Engineering, Radharaman Engineering College, Bhopal, Madhya Pradesh, India

ABSTRACT

Fibre Reinforced Concrete can be defined as a composite material consisting of mixtures of cement, mortar or concrete and discontinuous, discrete, uniformly dispersed suitable fibres. The synthetic fibres available in the United States, polypropylene is the most widely used in ready mixed concrete. The combinations of fly ash concrete with fibre reinforcements to enhance the mechanical properties. Addition of polypropylene fibre was found to improve the durability of concrete composites containing fly ash. Admixtures are generally used to alter the properties of concrete (such as increased workability or reduced water content, acceleration or retardation of setting time, acceleration of strength development, and improved resistance to weather and chemical attacks) to make it more suitable for a particular purpose. In this paper an experimental analysis has been carried out to show the impact of Polypropylene Woven Fibre including Admixture with different quantity of Fly Ash as a partial replacement of cement on flexural strength and split tensile strength of concrete cubes for M-30 grade of concrete mix. It is found that flexural strength and split tensile strength has been increased by using 5% & 10% PPWF including 5% Admixture with 10%, 20% and 30%Fly Ash as a partial replacement of cement.

Keywords: Polypropylene Woven Fibre, Admixture, Fly ash, Flexural Strength, Split Tensile Strength, Concrete.

I. INTRODUCTION

Concrete can bear up the severest environmental conditions; however, in several conditions it may show very low characteristics. Hence, engineers worldwide are constantly trying to improve its characteristics with the aid of modern admixtures and waste materials, usually called as alternate building materials (ABM). In this regard, basic construction materials like cement, sand and aggregates are very costly materials so they may be partially replaced by percentage wise using industrial and agricultural waste materials for economical development and for the growth of the country. There are so many modern construction materials (MCM) have been used in civil engineering construction based on their physical, chemical and mechanical properties. PPWF is a reinforced fibre which gives durability and strength to concrete and also improves workability of concrete. The fly ash created by coal-fired power plants supply a brilliant main substance used in blended cement, mosaic tiles, and hollow blocks among others. Fly ash can be an expensive substitute for Portland cement in concrete even though using it improves strength, separation, and ease of pumping concrete. Admixture is added to increase the setting time of cement, workability of concrete and to improve the compressive and flexural strength of concrete. Even split tensile strength of cylinders with fly ash and PPWF including admixture has not been found out till today. Flexural strength of beam using Fly Ash & PPWF including Admixture has not been observed till now. In this regard an experimental study in laboratory was conducted using 5%PPWF+5%ADMIXTURE & 10%PPWF+5% ADMIXTURE with 0%, 10%, 20% and 30% Fly Ash as a partial replacement material in concrete mix design M-30 GRADE. Sumant U. Ladole (2012) Corrosion of steel reinforcement is one of the main problems facing

the construction industries throughout the world. Aiswarya Sukumar and Elson John (2014) did an experimental investigation on the behavior of concrete specimens reinforced with steel fibers and subjected to compressive and flexural loading. Shubha Khatri (2014) investigated that 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 Polypropylene Woven Fibre (PPWF) including Admixture in the form of Super-plasticizer as CONPLAST (G-8) 410. Bhupendra Kumar, S.S. Kuswah and Amit Viswakarma (2015) This Research paper discusses the comparative study between Fly ash based coconut fiber concrete with plain cement concrete of M40 grade. Raphael Chacko, S Hema and M Vadivel (2016) This research describes experimental studies on the use of coconut fibre and banana fibre to enhance the strength and applications of concrete.

II. METHODOLOGY

In this paper an experimental analysis has been carried out in laboratory with respect to initial and final setting time of cement, workability of concrete by slump cone test and then by compaction factor test to find out the properties of cement and concrete. Since, flexural strength and split tensile strength are the basic mechanical properties of concrete. To find out the flexural strength of concrete beams beam size is taken 100mm×100mm×500mm and grade of concrete is M-30. Similarly, size of cylinder is taken as 150mm×300mm. Fly ash as a partial replacement material has been uses in concrete. Polypropylene woven fibre and admixture in the form of super-plasticizer by weight of cement has been added to the mix. Beams and cylinders of specific sizes are prepared for 7 and 28 days. Here percentage of fly ash has been used from 10%, 20% and 30% respectively for 5%PPWF, 10%PPWF including 5%admixture. First of all normal concrete mix designed concrete beams are moulded with 0% fly ash and without PPWF & ADMIXTURE for 7 and 28 days and flexural strength has been checked. Then again concrete beams with 0% fly ash but with 5% and 10% PPWF including Admixture have been moulded for 7 and 28 days to check the flexural strength. Then again this procedure was repeated for 10%, 20% and 30% fly ash as a partial replacement of cement. Similarly, same procedure was repeated for Split Tensile Strength of Cylinders.

III. EXPERIMENTAL ANALYSIS

As per above discussions observation tables are presented here. Following are values are obtained according to experimental analysis. Table 1 shows the slump and compaction factor according to water/cement ratio with different amount of fly ash and PPWF including admixture. Table 2 shows the results of flexural strength of concrete cubes for M-30 grade with normal mix i.e. 0%FA, 0%PPWF & 0%ADMIXTURE. In this table compressive strength results are shown from test are tabulated related to 0% FA with 5% and 10% PPWF including 5% admixture. Similarly results are obtained from lab work related to 10%, 20% & 30% Fly Ash as a partial replacement of cement with 5% and 10% PPWF including 5% Admixture are tabulated below in Table 2.

Similarly, same procedure has been repeated for split tensile strength of concrete cylinders.

Observation tables are prepared here as per laboratort experimental analysis.

TABLE I
DETAILS OF SLUMP AND COMPACTION FACTOR AS PER MIXES

S. No.	w/c Ratio	Fly Ash	PPWF + ADMIXTURE	Slump (mm)	Comp-action Factor
1	0.45	10%	5%PPWF+5% Admix	120	0.90
			10%PPWF+ 5% Admix	115	0.90
			15% PPWF+ 5% Admix	112	0.89
2	0.45	20%	5%PPWF+5%Admix	110	0.85
			10%PPWF+ 5% Admix	105	0.81
			15% PPWF+ 5% Admix	100	0.80
3	0.45	30%	5%PPWF+5%Admix	95	0.79
			10%PPWF+ 5% Admix	90	0.75
			15% PPWF+ 5% Admix	85	0.71

TABLE III

FLEXURAL STRENGTH TEST OF CONCRETE BEAMS OF SIZE 100MM×100×500MM FOR 7 AND 28 DAYS CURING WITH PPWF AND ADMIXTURE AT DIFFERENT CONTENT OF FLY ASH AS A PARTIAL REPLACEMENT OF CEMENT

S. No.	Fly Ash %	Polypropylene Woven Fiber %+ Admixture % (By weight of cement)	Flexural Strength of Beams 100mm×100mm×500mm N/mm^2	
			7Days	*28 Days*
Mix-1	0%	0% PPWF+0% ADMIX (Normal Mix)	2.5	3.0
Mix-2	0%	5% PPWF+5% ADMIX	2.71	3.10
		10% PPWF + 5% ADMIX	2.89	3.23
Mix-3	10%	5% PPWF+5% ADMIX	3.81	4.01
		10% PPWF + 5% ADMIX	4.50	5.03
Mix-4	20 %	5% PPWF+5% ADMIX	5.23	6.12
		10% PPWF + 5% ADMIX	5.71	6.75
Mix-5	30 %	5% PPWF+5% ADMIX	5.85	6.88
		10% PPWF + 5% ADMIX	6.12	7.11

TABLE IIIII

SPLIT TENSILE STRENGTH TEST OF CONCRETE CYLINDERS OF SIZE 150MM×300MM FOR 7 AND 28 DAYS CURING WITH PPWF AND ADMIXTURE AT DIFFERENT CONTENT OF FLY ASH AS A PARTIAL REPLACEMENT OF CEMENT

S. No.	Fly Ash %	Polypropylene Woven Fiber %+ Admixture % (By weight of cement)	Split Tensile Strength of Cylinders (150mm×300mm) N/mm^2	
			7Days	*28 Days*
Mix-1	0%	0% PPWF+0% ADMIX (Normal Mix)	2.7	3.2
Mix-2	0%	5% PPWF+5% ADMIX	2.75	3.30
		10% PPWF + 5% ADMIX	2.90	3.40
Mix-3	10%	5% PPWF+5% ADMIX	3.85	4.51
		10% PPWF + 5% ADMIX	4.55	5.71
Mix-4	20 %	5% PPWF+5% ADMIX	5.27	6.15
		10% PPWF +	5.79	6.77
		5% ADMIX		
Mix-5	30 %	5% PPWF+5% ADMIX	5.89	7.0
		10% PPWF + 5% ADMIX	6.17	7.22

IV. RESULTS & DISCUSSIONS

After conducting experimental analysis results are plotted in excel sheet and discussions have been made.

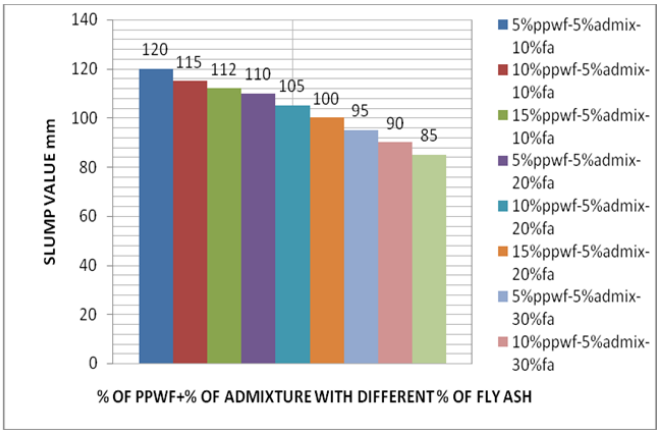

Figure 1. Workability Analysis of M-30 grade concrete mix with different percentage of PPWF-ADMIXTURE-FLY ASH

As shown in Figure 1 that by increasing the amount of fly ash from 10% to 30% slump value is decreasing continuously. In the mean time it is also shown in figure that percentage of Polypropylenes Woven Fibre including percentage of admixture by weight of cement has been mixed in concrete for M-30 grade so by increasing these amounts with different percentage of fly ash slump value is decreased. For 5% PPWF+5%ADMIX with 10% FA slump value is 120mm, for 10%PPWF+5%ADMIX with 10% FA it is 115mm and for 15% PPWF+5%ADMIX with 10% FA it is 112 mm. Similarly, for 5%PPWF+5%ADMIX with 20% FA it is 110mm, for 10%PPWF+5%ADMIX with 20% FA it is 105mm and for 15%PPWF+5%ADMIX with 20% FA it is 100mm.

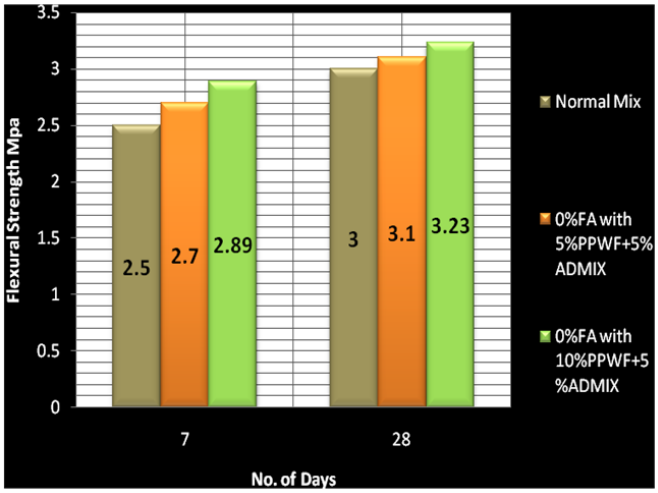

Figure 2. Flexural Strength of Concrete Beams with: 5% & 10 % of PPWF+5%Admixture with 0 % Fly Ash for M-30 MIX Concrete

As shown in figure 2 that flexural strength of concrete beam for normal mix is obtained as 2.5 N/mm2 and 3 N/mm2 for 7 and 28 days respectively. When 5%PPWF+5%admixture by weight of cement is added to the mix it gives slightly higher value of flexural strength i.e. 2.7 N/mm2 and 3.1 N/mm2 and percentage increment is 7.4% and 13.49% respectively for 7 days. While 10%PPWF+5%admixture is added to the mix by weight of cement so it gives 2.89 N/mm2 and 3.23 N/mm2 as compare to earlier values for 28 days respectively. Percentage increment is 3.2% and 7.14% for 28 days respectively.

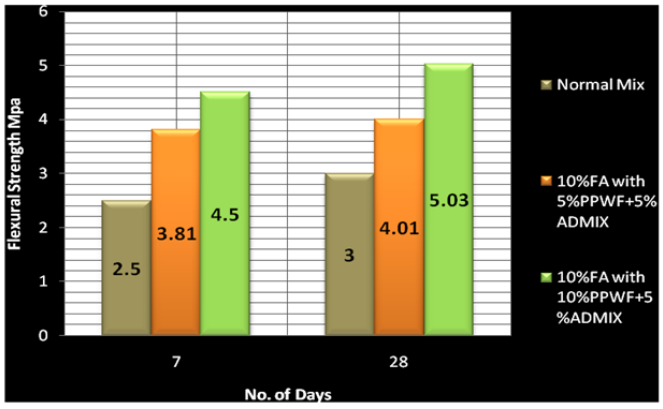

Figure 3. Flexural Strength of Concrete Beams with: 5% & 10 % of PPWF+5%Admixture with 10 % Fly Ash for M-30 MIX Concrete

From figure 3 Flexural strength of concrete beam for normal mix is obtained as 2.5 N/mm2 and 3 N/mm2 for 7 and 28 days respectively. When 5%PPWF+5%admixture by weight of cement is added to the mix it gives slightly higher value of flexural strength i.e. 3.81 N/mm2 and 4.5 N/mm2 and percentage increment is 34.38% and 44.44% respectively for 7 days. While 10%PPWF+5%admixture is added to the mix by weight of cement so it gives 4.01 N/mm2 and 5.03 N/mm2 as compare to earlier values for 28 days respectively. Percentage increment is 25.18% and 40.35% for 28 days respectively.

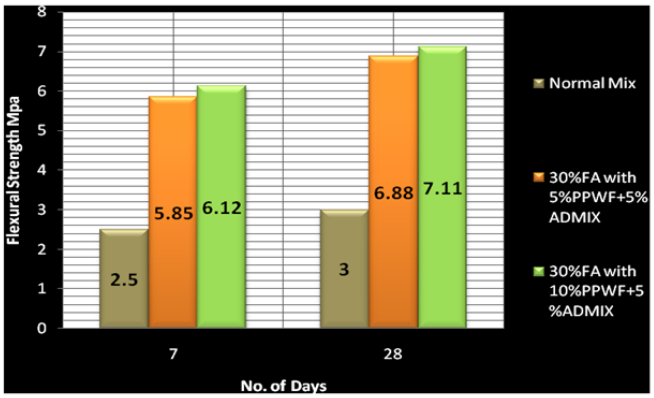

Figure 4. Flexural Strength of Concrete Beams with: 5% & 10 % of PPWF+5%Admixture with 30 % Fly Ash for M-30 MIX Concrete

A Comparison study of Flexural Strength of Concrete Beams of size 500mm×100mm×100mm for 7 & 28 days curing with normal mix concrete and with different amount % of PPWF including % of Admixture by weight of cement mixed with 30% FLY ASH has been carried out. From figure 4 Flexural strength of concrete beam for normal mix is obtained as 2.5 N/mm2 and 3 N/mm2 for 7 and 28 days respectively. When 5%PPWF+5%admixture by weight of cement is added to the mix it gives slightly higher value of flexural strength i.e. 5.85 N/mm2 and 6.12 N/mm2 and percentage increment is 57.26% and 59.15% respectively for 7 days. While 10%PPWF+5%admixture is added to the mix by weight of cement so it gives 6.88 N/mm2 and 7.11 N/mm2 as compare to earlier values for 28 days respectively. Percentage increment is 56.39% and 57.8% for 28 days respectively.

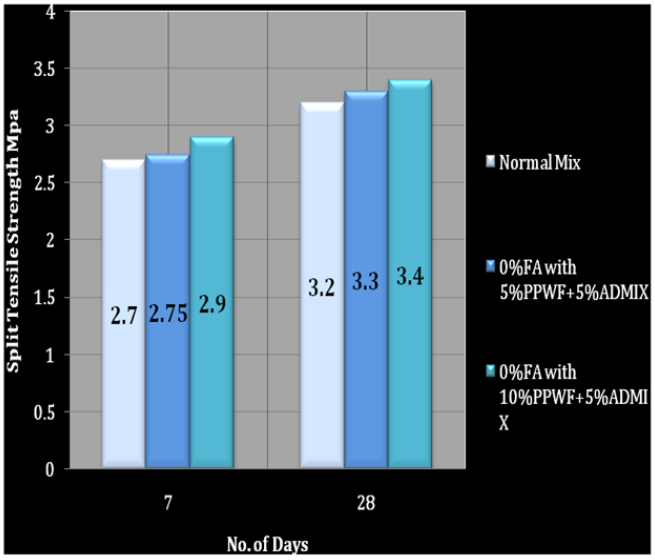

Figure 5. Split Tensile Strength of Concrete Cylinders with: 5% & 10 % of PPWF+5%Admixture with 0% Fly Ash for M-30 MIX Concrete

Split tensile strength of concrete cylinders with 0% fly ash and with 5%PPWF+5%admix are 2.75 N/mm2 and 3.3 N/mm2 for 7 and 28 days respectively. Split tensile strength of concrete cylinders with 0% fly ash and with 10%PPWF+5%admix are 2.9 N/mm2 and 3.4 N/mm2 for 7 and 28 days respectively. Percentage increments in split tensile strength for 5%PPWF+5%admix with 0% fly ash for 7 days are 1.81% and 6.89% respectively. Percentage increments in split tensile strength for 10%PPWF+5%admix with 0% fly ash for 28 days are 3.03% and 5.88% respectively.

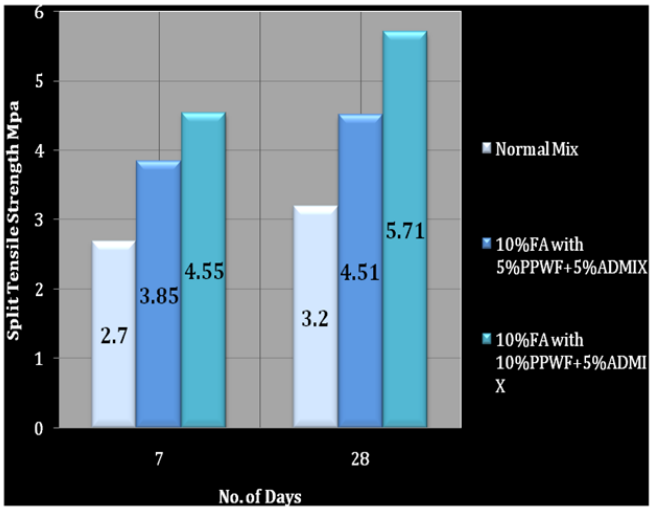

Figure 6. Split Tensile Strength of Concrete Cylinders with: 5% & 10 % of PPWF+5%Admixture with 10 % Fly Ash for M-30

Figure 5.11 shows a comparison study of Split Tensile Strength of Concrete Cylinders of size 150mm×300mm with 5% & 10 % of PPWF with 5%Admixture respectively with 10 % FLY ASH. Split tensile strength of normal concrete mix cylinders for 7 and 28 days are 2.7 and 3.2 respectively. Split tensile strength of concrete cylinders with 10% fly ash and with 5%PPWF+5%admix are 3.85 N/mm2 and 4.51 N/mm2 for 7 and 28 days respectively. Split tensile strength of concrete cylinders with 10% fly ash and with 10%PPWF+5%admix are 4.55 N/mm2 and 5.71 N/mm2 for 7 and 28 days respectively. Percentage increments in split tensile strength for 5%PPWF+5%admix with 10% fly ash for 7 days are 29.87% and 40.65% respectively. Percentage increments in split tensile strength for 10%PPWF+5%admix with 10% fly ash for 28 days are 29.04% and 43.95% respectively.

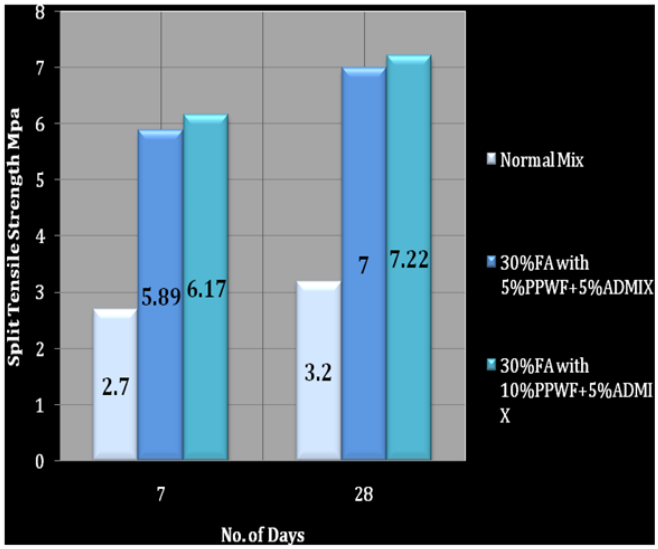

Figure 7. Split Tensile Strength of Concrete Cylinders with: 5% & 10 % of PPWF+5%Admixture with 30 % Fly Ash for M-30

Split tensile strength of concrete cylinders with 30% FLY ASH and with 5%PPWF+5%admix are 5.89 N/mm2 and 7 N/mm2 for 7 and 28 days respectively. Split tensile strength of concrete cylinders with 30% fly ash and with 10%PPWF+5%admix are 6.17 N/mm2 and 7.22 N/mm2 for 7 and 28 days respectively. Percentage increments in split tensile strength for 5%PPWF+5%admix with 20% fly ash for 7 days are 54.15% and 56.23 respectively. Percentage increments in split tensile strength for 10%PPWF+5%admix with 30% fly ash for 28 days are 54.28% and 55.6% respectively.

V. CONCLUSION

Flexural strength of concrete beam for normal mix is obtained as 2.5 N/mm2 and 3 N/mm2 for 7 and 28 days respectively. With 5%PPWF+5%admixture with 0% FLY ASH flexural strength is obtained as 2.7 N/mm2 and 3.1 N/mm2 and percentage increment is 7.4% and 13.49% respectively for 7 days. While with 10%PPWF+5%admixture it is 2.89 N/mm2 and 3.23 N/mm2 as compare to earlier values for 28 days respectively. Percentage increment is 3.2% and 7.14% for 28 days respectively.

Flexural strength results are obtained as 3.81 N/mm2 and 4.5 N/mm2 and percentage increment is 34.38% and 44.44% for 7 days respectively with 5%PPWF+5%ADMIX AND 10%FLY ASH as a partial replacement of cement. While 10%PPWF+5% admixture with 10%FLY ASH is added to the mix by weight of cement so it gives 4.01 N/mm2 and 5.03 N/mm2 as compare to earlier values for 28 days respectively. Percentage increment is 25.18% and 40.35% for 28 days respectively.

For 10%PPWF+5%admixture and 20% FLAY ASH is added to the mix by weight of cement so Flexural Strength results are obtained as 6.12 N/mm2 and 6.75 N/mm2 as compare to 7 days values for 28 days respectively. Percentage increment is 50.98% and 55.72% for 28 days respectively.

For 10%PPWF+5%admixture and 30% FLAY ASH is added to the mix by weight of cement so Flexural Strength results are obtained as 6.88 N/mm2 and 7.11 N/mm2 as compare to 7 days values for 28 days respectively. Percentage increment is 56.39% and 57.8% for 28 days respectively.

Split Tensile Strength of normal concrete mix cylinders for 7 and 28 days are 2.7 and 3.2 respectively. Split tensile strength of concrete cylinders with 0% FLY ASH and with 5%PPWF+5%admix are 2.75 N/mm2 and 3.3 N/mm2 for 7 and 28 days respectively. Split tensile strength of concrete cylinders with 0% fly ash and with 10%PPWF+5%admix are 2.9 N/mm2 and 3.4 N/mm2 for 7 and 28 days respectively.

Percentage increments in split tensile strength for 5%PPWF+5%admix with 10% FLY ASH for 7 days are 29.87% and 40.65% respectively. Percentage increments in split tensile strength for 10%PPWF+5%admix with 10% fly ash for 28 days are 29.04% and 43.95% respectively.

Percentage increments in split tensile strength for 5%PPWF+5%admix with 20% FLY ASH for 7 days are 48.76% and 53.36% respectively. Percentage increments in split tensile strength for 10%PPWF+5%admix with 20% fly ash for 28 days are 47.96% and 52.73% respectively.

Percentage increments in split tensile strength for 5%PPWF+5%admix with 20% fly ash for 7 days are 54.15% and 56.23 respectively. Percentage increments in split tensile strength for 10%PPWF+5%admix with 30% fly ash for 28 days are 54.28% and 55.6% respectively.

VI. REFERENCES

[1]. Sumant U. Ladole, "Flexural Behaviuor of concrete beams Reinforced with Glass Fibre Polymer", International Journal of Scientific & Engineering Research, Volume 3, Issue 10, October-2012, ISSN 2229-5518.

[2]. Aiswarya Sukumar Elson John, "Fiber Addition And Its Effect On Concrete Strength", International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163 Volume 1 Issue 8 (September 2014).

[3]. Shubha Khatri, "Impact of Coconut Fibre & Polypropylene Woven Fibre including Admixture on Concrete Mix", International Journal of Scientific & Engineering Research, Volume 5, Issue 6, June (2014).

[4]. Bhupendra Kumar, S.S. Kuswah and Amit Viswakarma, "Effect of Coconut Fiber and Fly Ash on Concrete", International Journal of Science Technology & Engineering | Volume 2 | Issue 3 | September (2015).

[5]. Raphael Chacko, S Hema1 And M Vadivel, "Experimental Studies On Coconut Fibre And Banana Fibre Reinforced Concrete", International Journal Of Earth Sciences And Engineering, Indexed In Scopus Compendex And Geobase Elsevier, Geo-Ref Information Services-Usa, List B Of Scientific Journals, Poland, Directory Of Research Journals Issn 0974-5904, Volume 09, No. 03 June 2016, P.P.529-533, 2016.