

# International Journal of Innovative Research in Science, Engineering and Technology

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## Impact Test on Kevlar Carbon Rubber Composite

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**ABSTRACT:** This project is aim investigate the impact performance of composite panels consisting of plain-woven Kevlar fabric and rubber matrix. Each warp and weft yarn of fabric was individually modeled and combined with rubber matrix network to form the composite. Ballistic fabrics provide ballistic resistance against high-velocity projectiles. Polymer matrix composites are produced by combining high strength fabrics with a polymer matrix.

**KEYWORDS:** Rubber, Kevlar, polymer matrix

### I. INTRODUCTION

Woven fabrics made of high strength fibers such as Kevlar, Twaron and Dynama have attracted considerable attention and are widely used as ballistic protective vest. Ballistic fabrics provide ballistic resistance against high-velocity projectiles.

From the point of view of energy transfer, it can be stated that projectile kinetic energy is dissipated through a combination of mechanisms: energy absorption due to stretching and tensile failure of primary yarns, energy absorption due to stretching of secondary yarns, energy dissipated through frictional slips (yarn/yarn and projectile/yarn), and yarn pull-out from the fabric.

In recent years, extensive studies have been conducted to investigate the impact behavior of fabrics and factors affecting their performance. Polymer matrix composites are produced by combining high strength fabrics with a polymer matrix. Matrix plays an important role in ballistic performance of a composite.

Rubber is a good option, which can be used as a matrix in composites. Rubber materials have been widely used in shock absorbers, and other engineering applications. High flexibility and high damping properties of rubber combined with high strength fabric form an impact resistance composite suitable for blast and ballistic applications.

Recently, some studies have been conducted to model the behavior of fabric reinforced rubber composites. The energy absorption of high performance fabrics coated with natural rubber latex and its resistance under impact loading. Higher ballistic limit with the system containing fabric layers coated by natural rubber obtained than the all-neat layer fabric system.

Today, the use of composites has evolved to commonly incorporate a structural fiber and a plastic, this is known as Fiber Reinforced Plastics or FRP for short. Like straw, the fiber provides the structure and strength of the composite, while a plastic polymer holds the fiber together. Common types of fibers used in FRP composites include:

- Fiberglass
- Carbon fiber
- Aramid fiber
- Boron fiber
- Basalt fiber
- Natural fiber (wood, flax, hemp, etc.)

In the case of fiberglass, hundreds of thousands of tiny glass fibers are compiled together and held rigidly in place by a plastic polymer resin. Common plastic resins used in composites include:

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- Epoxy
- Vinyl Ester
- Polyester
- Polyurethane
- Polypropylene

The biggest advantage of modern composite materials is that they are light as well as strong. By choosing an appropriate combination of matrix and reinforcement material, a new material can be made that exactly meets the requirements of a particular application.

Composites also provide design flexibility because many of them can be moulded into complex shapes. The resulting product is more efficient. Body armor made of modern composites are more resistant to bullets and make turbine blades that can withstand the stress of high wind speeds.

## II. MOTIVATION & OBJECTIVES

### 2.1 Motivation

Conventional safety products like bulletproof jackets, Helmets and daily usable like shoes, furniture's are made of steel or wood which heavy and less weight to strength ratio

### 2.2 Objectives

Based on the problem identification the following objectives is to be made:

- Change in materials used conventionally
- High weight to strength ratio
- Lightweight materials

## III. METHODOLOGY

Vacuum bagging is a technique which creates a vacuum; an airtight barrier between the open atmosphere and the closed system. When the vacuum bag is first sealed, air pressure on both sides of the barrier equals that of atmospheric pressure.

Vacuum bagging is a technique employed to create mechanical pressure on a laminate during its cure cycle. Pressurizing a composite lamination serves several functions. First, it removes trapped air between layers. Second, it compacts the fiber layers for efficient force transmission among fiber bundles and prevents shifting of fiber orientation during cure. Third, it reduces humidity. Finally, and most important, the vacuum bagging technique optimizes the fiber-to-resin ratio in the composite part. These advantages have for years enabled aerospace and racing industries to maximize the physical properties of advanced composite materials such as carbon, aramid, and epoxy.

The reason that composites are used increasingly is the strength-to-weight advantages that they offer. The key to obtaining these advantages is maximizing the fiber-to-resin ratio. The reinforcement (fiberglass, aramid Kevlar, carbon, etc. is not particularly strong in the textile state. Also, thermosetting resins such as polyester and epoxy are quite brittle if cured without reinforcement. If excess resin exists in the laminate, the laminate will have more of the properties of resin only. If too little resin exists, places where the reinforcement is dry will cause weak spots. To optimize the resin content, the entire reinforcement must be saturated with resin with as little excess as possible. The technique of "squeezing out" excess resin to obtain a maximized fiber-to-resin content is the theory of vacuum bagging.

## IV. TESTING OF COMPOSITE

### 4.1 Impact Test (or) Charpy Test

A simple analysis method of impact properties is the measurement of the stiffness expressed in the necessary energy for breaking a random geometry bar. For homogeneous and isotropic materials, Charpy conventional tests and notched bars are being used which lead to great tension concentrations, thus minimizing the energy necessary for breaking. These tests may be also successfully used in the case of the composite materials, for comparative studies.

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## 4.2 Sample Preparation

In this work, vacuum bagging method is preferred to manufacture the desired composite material. And the resin used here is epoxy resin. By the vacuum bagging process, the specimens are prepared with different compositions. Among which one specimen is Kevlar Carbon with low hardness rubber and the other with high hardness rubber. The low hardness rubber used here is EPDM rubber (Shore 30A) and the high hardness rubber used is nitrile rubber (Shore 80A).

The Kevlar Carbon are cut into pieces of dimensions 150\*300 mm and the rubber is powdered. The epoxy resin is mixed with hardener and catalyst in the ratio 3:1. Then the Kevlar carbon rubber are made into layers with epoxy resin and kept inside the vacuum bag. And the composite is prepared by compressing or removing the air inside it.



Fig 4.1 kevlar carbon low hardeness rubber

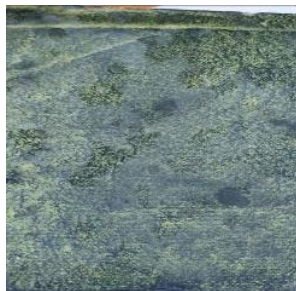


Fig 4.2 Kevlar carbon high hardness rubber

## V. RESULT AND DISSCUSSION

### SAMPLES USED

Table 5.1 Specimen Fabricated

Specimen	COMPOSITE
1	Kevlar,carbon,low hardness rubber
2	Kevlar,carbon,high hardness rubber

### 5.1 Impact test

Impact properties indicate the energy needed to break the composite material when applied to a sudden force. For homogeneous and isotropic materials,Charpy conventional great tension concentrations, thus minimizing the energy necessary for breaking the material.

This is one of the most common mechanical testing techniques. This tests may be also successfully used

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in the case of the composite materials, for comparative studies.

The impact strength of the composite material are as follows. The impact strength of the composite is expressed in  $\frac{KN}{m^2}$



Fig 5.1 Kevlar carbon H rubber before impact



Fig 5.2 Kevlar carbon H rubber after impact



Fig 5.3 Kevlar carbon L rubber before impact

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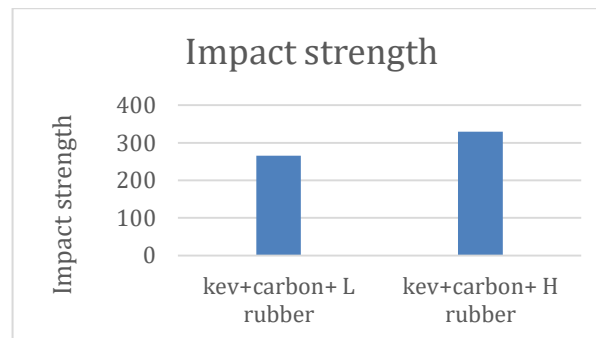
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Fig 5.4 Kevlar carbon L rubber after impact

It is seen that the composite high hardness rubber did not break during impact test and the composite with low hardness rubber breaks and the other almost breaks during the impact test.



From the above chart, it is noted that the composite with high hardness rubber has the high impact strength of  $330 \frac{KN}{m^2}$  and the composite with low hardness rubber has the considerably low impact strength of  $266 \frac{KN}{m^2}$ .

### VI. CONCLUSION

It is noted that the composite with high hardness rubber that is rubber with grade Shore 80 A has the better impact strength than the composite with low hardness rubber that is rubber with grade shore 30 A. And so it is concluded that the impact strength of rubber composite will increase with the shore value.

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