5. RESULTS AND DISCUSSION

5.1 Tensile Properties of the Composites Prepared with PPC

The depicted tensile strength values in table 5.1 are the average of five specimens' values.

Table 5.1 Tensile Properties of the Composites Prepared with Post-Process Curing (PPC)

Load (N)	Temperature (^{O}C)	Time (Min)	Tensile Strength (Jute)	Tensile Strength (Basalt)	Tensile Strength (Carbon)
180	40	60	30.0000	246.5000	228.3333
180	60	120	34.4666	255.6666	238.3333
180	80	180	35.7000	263.0000	321.0000
230	40	120	39.4500	275.7500	264.3333
230	60	180	39.6500	301.7500	285.3333
230	80	60	40.5333	308.2500	327.0000
280	40	180	41.2500	315.000	289.2500
280	60	60	41.6000	321.6000	292.2500
280	80	120	42.8000	331.0000	337.2500

5.2 Flexural Properties of the Composites Prepared with PPC

The depicted flexural strength values in table 5.2 are the average of five specimens' values.

Table 5.2 Flexural Properties of the Composites Prepared with Post-Curing

Load (N)	Temperature (^{0}C)	Time (Min)	Flexural Strength (Jute)	Flexural Strength (Basalt)	Flexural Strength (Carbon)
180	40	60	57.0500	270.0000	193.5000
180	60	120	58.6500	280.7500	236.8000
180	80	180	71.3750	294.5000	270.6667
230	40	120	72.3000	306.2500	269.6667
230	60	180	74.3666	335.7500	303.7500
230	80	60	79.2000	365.0000	313.5000
280	40	180	80.5200	364.4000	321.6667
280	60	60	84.8500	399.4000	335.3333
280	80	120	88.0800	406.0000	370.0000

5.3 Tensile and Flexural Properties of the Composites Prepared with IPC

The depicted tensile and flexural strength values in table 5.3 are the average of five specimen values.

5.3 Tensile and Flexural Properties of The Composites Prepared with In-Process Curing.

Load (N)	Temperature (ºC)	Tensile Strength (MPa)	Flexural Strength (MPa)
180	40	32.5000	71.1400
180	60	37.6000	77.7500
180	80	39.9333	80.2750
230	40	35.1500	75.0333
230	60	34.9666	75.4000
230	80	40.4333	80.3333
280	40	36.0500	77.3000
280	60	36.7000	75.6000
280	80	43.3500	84.0333

5.4 Tensile Strength of Jute-Vinyl ester Composite (JVC-PPC)

The main effect plot of tensile strength for Jute is shown in fig. 5.1. It is observed that as the load and temperature increase the tensile strength is increased. There is a little increment in tensile strength is observed with increase in time.

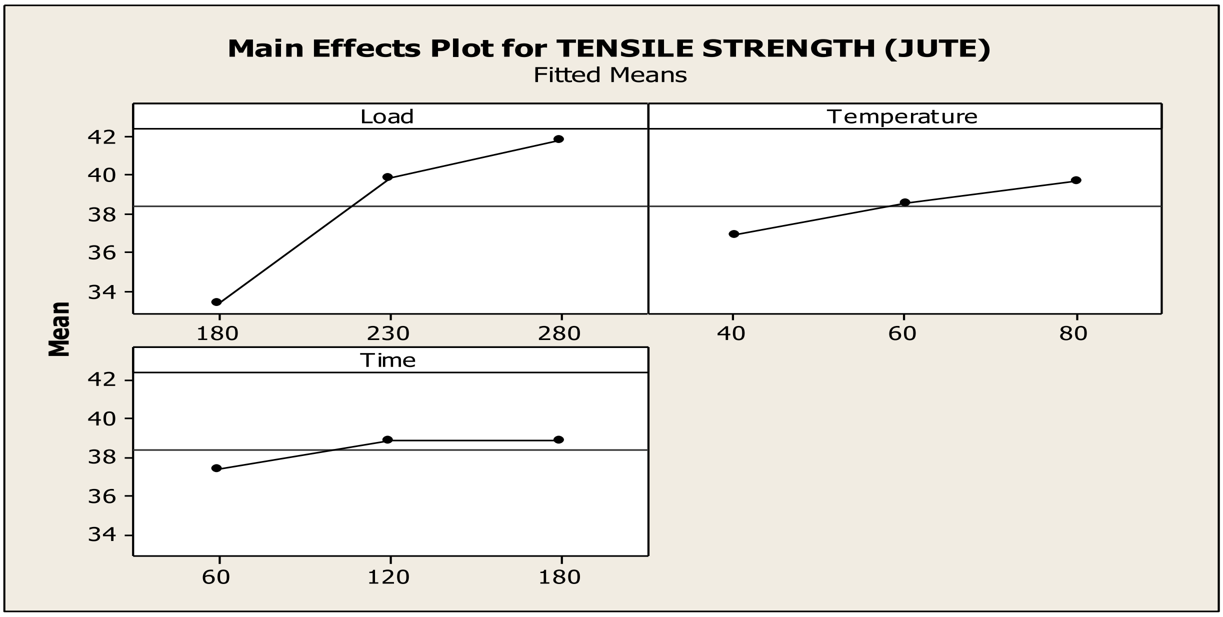


Figure 5.1 Main Effects Plot for Tensile Strength for Jute-Vinyl ester Composite (PPC)

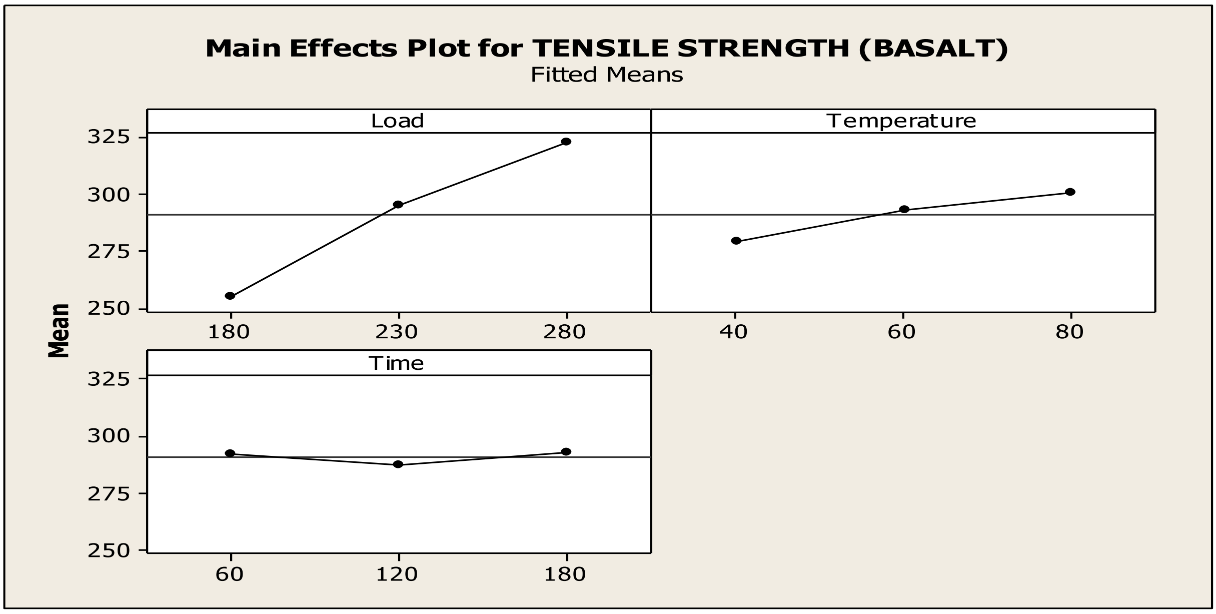
ANOVA was carried out for the tensile strength of jute-vinyl ester composites. Table 5.1 shows the ANOVA results for the tensile strength. The p-value from the ANOVA results represents that the load has significant effects on the tensile strength of jute-vinyl ester composites (PPC). The adjusted R^2value for the tensile strength of jute-vinyl ester composites (89.33%) suggests an acceptable fitting of the model.

Table 5.4 ANOVA Table for Tensile Strength of Jute-Vinyl ester Composites (PPC)

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Load	2	118.284	118.284	59.142	32.08	0.03
Temperature	2	11.735	11.735	5.867	3.18	0.239
Time	2	4.552	4.552	2.276	1.23	0.447
Error	2	3.687	3.687	1.843		
Total	8	138.257				
S = 1.35769		R-Sq = 97.33%		R-Sq(adj) =89.33%		

5.5 Tensile Strength of Basalt-Vinyl ester Composite (BVC-PPC)

The main effect plot of tensile strength for basalt is shown in fig. 5.2. It is observed that as the load increases the tensile strength is increased. There is little increment in tensile strength is observed with an increase in temperature while there is no effect of time on the tensile strength of basalt vinyl ester composites



.Figure 5.2 Main effect plot for tensile strength of basalt-vinyl ester composites (PPC)

ANOVA was carried out for tensile strength of basalt-vinyl ester composites. Table 5.2 shows the ANOVA results for the tensile strength. The p-value from the ANOVA results represents that the load has significant effects on the tensile strength of basalt-vinyl ester composites. The adjusted R^2value for the tensile strength of basalt-vinyl ester composites (95.98%) suggests an acceptable fitting of the model.

Table5.5 ANOVA Table for Tensile Strength of Basalt-Vinyl ester Composites

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Load	2	6913.2	6913.2	3456.6	88.63	0.011
Temperature	2	723.2	723.2	361.6	9.27	0.097
Time	2	56.2	56.2	28.1	0.72	0.581
Error	2	78	78	39		
Total	8	7770.7				
S = 6.24519		R-Sq = 99.00%		R-Sq(adj) = 95.98%		

5.6 Tensile Strength of Carbon-Vinyl ester Composite (CVC-PPC)

The main effect plot of tensile strength for carbon-vinyl ester is shown in fig. 5.3.Itis observed that as the load and temperature increase the tensile strength is increased. There is little increment in tensile strength is observed with increase in time.

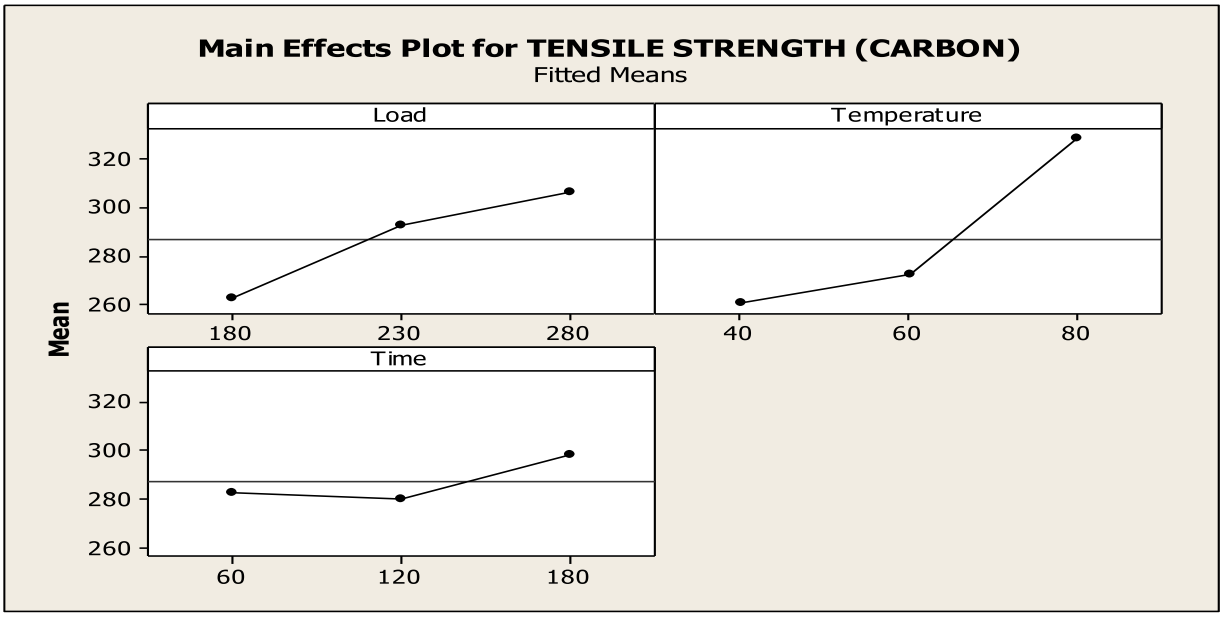


Figure 5.3 Main Effect Plot for Tensile Strength of Carbon-Vinyl ester Composites (PPC)

ANOVA was carried out for tensile strength of carbon-vinyl ester composites. Table 5.3 shows the ANOVA results for the tensile strength. The p-value from the ANOVA results represents that the load and temperature has significant effects on the tensile strength of carbon-vinyl ester composites. The adjusted R^2 value for tensile strength of carbon-vinyl ester composites (95.21%) suggests an acceptable fitting of the model.

Table 5.6 ANOVA Table for Tensile Strength of Carbon-Vinyl ester Composites

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Load	2	2986.1	2986.1	1493	21.44	0.045
Temperature	2	7908.2	7908.2	3954.1	56.78	0.017
Time	2	606.8	606.8	303.4	4.36	0.187
Error	2	139.3	139.3	69.6		
Total	8	11640.5				
S = 8.34518		R-Sq = 98.80%		R-Sq(adj) = 95.21%		

5.7 Flexural Strength of Jute-Vinyl ester Composites (JVC-PPC)

The main effects plot of flexural strength for Jute is shown in fig. 5.4. It is observed that as the load and temperature increase the flexural strength is increased. There is no effect on flexural strength is observed with increase in time

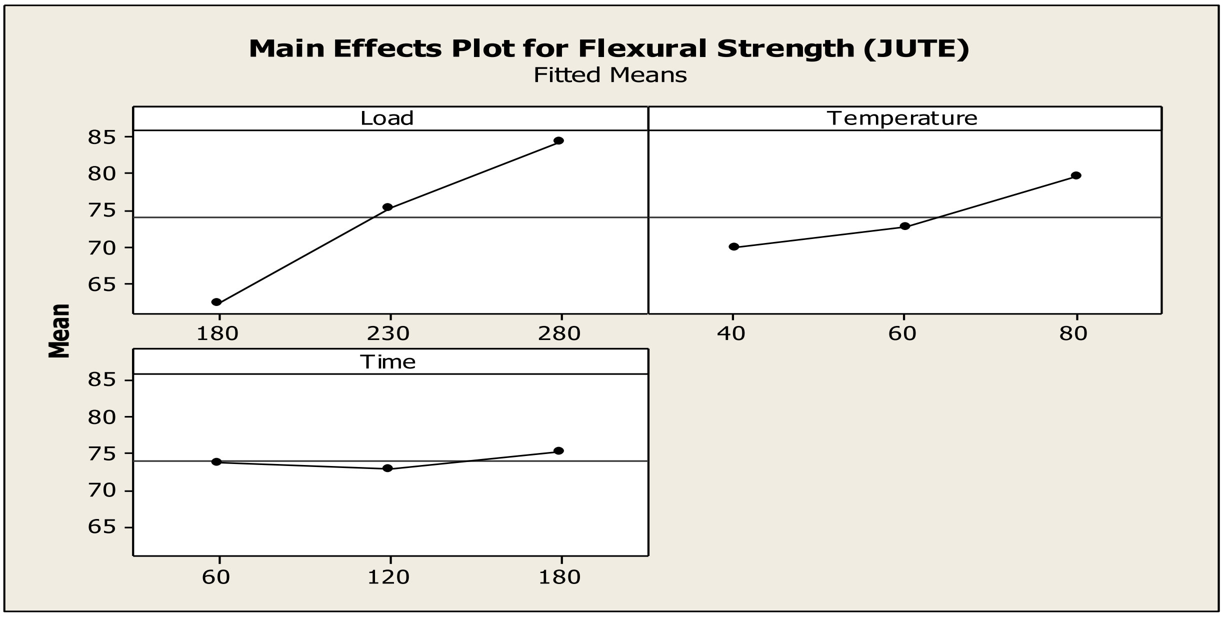


Figure 5.4 Main Effects Plot for Flexural Strength of Jute-Vinyl ester Composites (PPC).

ANOVA was carried out for the flexural strength of jute-vinyl ester composites. Table 5.4 shows the ANOVA results for the flexural strength. The p-value from the ANOVA results represents that the load has significant effects on the flexural strength of jute-vinyl ester composites. The adjusted R^2 value for the flexural strength of jute-vinyl ester composites (91.00%) suggests an acceptable fitting of the model.

Table 5.7 ANOVA Table for Flexural Strength of Jute-Vinyl ester Composites

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Load	2	741.25	741.25	370.63	35.89	0.027
Temperature	2	147.19	147.19	73.59	7.13	0.123
Time	2	9.25	9.25	4.62	0.45	0.691
Error	2	20.66	20.66	10.33		
Total	8	918.34				
S = 3.21372		R-Sq = 97.75%			R-Sq(adj) =91.00%	

5.8 Flexural Strength of Basalt-Vinyl ester Composites (BVC-PPC)

The main effect plot of flexural strength for basalt is shown in fig. 5.5 It is observed that as the load and temperature increase the flexural strength is increased. There is no effect of time on the flexural strength of basalt vinyl ester composites.

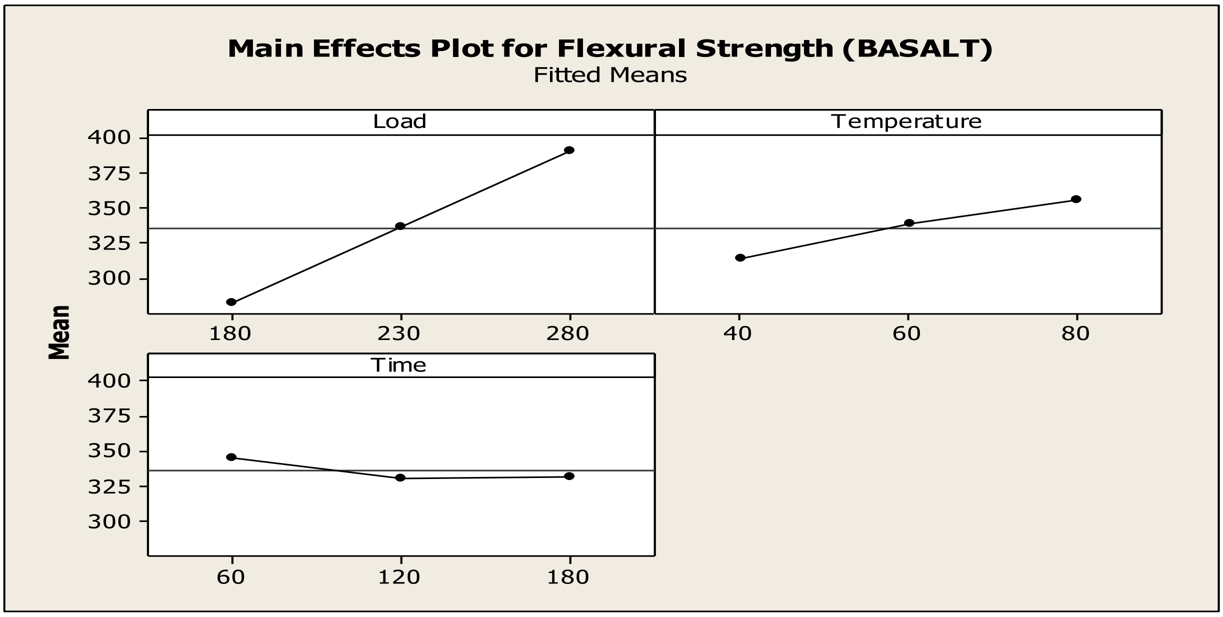


Figure 5.5 Main Effects Plot for Flexural Strength of Basalt-Vinyl Ester Composites(PPC)

ANOVA was carried out for the flexural strength of basalt-vinyl ester composites. Table 5.5 shows the ANOVA results for the flexural strength. The p-value from the ANOVA results represents that the load and temperature have significant effects on the flexural strength of basalt-vinyl ester composites. The adjusted R^2value for the flexural strength of basalt-vinyl ester composites (99.49%) suggests an acceptable fitting of the model.

Table 5.8 ANOVA Table for Flexural Strength of Basalt-Vinyl ester Composites

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Load	2	17555.5	17555.5	8777.8	666.33	0.001
Temperature	2	2634.5	2634.5	1317.2	99.99	0.01
Time	2	366.3	366.3	183.2	13.9	0.067
Error	2	26.3	26.3	13.2		
Total	8	20582.6				
S = 3.6295		R-Sq = 99.87%			R-Sq(adj) = 99.49%	

5.9 Flexural Strength of Carbon-Vinyl ester Composites (CVC-PPC)

The main effect plot of flexural strength for carbon-vinyl ester is shown in fig. 5.6 It is observed that as the load and temperature increase the flexural strength is increased. There is little increment in flexural strength is observed with increase in time.

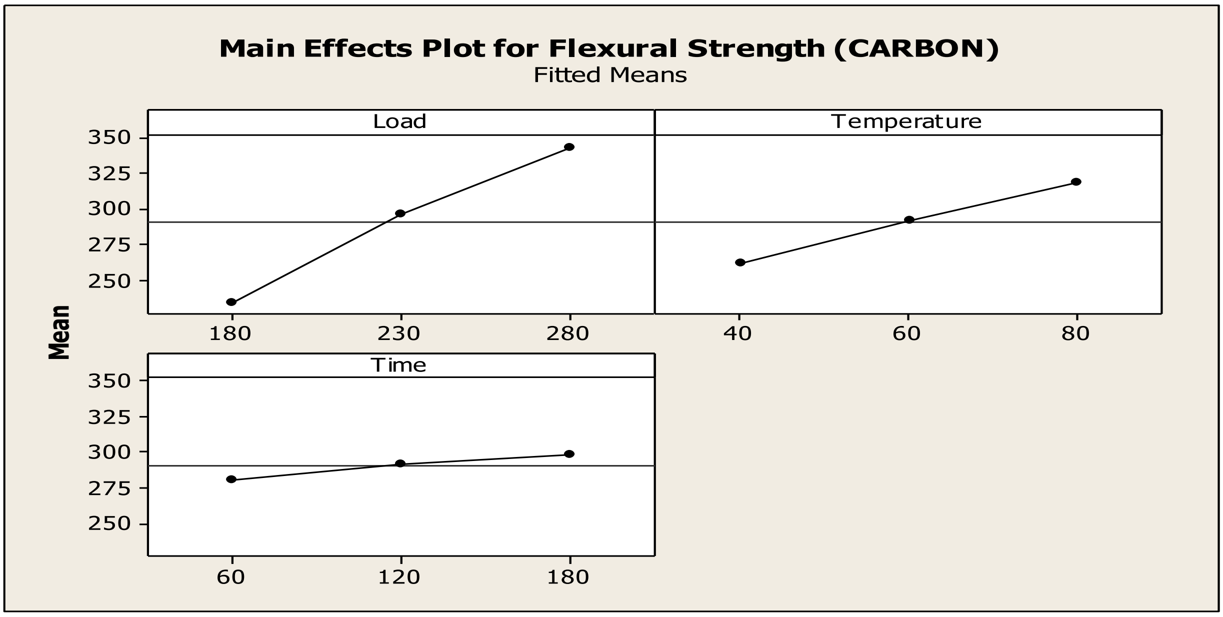


Figure 5.6 Main Effects Plot for Flexural Strength of Carbon-Vinyl ester Composites (PPC)

ANOVA was carried out for the flexural strength of carbon-vinyl ester composites. Table 5.9 shows the ANOVA results for the flexural strength. The p-value from the ANOVA results represents that the load, temperature, and time have significant effects on the flexural strength of carbon-vinyl ester composites. The adjusted R^2 value for the flexural strength of carbon-vinyl ester composites (99.79%) suggests an acceptable fitting of the model.

Table 5.9 ANOVA Table for Flexural Strength of Carbon-Vinyl ester Composites

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Load	2	17833.2	17833.2	8916.6	1503.12	0.001
Temperature	2	4788	4788	2394	403.57	0.002
Time	2	493.2	493.2	246.6	41.57	0.023
Error	2	11.9	11.9	5.9		
Total	8	23126.3				
S = 2.43558			R-Sq = 99.95%		R-Sq(adj) = 99.79%	

5.10 Tensile strength of Jute-Vinyl ester Composites (JVC-IPC)

The main effect plot of tensile strength for Jute is shown in fig. 5.7. It is observed that as the load and temperature increase the tensile strength is increased.

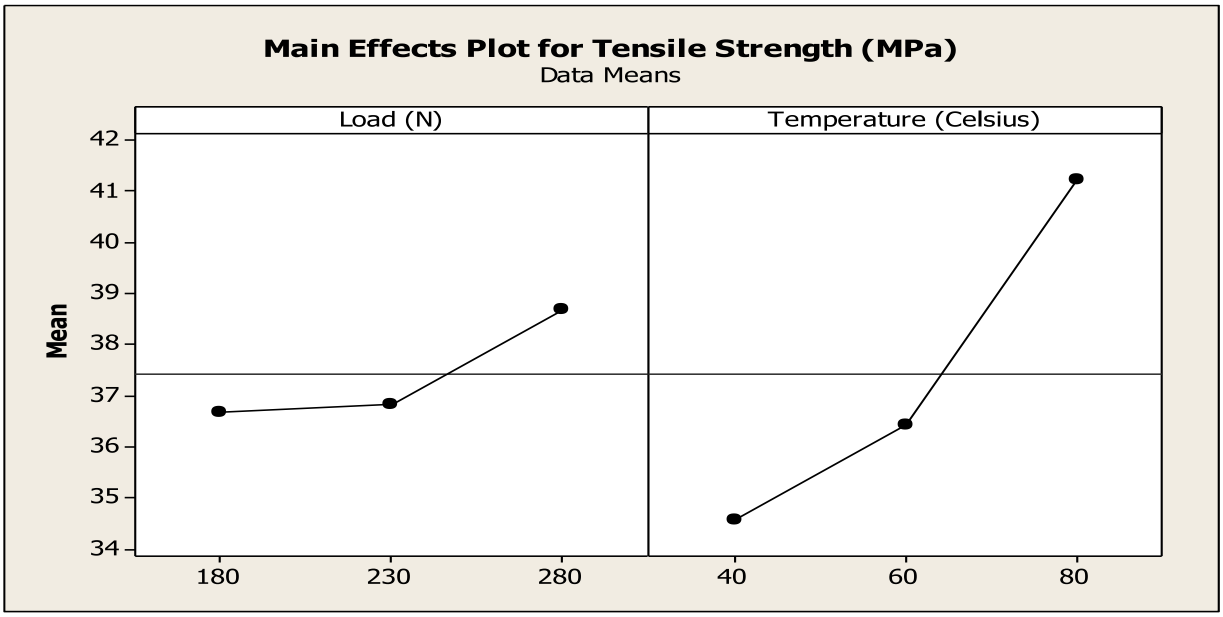


Figure 5.7 Main Effects Plot for Tensile Strength of Jute -Vinyl ester Composites (IPC)

ANOVA was carried out for the tensile strength of jute-vinyl ester composites. Table 5.7 shows the ANOVA results for the tensile strength. The p-value from the ANOVA results represents that the temperature has the most significant effect on tensile strength while load has no significant effects on the tensile strength of jute-vinyl ester composites. The adjusted R^2 value for tensile strength of jute-vinyl ester composites (78.13%) suggests an acceptable fitting of the model

Table5.10 ANOVA Table for Tensile Strength of Jute-Vinyl ester Composites (IPC)

Source	**DF**	**Seq SS**	**Adj SS**	**Adj MS**	**F**	**P**
Load (N)	2	7.542	7.542	3.771	1.56	0.315
Temperature (Celsius)	2	71.162	71.162	35.581	14.73	0.014
Error	4	9.663	9.663	2.416		
Total	8	88.367				
S = 1.55429		R-Sq = 89.06%			R-Sq(adj) = 78.13%	

5.11 Flexural Strength of Jute-Vinyl ester Composites(JVC-IPC)

The main effect plot of flexural strength for Jute is shown in fig. 5.8 It is observed that as the load and temperature increase the flexural strength is increased.

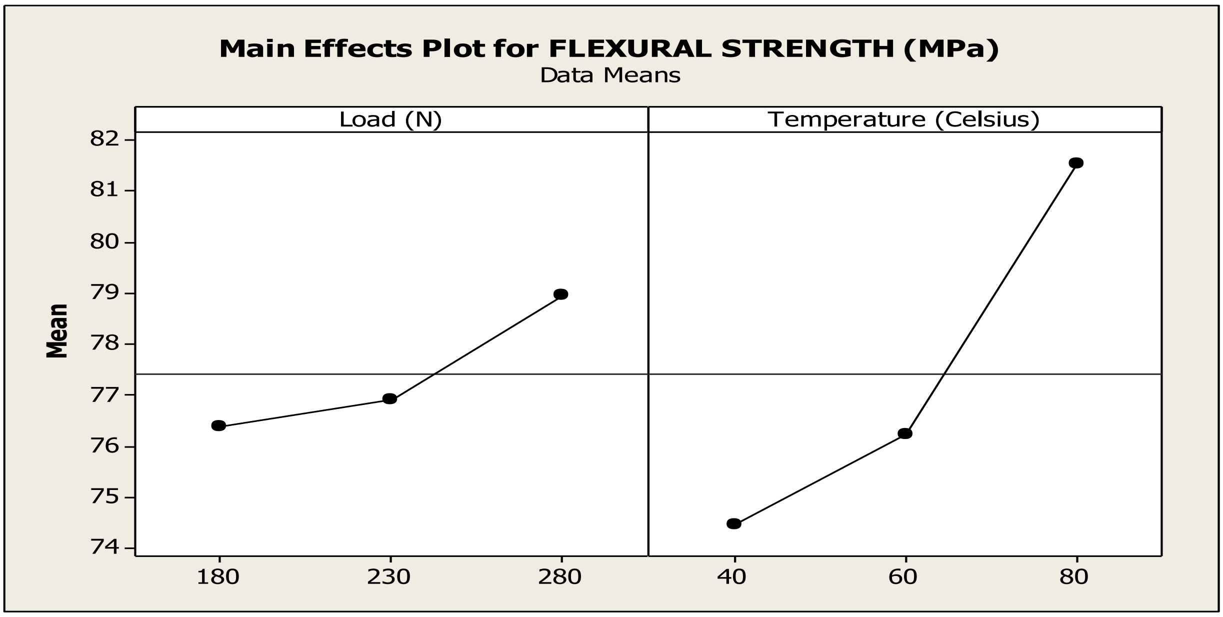


Figure 5.8 Main Effects Plot for Flexural Strength of Jute –Vinyl ester Composites(IPC)

ANOVA was carried out for the flexural strength of jute-vinyl ester composites. Table 5.8 shows the ANOVA results for the flexural strength. The p-value from the ANOVA results represents that the temperature has the most significant effect on flexural strength while load has no significant effects on the flexural strength of jute-vinyl ester composites. The adjusted R^2 value for the flexural strength of jute-vinyl ester composites (63.08%) suggests an acceptable fitting of the model.

Table 5.11 ANOVA Table for Flexural Strength of Jute-Vinyl ester Composites

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Load (N)	2	11.216	11.216	5.608	1.08	0.423
Temperature (Celsius)	2	80.943	80.943	40.471	7.76	0.042
Error	4	20.866	20.866	5.217		
Total	8	113.025				
S = 2.28397	R-Sq = 81.54%			R-Sq(adj) = 63.08%		

5.12 Regression Analysis (POST PROCESS CURING - PPC)

The regression analysis helps to approximate the value of one variable from the given value of another. Regression modelling was done to propose empirical models for tensile strength and flexural strength. The empirical models as determined by regression analysis to predict are tensile strength and flexural strength for JVC, BVC and CVC are as follow,

TENSILE STRENGTH:

$\sigma_{t\_Jute\_PPC=}13.1906 + 0.084944 * L + 0.0694444 * T + 0.0124074 * t$ (Eqn no 5.1)

$\sigma_{t\_Basalt\_PPC=}102.114 + 0.674778 * L + 0.541667 * T + 0.00944444 * t$ (Eqn no 5.2)

$\sigma_{t\_Carbon\_PPC=}68.8454 + 0.436944 * L + 1.69444 * T + 0.133333 * t$ (Eqn no 5.3)

FLEXURAL STRENGTH:

$\sigma_{f\_Jute\_PPC=}7.04296 + 0.22125 * L + 0.239875 * T + 0.014338 * t$ (Eqn no 5.4)

$\sigma_{f\_Basalt\_PPC=}37.7867 + 1.08183 * L + 1.04042 * T + 0.110417 * t$ (Eqn no 5.5)

$\sigma_{f\_Carbon\_PPC=} - 61.9996 + 1.08678 * L + 1.41111 * T + 0.149306 * t$ (Eqn no 5.6)

Where,

L= Load applied in Newton

T= Process Temperature in Centigrade (^{o}C)

t = Time duration in minutes

5.13 Regression Analysis (IN-PROCESS CURING - IPC)

The empirical models as determined by regression analysis to predict are tensile strength and flexural strength for JVC are as follow,

$\sigma_{t\_Jute\_IPC} = 22.7498 + 0.0202222 * L + 0.166806 * T$ (Eqn no 5.7)

$\sigma_{f\_Jute\_IPC} = 60.8896 + 0.0258944 * L + 0.176403 * T$ (Eqn no 5.8)

5.14 Effect of Volume Fraction Of Bamboo (Natural)and Glass (Synthetic) Fibers On Thermal Conductivity

Experiments were conducted to find thermal conductivity of bamboo fibers and glass fibers separately and hybrid composite plates made from both fibers on developed experimental set up for measuring thermal conductivity. The observed values are shown in table 5.12 below,

Table 5.12 Thermal Conductivity of Composite Plates Made from Bamboo Fibers, Glass Fibers and Bamboo-Glass Hybrid Fibers with Vinyl ester of Various Composition

Specimen	Thickness (mm)	Time	T_{hp} (ºC)	T_{cp} (ºC)	T_{wo} (ºC)	T_{wi} (ºC)	Flow Rate	k (W/m.K)	Average
B10G30	3	2.18	50	38	37.5	36.8	9.16	0.291	0.293
		2.25	50	38.1	37.5	36.8	9.16	0.294	
		2.35	50	38.1	37.5	36.8	9.16	0.294	
B10G20	3	2.55	50	35.2	34.6	33.1	4.5	0.248	0.259
		3.00	50	35.2	34.7	33.1	4.5	0.265	
		3.15	50	35.2	34.7	33.1	4.5	0.265	
B30	3	10.01	50	34.3	33.7	32.7	3.937	0.136	0.145
		10.11	50	34.3	33.8	32.7	3.937	0.150	
		10.15	50	34.3	33.8	32.7	3.937	0.150	
G40	2.5	9.55	50	36.2	35.6	34.2	7.5	0.345	0.346

		10.00	50	36.2	35.6	34.2	7.5	0.345	
		10.02	50	36.3	35.6	34.2	7.5	0.348	

In the above composites, resin material used is vinyl ester. B and G stand for bamboo fiber and glass fiber used as reinforcement. The number next to them indicates the proportion of reinforcement material by weight. e.g. B30 indicates 30% of bamboo fiber by weight and remaining is a matrix. The specimens are prepared by hand layup technique

5.15 Validation of Experimental Results

The experimental results obtained from the developed experimental set up developed for measuring the thermal conductivity of the composite material are also compared with other analytical methods existing in the literature for the validity of the results which are as follows,

5.15.1Comparative Cut Bar Technique:

Hot and Cold plates are made of aluminium which is placed on either side of the specimen. So comparative cut bar technique of measuring thermal conductivity can be applied. The related formula is as below:

$$Q = \frac{T_h - T_c}{\frac{L_h}{k_h A_h} + \frac{L_s}{k_s A_s} + \frac{L_c}{k_c A_c}} \qquad \text{(Eqn no 5.9)}$$

Where, Q = Heat supplied (W)

T_h = Temperature of a hot plate (K)

T_c = Temperature of a cold plate (K)

k_s, k_h, and k_c = Thermal conductivity of specimen material, hot plate and cold plate respectively (W/mK)

A_s, A_h and A_c = Surface area of the specimen, hot plate, and cold plate respectively (m^2)

L_s, L_h, and L_c = Thickness of specimen, hot plate and cold plate respectively (m)

Here let $k_h = k_c = k$ and $A_h = A_c = A$, so equation in terms of k_s can be reduced to as follow:

$$k_s = \frac{L_s}{A_s\left[\frac{T_h - T_c}{Q} - \frac{L_h + L_c}{kA}\right]} \qquad \text{(Eqn no 5.10)}$$

The experimental value of k calculated using Fourier equation and comparative cut bar technique, its standard value with relative error are tabulated below

Table 5.13: Relative Error in Measurement of Thermal Conductivity

Material	Value of k by Fourier equation W/m.K	Value of k by Cut bar method W/m.K	Standard value@	Relative error
Acrylic	0.203	0.205	0.19	6.84%
HDP	0.528	0.537	0.52	1.5%
HDP	0.542	0.551	0.52	4.2%
Glass	0.705	0.718	0.8	11.8%
Glass	0.715	0.729	0.8	10.6%

@ https://www.engineeringtoolbox.com/thermal-conductivity-plastics-d_1786.html dated 14/02/2020 time 00.58 night

Many theoretical models have been proposed to predict the thermal conductivity of composites. For two components composite that is mono composite and for three components that is hybrid composite, the simplest alternative would be materials arranged in either series or parallel concerning heat flow, which gives lower and upper bounds of effective thermal conductivity as transverse and longitudinal thermal conductivity (4). The equations are as below

5.15.2 Series Model (Rule of Mixture):

For mono composite -

$$\frac{1}{k_T} = \frac{v_m}{k_m} + \frac{v_f}{k_f} \qquad \text{(Eqn no 5.11)}$$

$$k_T = \frac{k_m \times k_f}{k_f v_m + k_m v_f} \quad \text{(Eqn no 5.12)}$$

For hybrid composite –

$$\frac{1}{k_T} = \frac{v_{f1}}{k_{f1}} + \frac{v_{f2}}{k_{f2}} + \frac{v_m}{k_m} \quad \text{(Eqn no 5.13)}$$

$$k_T = \frac{k_{f1} \times k_{f2} \times k_m}{(k_{f1} \times k_{f2} \times k_m) + (k_{f1} \times v_{f2} \times k_m) + (k_{f1} \times k_{f2} \times v_m)} \quad \text{(Eqn no 5.14)}$$

Where,

k_T, k_L = Transverse and longitudinal thermal conductivity

k_m, k_f = Thermal conductivity of matrix, filler material

v_m, v_f =Volume fraction of matrix, filler material

The subscript 1 and 2 is for two different filler materials

The volume fraction is calculated using equations as follow:

For mono composites –

$$v_m = \frac{W_m/\rho_m}{(W_m/\rho_m) + (W_f/\rho_f)} \quad \text{(Eqn no 5.15)}$$

$$v_f = \frac{W_f/\rho_f}{(W_m/\rho_m) + (W_f/\rho_f)} \quad \text{(Eqn no 5.16)}$$

For hybrid composites –

$$v_m = \frac{\left({W_m}/{\rho_m}\right)}{\left({W_m}/{\rho_m}\right) + \left({W_{f1}}/{\rho_{f1}}\right) + \left({W_{f2}}/{\rho_{f2}}\right)} \qquad \text{(Eqn no 5.17)}$$

$$v_{f1} = \frac{\left({W_{f1}}/{\rho_{f1}}\right)}{\left({W_m}/{\rho_m}\right) + \left({W_{f1}}/{\rho_{f1}}\right) + \left({W_{f2}}/{\rho_{f2}}\right)} \qquad \text{(Eqn no 5.18)}$$

$$v_{f2} = \frac{\left({W_{f2}}/{\rho_{f2}}\right)}{\left({W_m}/{\rho_m}\right) + \left({W_{f1}}/{\rho_{f1}}\right) + \left({W_{f2}}/{\rho_{f2}}\right)} \qquad \text{(Eqn no 5.19)}$$

Where,

W = weight of the component

ρ = density of the component material

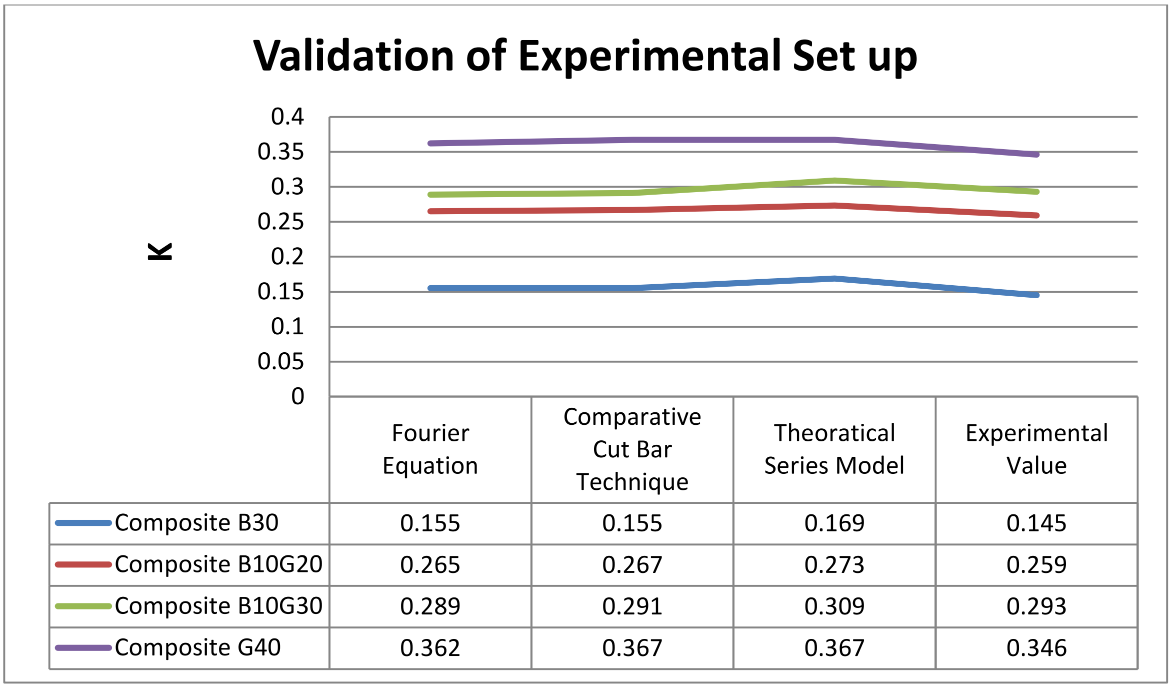
Other terms are as per earlier given notations

The experimental value of the thermal conductivity calculated using the Fourier equation, comparative cut bar technique is found in good agreement. The filler material is in a transverse direction to the heat flow. The applying series model gives a value close to the experimental values obtained. The results are as tabulated below

Table 5.14 Thermal Conductivity of Composite Plates Made from Bamboo Fibers, Glass Fibers and Bamboo-Glass Hybrid Fibers with Vinyl ester of Various Composition

Sr. No.	Specimen	Thermal Conductivity value derived based on			
		Experimental Methods		Theoretical value based Series Model	Relative error
		Fourier Equation	Comparative Cut Bar Technique		
1	Composite B30	0.155	0.155	0.1687	8.12%
2	Composite B10G20	0.265	0.267	0.2729	2.89%
3	Composite B10G30	0.289	0.291	0.3086	6.35%
4	Composite G40	0.362	0.367	0.3673	1.44%

The value of thermal conductivity increases on increasing the glass fiber content. The effect of bamboo fiber is to reduce thermal conductivity (fig5.9).The experimental results obtained from the developed experimental set up for measuring the thermal conductivity of the composite material are compared with other analytical methods existing in the literature for the validity of the results (fig 5.10)



	Fourier Equation	Comparative Cut Bar Technique	Theoratical Series Model	Experimental Value
Composite B30	0.155	0.155	0.169	0.145
Composite B10G20	0.265	0.267	0.273	0.259
Composite B10G30	0.289	0.291	0.309	0.293
Composite G40	0.362	0.367	0.367	0.346

Figure 5.9 Plot of the Effect of Volume Fraction of Fibers on Thermal Conductivity Measured by Different Methods

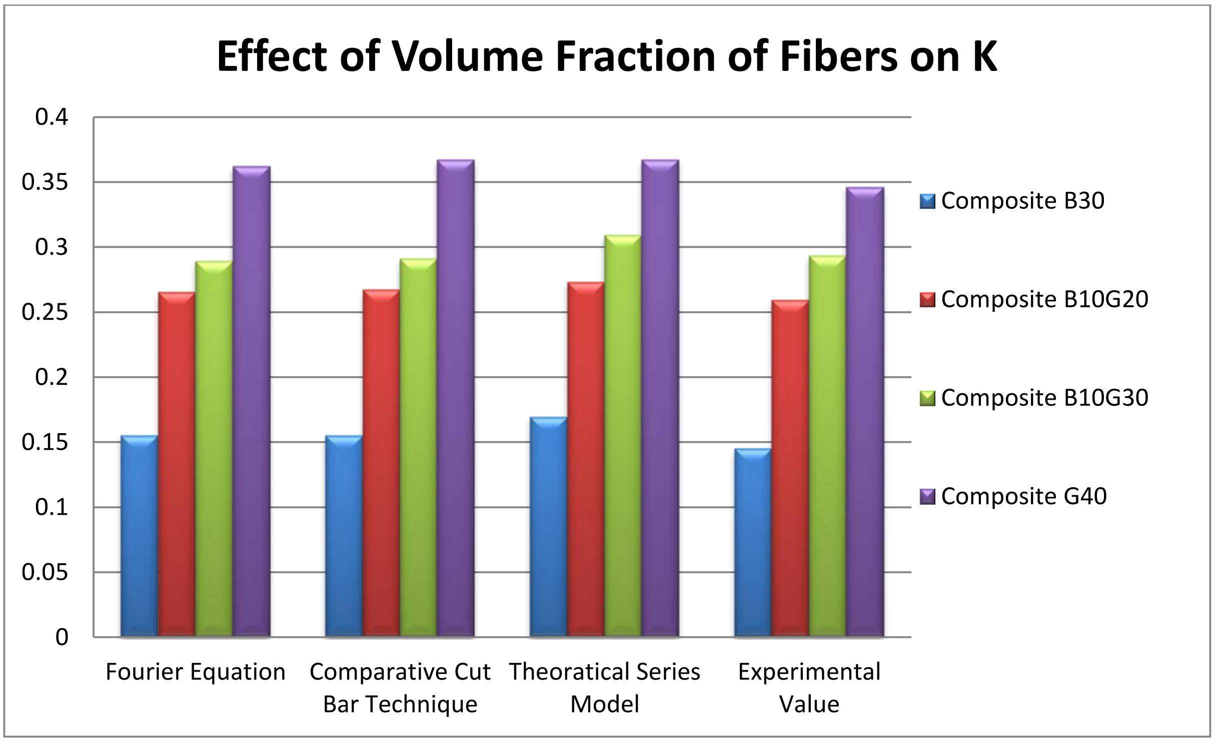


Figure 5.10 Plot of Validation of Experimental Results Compared with Other Methods

.Table 5.15 Experimental Data of Composite Sheet while Fabricating with Filler.

Sr No.	**Description**	**Measured Values**		
		SiC Filler	**Al Filler**	**Cu Filler**
1	No of layer	4 Nos	4 Nos	4 Nos
2	Mass of jute layers	106.81 gm	99.34 gm	102.94 gm
3	Mass of general-purpose resin	350 gm	350 gm	350 gm
4	Mass of hardener methyl ethyl ketone peroxide	6 gm	6 gm	6 gm
5	Mass of accelerating agent cobalt	2 gm	2 gm	2 gm
6	Mass of Sic powder	20 gm	20 gm	20 gm
7	Size of plate	300 X 300	300 X 300	300 X 300
8	Pressure on plate	2725 N/m^2	2725 N/m^2	2725 N/m^2
9	Mass of plate	359 gm	356 gm	350 gm
10	Fiber mass fraction(mass of jute / mass of plate)	0.297	0.279	0.294
11	Filler mass fraction (mass of filler / mass of plate)	0.0557	0.056	0.057
12	Thickness of plate	3.93	3.39	3.25

5.16 Effect of Filler on Mechanical Strength and Thermal Conductivity of Jute-Polyester Composite (JPC)

The following table no 5.16, shows the effect of conductive filler (Cu, Al, and Sic) on the mechanical strength of Jute-polyester composite and table no. 5.17 shows the effect of conductive filler (Cu, Al and Sic) on Thermal Conductivity (K) of Jute-polyester composite. Mechanical strength and thermal conductivity of the composite increase by adding filler in the resin during the fabrication process.

Table 5.16 Mechanical Strength of Jute - Polyester Composite Plate (with and without Filler)

Mechanical Strength of JUTE -POLYSTER Composites (JPC)								
	Tensile Strength (MPa)				Flexural Strength (MPa)			
Sr.No.	Without filler	SiC Filler	Cu Filler	Al Filler	Without filler	SiC Filler	Cu Filler	Al Filler
1	31.6	39.6	43	38.2	42.1	46.4	51.7	56
2	34.1	34.3	35.7	35.2	45.3	53.3	51.7	47.3
3	33.8	36.2	36.9	35.5	47.6	48.4	45.5	50.5
4	35.2	38.2	40.3	34.9	41.2	47.3	49.1	52.8
5	32.2	28.1	35	34.7	44.4	50	52.5	58.2
Average	33.38	35.28	38.18	35.7	44.12	49.08	50.1	52.96
% increase		5.69	14.3	6.95		11.24	13.55	20.03

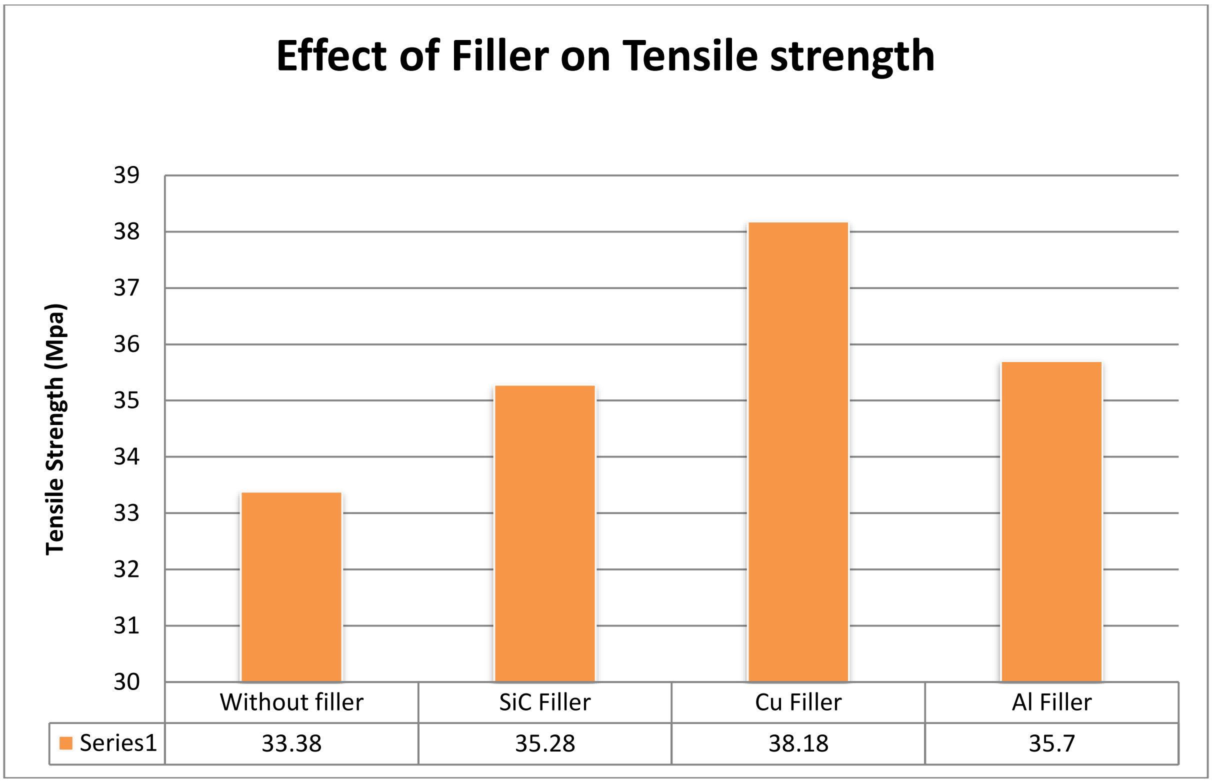


Figure 5.11 Effects of Filler on Tensile Strength

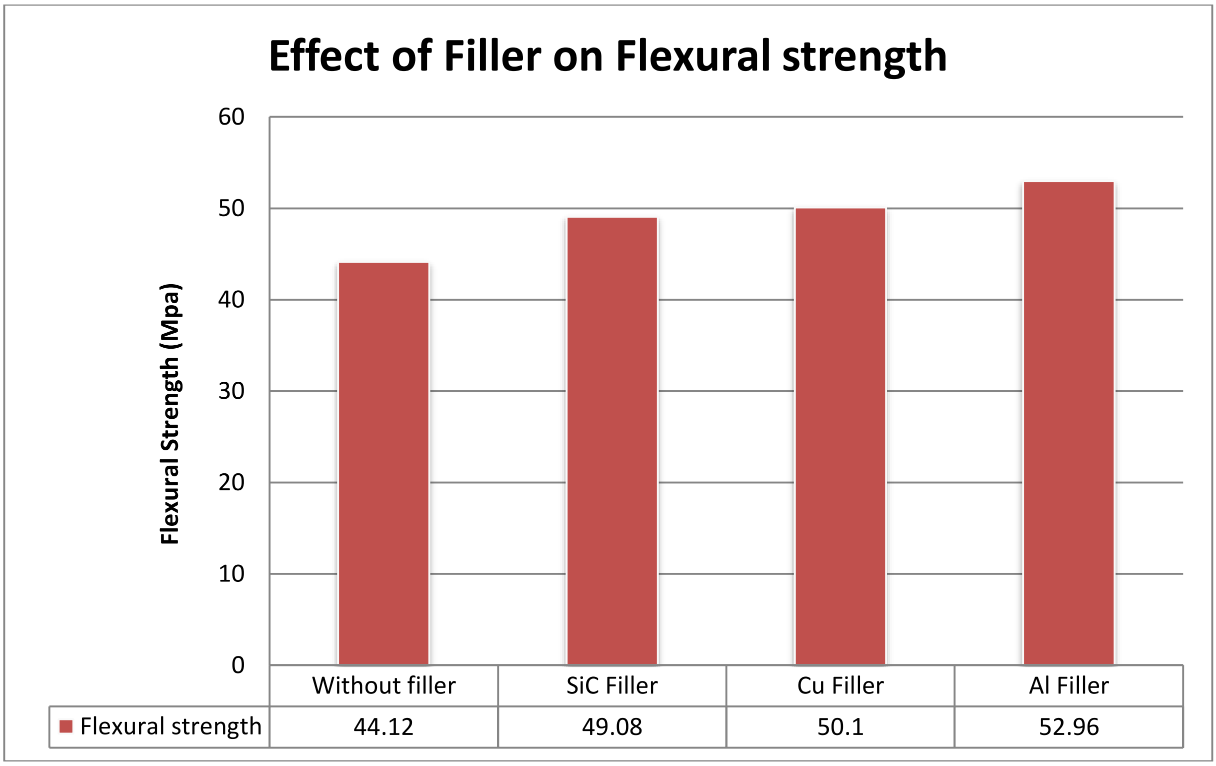


Figure 5.12 Effects of Filler on Flexural Strength

Table 5.17-Thermal Conductivity of Jute-Polyester Composite Plate (with and without Filler)

Sr No.	Specimen	K1 (w/mk)	K2(w/mk)	K3(w/mk)	Average(w/mk)
1	Jute-polyester without filler	0.194	0.198	0.204	0.198
2	Jute-polyester with Cu filler	0.475	0.478	0.480	0.477
% rise due to Cu		144.84	141.41	135.29	140.90
3	Jute-Polyester with Al filler	0.449	0.451	0.453	0.451
% rise due to Al		131.44	127.77	122.05	127.77
4	Jute-Polyester with SiC filler	0.391	0.393	0.397	0.393
% rise due to SiC		101.54	98.48	94.61	98.48

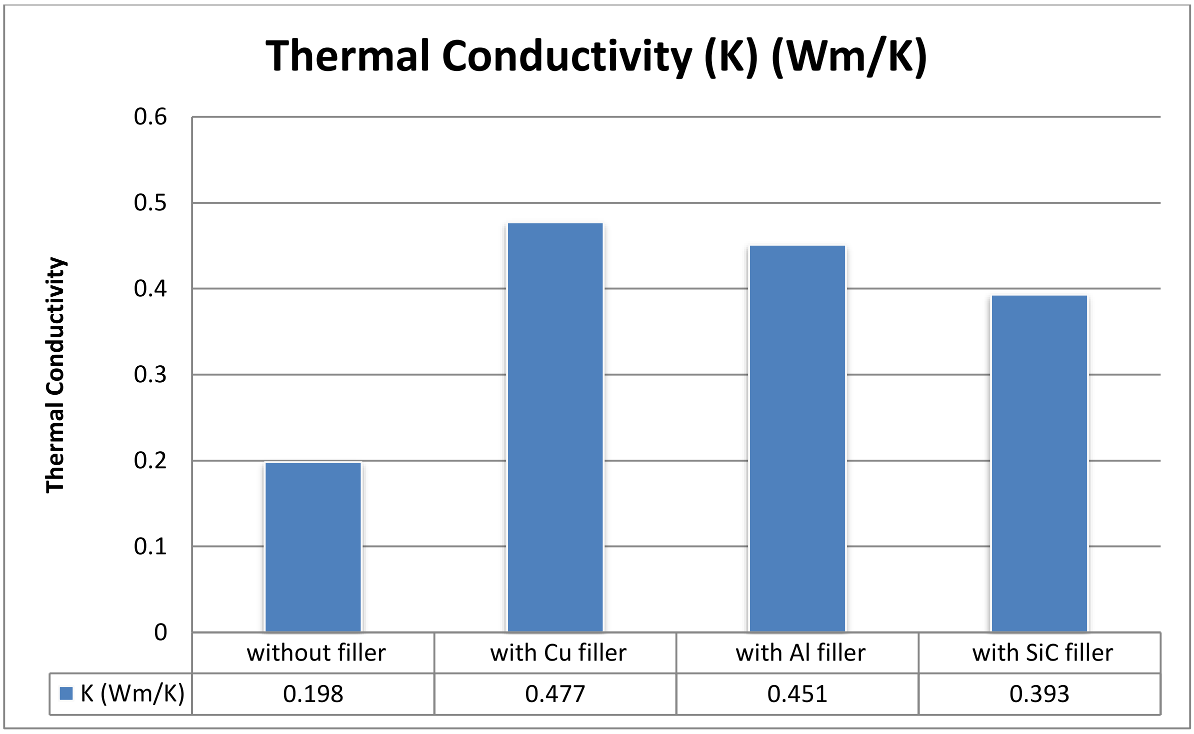


Figure 5.13 Effects of Filler on Thermal Conductivity

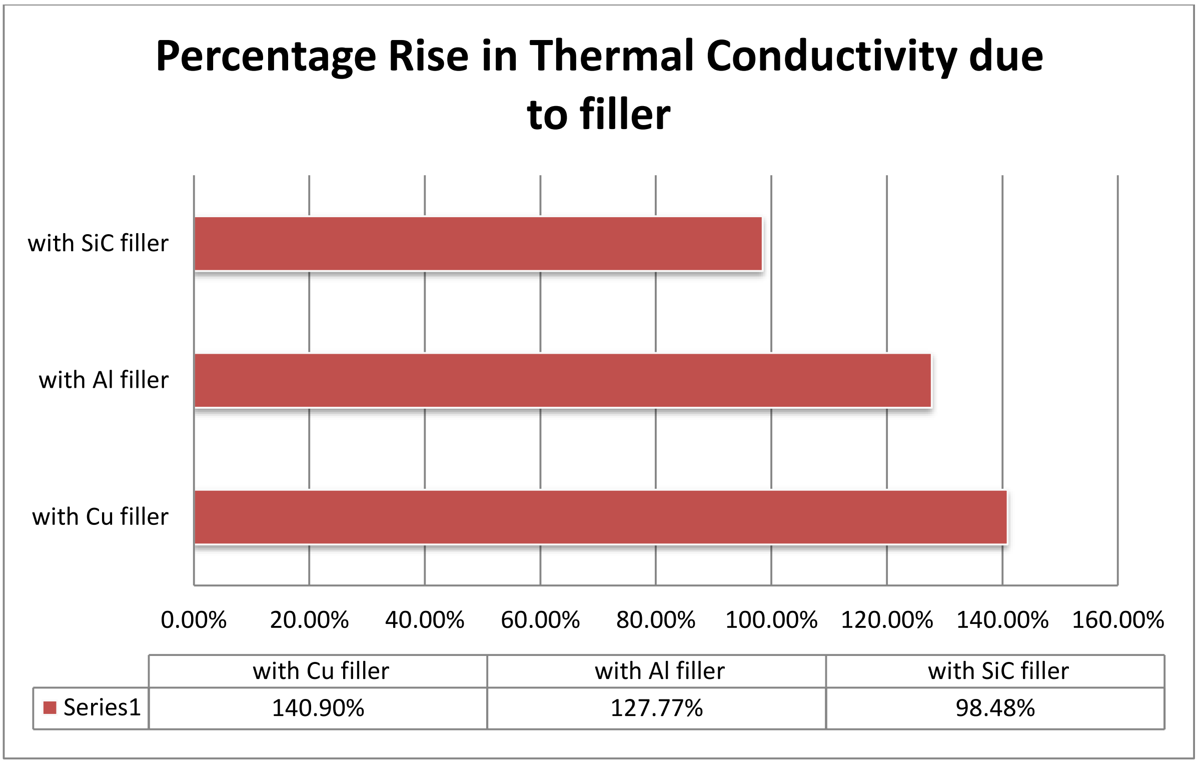


Figure 5.14 Percentage Rise in Thermal Conductivity due to Filler

The effect of the fillers on the JPC is to increase tensile strength and flexural strength (fig 5.11 and 5.12) as well as fillers affect positively on heat transfer i.e. rise in thermal conductivity. Amongst Cu, Al, and Sic fillers, the effects of Cu filler is more competent (fig 5.13 and 5.14)