

# Effect of Addition of Goat Hair Fiber on Mechanical Properties of Linear Low-Density Polyethylene Reinforced Composite-An Experimental Investigation

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## Abstract

The present experimental study aims on mechanical behavior of natural fiber (Goat Hair) composites, mixed with Linear low-density polyethylene (LLDP) particulate and fabricated by using injection molding method. Specimens are fabricated according to the ASTM standards in different combinations. Mechanical properties like compression strength, flexural strength, hardness and impact strength are determined. The addition of goat hair has great influence in the improvement of above mentioned properties.

**Keywords:** Composites, Goat hair, Linear low-density polyethylene, Injection moulding, Flexural strength.

## 1.Introduction

In present scenario the natural fiber has earned much attraction because of its environmental friendly properties. The wastage of goat hair can be turned into natural fiber as reinforcement in LLDP. Chandramohan [1] studied the utilization of natural fiber materials which are bio-degradable natural fibers widely used in many automotive application. Onuegbu [2] investigated the goat hair as reinforcement in epoxy resin into Teflon mold and dumbbell mold shape with hand lay-up process. Tensile and flexural tests were performed on the composite. Results show that tensile properties and flexural properties were decreased at high fiber load. Stalin [3] studied the Goat hair & modified polyester as a matrix with five different combinations, found better tensile, compressive and flexural strength among five components. Himanshu [4] studied the mechanical properties on two composites which is fabricated with goat hair and coir fiber of different proportions, exhibited improved impact strength and elevated flexural strength. Sunita Rajbhar[5] studied the mechanical properties of human hair and animal hair reinforced hybrid composite are obtained high tensile strength which is higher than plain epoxy. This paper represents the use of Goat hair with linear low-density polyethylene composite. Results from the experimentation with different proportions are presented.

## 2. Experimental details

### 2.1. Specimen Preparation

The materials used to develop the composite are naturally available fibers Goat Hair from a local source as shown in fig1. Linear low-density polyethylene fig2. Forms the matrix material in the composites. To enhance the properties of the fiber Goat Hair into H<sub>2</sub>O<sub>2</sub> solution for one day. After fibers were then thoroughly washed with distilled water to remove further impurities followed by sun drying for about one week.



Fig1. Goat Hair



Fig2. LLDP

Preparation of composite:

The fiber cuts in small pieces in (5mm) size randomly. LLDP acts material and fiber acts as reinforcement. The mixture dumped into injection moulding at low temperature curing linear low density polyethylene and the corresponding hardener are blended in a degree of 130<sup>0</sup>c by weight. A mould of size 55×16 mm<sup>3</sup> (cylindrical) 55×10 mm<sup>3</sup> (rectangular) is used for fabrication of composites. The Goat hair fibers are blended with linear low density polyethylene by the basic mechanical mixing. The composites are prepared with three distinctive fibers. The mixture is put into different moulds adjusting to the necessities of different testing conditions and characterization models. The designation and detail composition of composites are presented in table 1.

**Table1.** Combination of liner low density polyethylene and the natural fiber in weight %

Class of Natural Fiber Composite	Compositions	
	Linear Low Density Polyethylene Weight (%)	Goat Hair Weight (%)
C1	99	1
C2	98	2
C3	97	3



**Fig3.**Cylindrical mould



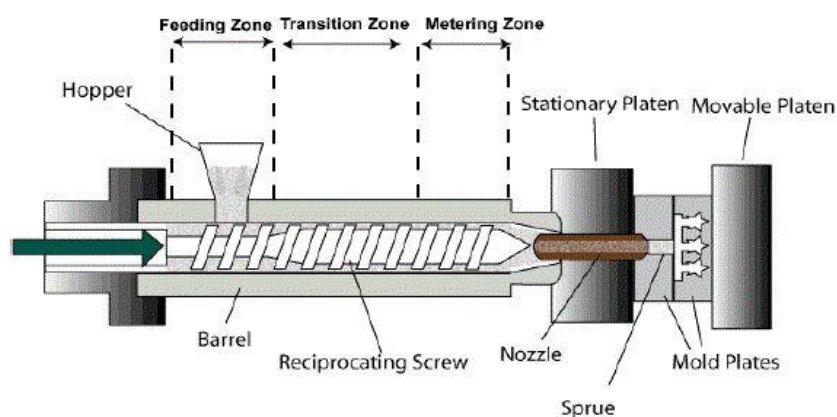
**Fig4.**Cylindrical mould



**Fig5.**Cylindrical cavity



**Fig6.**Rectangular cavity



**Fig.7** Injection moulding machine



**Fig.8** Goat hair composite

## 2.2. Mechanical Properties

### Flexural Test

The flexural test was performed on Universal Testing Machine which has the capacity of 40T. The composite is placed horizontally over two points of contact the crosshead rate is 2mm/min and span of 60mm. The force is applied at the centre of the composite until the samples fails.

### Compression Test

The compression test was performed on Universal Testing Machine which has the capacity of 40T

### Hardness Test

Hardness measurements were made with Brinell hardness testing machine conducted at different loads.

### Charpy Test

Charpy impact test conducted for the composite with cross-section area at the notch is 60 mm<sup>2</sup>.

### Result and discussions

The mechanical properties such as Flexural strength, Compression strength, Hardness and Impact strength are performed on goat hair composites with different proportions (i.e 1%, 2% & 3%). From the results of it shows the significant improvement of flexural strength from 1% of goat hair composite to 2% and 3% of composites. It is noticed that percentage of goat hair composites increases then the flexural strength of the composite gradually increases. The flexural properties of the composite results are shown in Table 2, Fig 9

**Tabel.2** Effect on flexural strength of goat hair composite

Percentage of Goat Hair composite (%)	Load(KN)	Flexural strength(N/mm <sup>2</sup> )
1	2.5	81.54
2	2.7	85.48
3	2.8	85.48

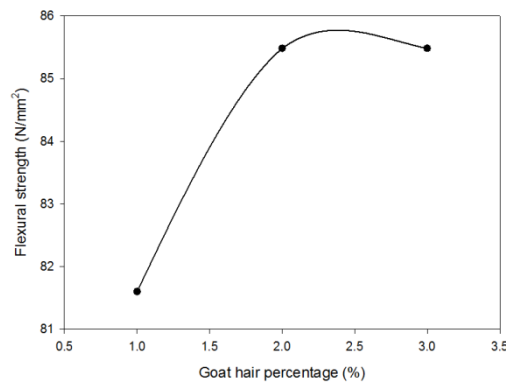


Fig.9 Flexural plot for goat hair

For the comparison, flexural test was performed on LLDP specimen which shows the result of 0.84N/mm<sup>2</sup>. The result of the reinforced composite was higher (1.335N/mm<sup>2</sup>) when compared with the LLDP specimen (0.84N/mm<sup>2</sup>).

From the results, it shows the significant improvement of compression strength increases gradually from 1% of goat hair composite to 3% of composites. It is noticed that percentage of goat hair composites increases then the compression strength of the composite gradually increases. The compression properties of the composite results are shown in Table 3, Fig 10.

Table.3 Effect on compression strength of goat hair composite

Percentage of Goat Hair composite (%)	Load(N)	Compression strength(Mpa)
1	28.5	141.75
2	34.5	171.59
3	46.5	231.27

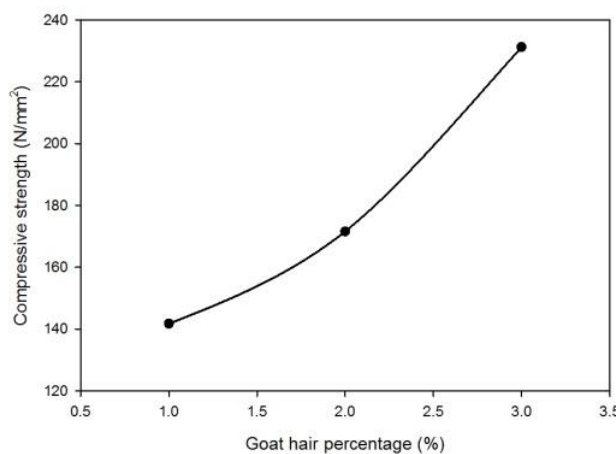


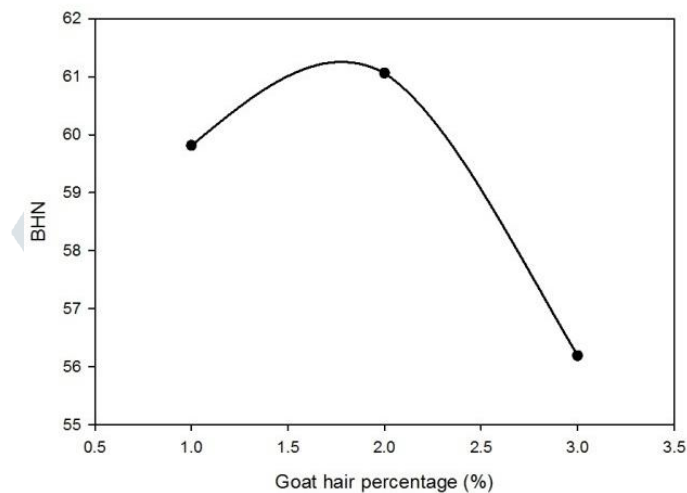
Fig.10 Compression plot for Goat hair

For the comparison, compression test was performed on LLDP specimen which shows the result of 160.63Mpa. The result of the reinforced composite was higher (231.27Mpa) when compared with the LLDP specimen (160.63Mpa).

From the results of Hardness, it shows that the goat hair composite has increased from 1% to 2% and later it decreased at 3% with constant load. The hardness test of the composite results is shown in Table 4, Fig 11.

**Tabel.4** Effect on hardness test of goat hair composite

Percentage of Goat Hair composite (%)	Load(Kgf)	Brinells Hardness Number (BHN)
1	60	59.81
2	60	61.06
3	60	56.81



**Fig.11** Hardness plot for goat hair

For the comparison, hardness test was performed on LLDPE specimen which shows the result of 58.16BHN. The result of the reinforced composite was higher (61.06BHN) when compared with the LLDPE specimen (58.16).

From the results of Impact test, it shows that the goat hair composite has decreases from 1% to 2% and later it increased at 3%. The Impact test of the composite results is shown in Table 4, Fig 11.

**Tabel.5** Effect on impact test of goat hair composite

Percentage of Goat Hair composite (%)	Total reading (J)	Reading after impact (J)	Impact (J/mm <sup>2</sup> )
1	295	8	4.78
2	295	8.8	4.77
3	295	8	4.78

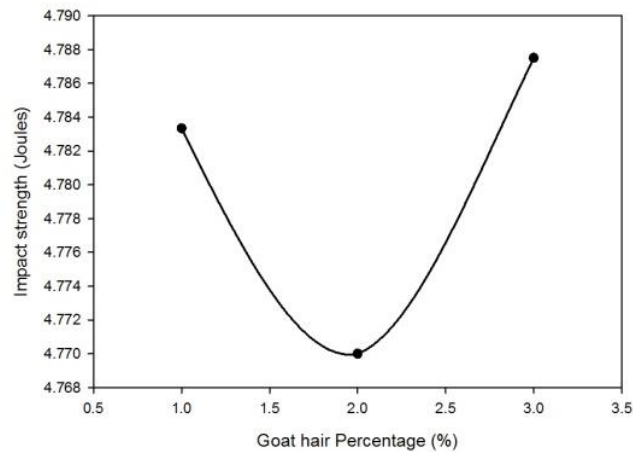


Fig.11 Impact plot for goat hair

For the comparison, Impact test was performed on LLDP specimen which shows the result of 4.75J. The result of the reinforced composite was higher (4.78J) when compared with the LLDP specimen (4.75J).

### Conclusions

The successful fabrications of cylindrical, rectangular polymer composites using the goat hair fiber are fabricated. The fiber treatment by  $H_2O_2$  improved the mechanical properties like compression strength, flexural strength, and impact strength and hardness value.

- Goat hair composite shows the beneficial results while comparing to the LLDP .
- From this study goat hair composite can be taken as alternate source for the synthetic material which is the lower in cost while comparing to the other fibers.

### References

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