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The Effect of Fly Ash Addition on Properties of Hemp Fiber Based Composites

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Abstract

World is now trying to use alternate material sources that are environment friendly and biodegradable in nature. Green composite produced using regular fiber and polymeric resin can help us to reduce our dependence on those materials which harm our environment. The composite materials have wide range of application in engineering. The composite consists of mainly two phases i.e. matrix and fiber. [1], [6], Fiber reinforced polymer composites has numerous preferences, for example, generally minimal effort of creation. This work describes the Delamination factor, water absorption capacity and strength of hemp fiber reinforced polymer composite with and without use of fly ash as filler material. Various tests are conducted to observe the impact of use of fly ash in hemp fiber reinforced polymer composite.
Keywords: Composites, Delamination Factor, Mechanical Properties, Tensile test and Water Absorption Testing

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I. INTRODUCTION

A. *Overview of Fiber and Composites*

Fiber is a thread or filament from which vegetable tissue, internal substances are obtained. There are mainly two types of fiber.

- Natural fiber
- Glass fiber

Natural fibers are considered more advantageous than glass fiber because they are biodegradable, have low thickness and are recyclable.

Natural fibers are of three types on the basis of source

1) Plant Fibers: Plant fibers are mainly consists of cellulose: examples cotton, jute, bamboo, hemp, and sisal.
2) Mineral Fibers: Mineral fibers are those which we get from minerals body, examples-asbestos.
3) Animal Fibers: Animal fiber contains proteins; cases, silk, alpaca, mohair, downy. Animal hair is a strand got from animals like sheep, goat and horse.

Composites of natural fiber used for drives of structural, but typically with synthetic thermoset matrix which of course bound the environmental benefits. Now a days natural fiber composite are used in automotive industry, buildings and the place where dimensional constancy under moist and high thermal conditions and load bearing capacity are of importance. Among all the natural fiber is considered more advantageous due to its ease of availability low cost comparable strength and properties. Generally, natural fibers are consists of cellulose, lignin, pectin etc. The composite materials could be termed as those materials which are synthesized by two or more materials having diverse properties. The primary constituents of composites are matrix and reinforcement. [2],[5],[8],The primary constituent of composites has a nonstop stage which is the significant a piece of the composite is called matrix. Matrix are by and large more ductile and less hard and these are generally either inorganic or natural. Optional constituent of composites have ductile called reinforcement and they are implanted in the matrix. The constituents of composite materials have their property however when they are consolidated together, they give a blend of properties that a singular can't have the capacity to give. Generally, composite materials are arranged on the basis of matrix materials as:

B. *Ceramic Matrix Composite:*

The composite which is consisting of a ceramic combined with a ceramic dispersed phase. It is very advantageous because of its brittleness and high performance products.

C. *Polymer Matrix Composite:*

It the material consisting of a polymer (matrix) combined with a fibrous reinforcing dispersed phase.

It includes a matrix from thermoplastic (polystyrene, nylon) or thermosetting (epoxy, unsaturated polyester) or and inserted the steel, glass carbon, or Kevlar strands.

D. Metal Matrix Composite:

Composites consisting of metal matrix such as Mg, Al, Fe is called metal matrix composites. [6], [7], [8], they are advantageous because of their high stiffness, light weight and low specific weight as compared to other. They have also high strength to weight ratio, cost, high toughness, high tensile strength and high creep resistance at increases in temperatures.

II. EXPERIMENTAL DETAILS

Detail of manufacturing of the composite material.

A. The Materials used are:

– Hemp fiber, Epoxy, Hardener, Fly ash etc.

B. Development of Hemp fiber based composite:-

The hemp fiber is obtained from hemp plant, which has been collected from local sources. The extracted hemp fiber were subsequently sun dried for eight to remove free water present in the fiber. The dried fibers were subsequently cut into length 15 cm. The epoxy resins and hardener are collected from local source. The hemp fiber based epoxy composite is fabricated using hand lay-up process. The mould has been prepared with dimensions of 180×180×40 mm3. The hemp fiber was mixed with mixture of epoxy, hardener and fly ash, keeping the characterization standards and view on testing condition. The releasing agent has been use on mould sheet which give easy to composites removal from the mould after curing the composites.[6],[7], A roller has been used to remove the trapped air from the uncured composite and mould has been closed at temperature 30° C duration 24 hour. The constant load of 30 kg is applied on the mould in which the mixture of the hemp, epoxy resin and hardener has been poured. After curing, the specimen has been taken out from the mould.

C. Development of hemp fiber composite

Ratio of epoxy and hardener = 70:30
Surface finish was smooth and void free.

D. Development of fly ash mixed hemp fiber composite

Ratio of epoxy and hardener = 70:30
Fly ash=10gm

III. RESULTS AND DISCUSSION

A. Tensile Strength Test

Fabricated composite was cut to get the desired dimension of specimen for mechanical testing. For the tensile test, the specimen size was 170×25×4 mm and gauge length was 50 mm. Tensile strength was tested in UTM machine. The specimen with desired dimension was fixed in the grips of the UTM machine.[3],[7],[13], The experimental set up for tensile test is shown in Figure.

Fig. 1: Specimen For Tensile Test

Fig. 2: Hemp

B. Result of tensile test:

Composite without fly ash
Dimension of specimen = 170x25x4.5mm, Cross section area = 112.5mm^2,
1) Sample test 1:
Breaking load = 15500.5N, Tensile stress = 137.78MPa
2) Sample test 2:
Dimension of specimen = 170x25x3.75mm, Cross section area = 93.75mm^2, Breaking load = 14580.85N, Tensile stress = 155.52MPa

3) Sample test 3

Dimension of specimen = 170x25x3.5mm, Cross section area = 87.5mm^2, Breaking load = 14200.75N, Tensile stress = 162.29MPa

Average tensile strength = 151.86MPa

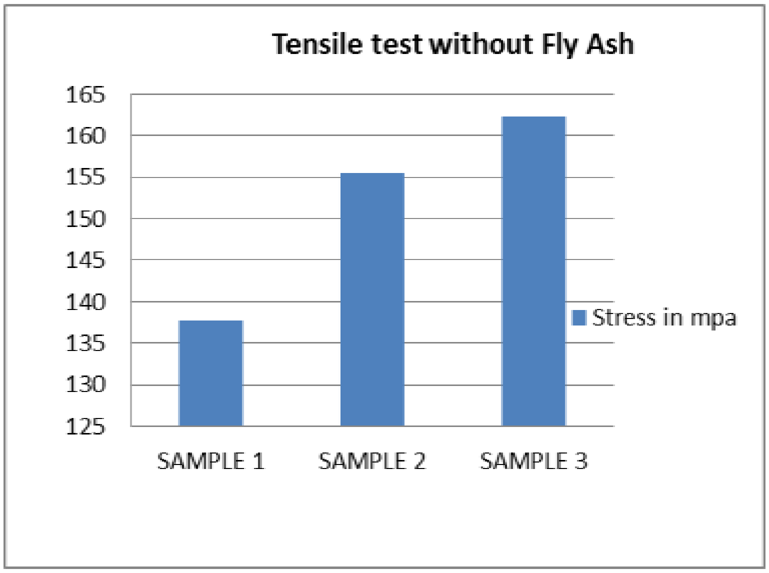


Fig. 3: Tensile Test without Fly Ash

Composite with fly ash, Dimension of specimen = 170x25x4mm, Cross section area = 100mm^2

1) Sample test 1:

Breaking load = 16500.47N, Tensile stress = 165.04MPa

2) Sample test 2:

Dimension of specimen = 170x25x3.75mm, Cross section area = 93.75mm^2, Breaking load = 15540.5N, Tensile stress = 165.76MPa

3) Sample test 3:

Dimension of specimen = 170x25x3.5mm, Cross section area = 87.5mm^2, Breaking load = 15200.55N, Tensile stress = 173.72MPa

Average tensile strength = 168.16MPa

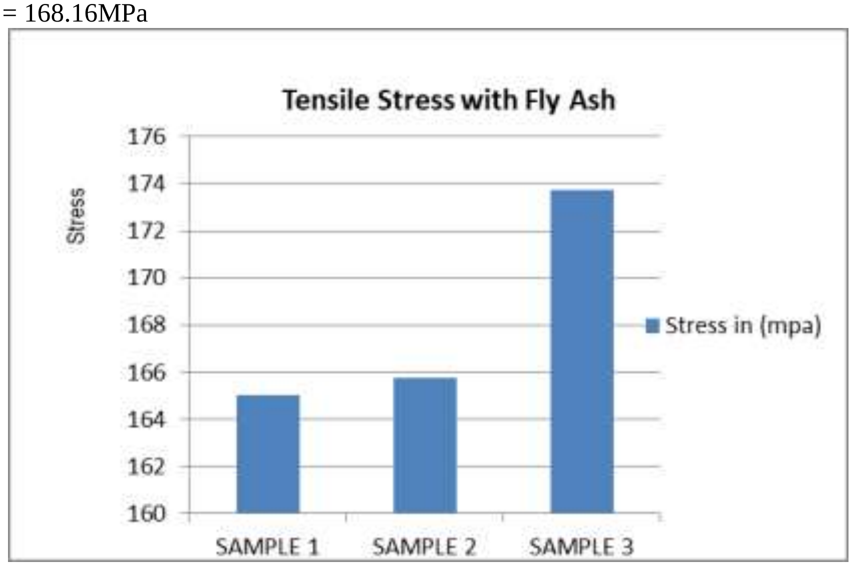


Fig. 4: Tensile Test with Fly Ash

C. Results of Compression test

Composite without fly ash, Dimension of specimen = 50x25x3.75mm, Cross section area = 93.75 mm^2

1) Sample test 1:

Breaking load = 18100.5N, Compressive stress = 193.07MPa

Composite with fly ash, Dimension of specimen = 50x25x3.75mmCross section area = 93.75mm^2

2) Sample test 1:
Breaking load = 19500.47N, Compressive stress = 208.05MPa

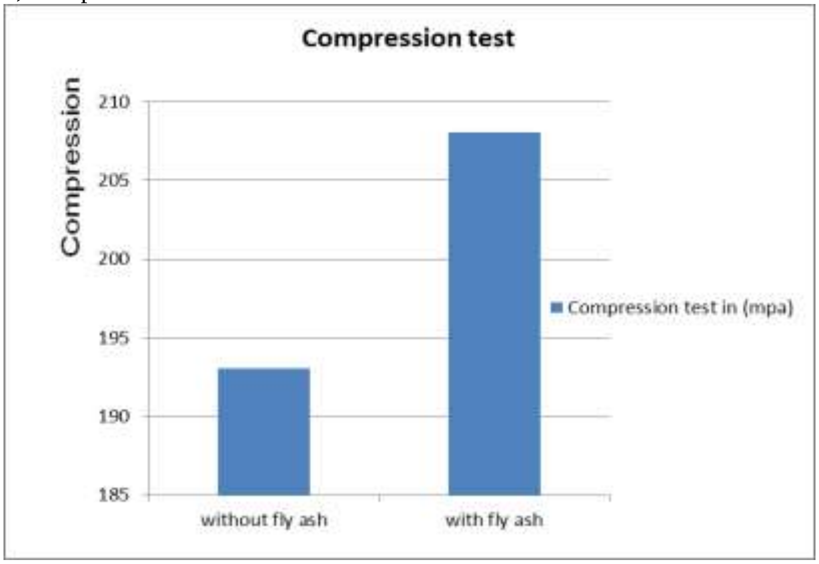


Fig. 4: Compression Test

D. Water Absorption Test

Sample without fly ash, Initial weight= 5 gm, Weight after 24hr =5.5 gm, Weight after 72hr =6 gm
Sample with fly ash, Initial weight= 5 gm, Weight after 36hr =5.5 gm, Weight after 72hr =5.5 gm

Fig. 5: Water Absorption

E. Conclusion

Percentage increase in weight in (gm) of sample without fly ash was 20% in 72hrs.
Percentage increase in weight of sample with fly ash was 10% in 72hrs.
1) Observation:-
Use of fly ash reduced the water absorption capacity by 10.00%.

IV. DELAMINATION TEST

A. Tool used:

1) Parabolic drills are more spiral**.** [11], parabolic drills often have other geometry advantages including more room in the flute for more chips and a wider web on the tip for greater durability. Parabolic are quite a bit more expensive than the average jobber length twist drills, but for deep holes, they're darned well worth it.

2) 8 facet drill bit is less spiral as compared to parabolic drill bit. It reduces cutting forces and eliminates Delamination when exiting the material.

B. Result obtained:

A lot of research work has been carried out in the field of drilling of composite material and reported that the parameter such as cutting speed feed rate tool geometry etc.[1],[5],[7],[9],[12], will affect the quality of the drilled holes.
We have calculated Delamination factor by varying following parameters:-

– By varying spindle speed at constant feed.
– By varying feed at constant spindle speed.
– By using different types of drill bit.

The result obtained are shown in following table and also plotted on graph for better analysis

Table – 1
Sample without fly ash

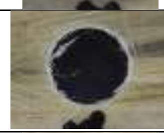
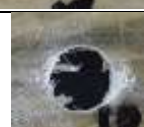
Sr.No.	*Feed mm/min*	*Spindle speed (rpm)*	*Drill point geometry*	*Image entry side*	*Delamination facto r entry side*	*Image(exit side)*	*Delamination Factor (exit side)*
1	*8*	*710*	*8-Facet*		*1.0529*		*1.1332*
2	*8*	*1400*	*8-Facet*		*1.0624*		*1.215*
3	*8*	*2000*	*8-Facet*		*1.0843*		*1.2754*
4	*8*	*710*	*parabolic*		*1.0993*		*1.1824*
5	*8*	*1400*	*parabolic*		*1.2715*		*1.4070*
6	*8*	*2000*	*parabolic*		*1.2763*		*1.4421*

Table – 2
Sample with Fly Ash

Sr .NO	*Feed mm/min*	*Spindle speed (rpm)*	*Drill point geometry*	*Image entry side*	*Delami nation factor entry side*	*Image(exit side)*	*Delami nation factor (exit side)*
1	*8*	*710*	*8-Facet*		*1.0728*		*1.1649*
2	*8*	*1400*	*8-Facet*		*1.1191*		*1.2335*
3	*8*	*2000*	*8-Facet*		*1.1336*		*1.1836*

4	*8*	*710*	*Parabolic*		*1.1275*		*1.2697*
5	*8*	*1400*	*Parabolic*		*1.1995*		*1.400*
6	*8*	*2000*	*Parabolic*		*1.1535*		*1.3233*

– Tool used- 8 facet, Feed- 8mm/min, Delamination at entry level &exit level

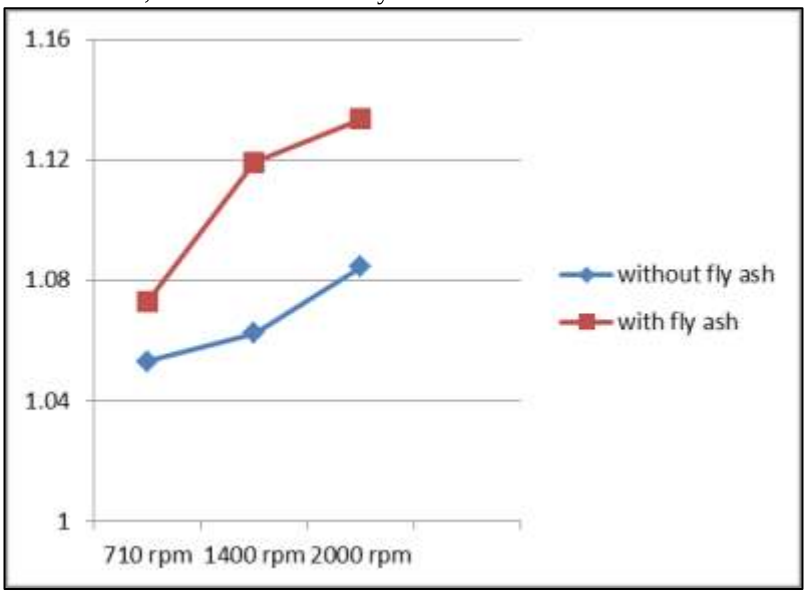


Fig. 6: Speed V/s Delamination Factor at entry level

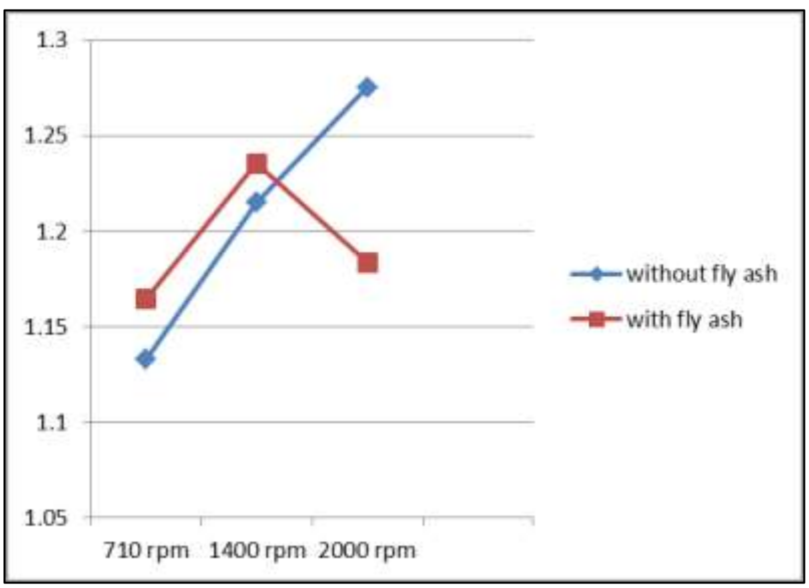


Fig. 7: Speed V/s Delamination Factor at exit level

1) *Tool used-*
parabolic, Feed- 8mm/min and Delamination at entry level & exit level

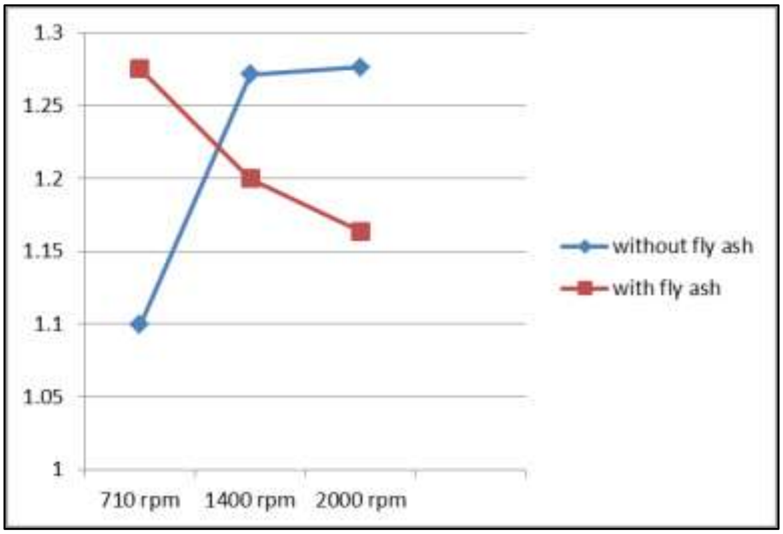


Fig. 8: Speed V/s Delamination Factor at entry level

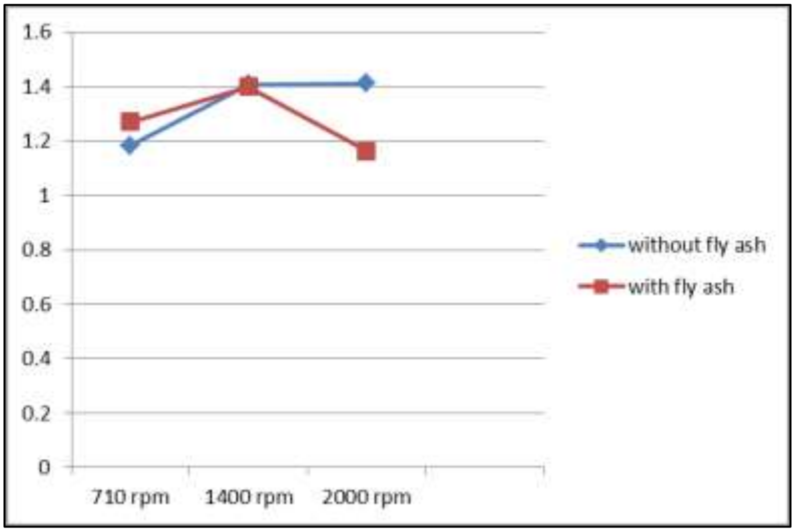


Fig. 9: Speed V/s Delamination Factor at exit level

- Delamination increases with increase in speed of tool.
- Delamination was less in case of 8 Facet than parabolic drill.
- Low feed and low spindle speed is optimum condition for least delamination.

V. CONCLUSION & FUTURE SCOPE

- Use of fly ash has increased the tensile strength of composite.
- Due to fly ash tensile strength has increased by about 10%
- Use of fly ash reduced the water absorption capacity by 10%
- Delamination was less in case of 8 Facet drill than parabolic drill.
- Low feed and low spindle speed is optimum condition for least delamination.
- Composite having fly ash has higher delamination factor than composite without fly ash.
- Further study can be carried out by changing the fiber orientation**.**
- Further study can also made by changing ratio of hemp fiber and epoxy.

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