DESIGN AND FABRICATION OF BULLET PROOF VEST

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ABSTRACT

Design and analysis of a bullet proof vest with metal reinforcement. The base material is Kevlar (ballistic material) and carbon is used for reinforcement. The optimum weight of the bullet proof vest when reinforced is determined in order to compensate for the body performance with less bullet penetration and also reduce the weight of vest. Ballistic vests use layers of very strong fiber to "catch" and deform a bullet, mushrooming it into a dish shape, and spreading its force over a larger portion of the vest fiber.

Keywords: Ballistic Material, Reinforcement, Kevlar-29, Carbon fiber.

INTRODUCTION

A composite material is defined as a material comprising of two or more chemically and/or physically distinct constituents (phases) combined on a macroscopic scale. The constituents present in the composite material retain their individual identities and properties, but together they produce a material system, the properties of which are designed to be superior to those of the constituent materials acting independently.

Kevlar is a registered trade mark for para-aramid synthetic fibre. It was developed by Stephanie Kwolek in 1965 at DuPont. It was commercially used in early 1970s as a replacement for steel in racing tires (Typically spun into ropes or as fabric sheets that can be used as an ingredient in composite material components).

Recently application of Kevlar boosted a lot, from bicycle tire to body armour because of its high tensile strength to weight ratio. It is 5 times stronger than steel. Nowadays in modern drumheads Kevlar is employed to withstand high impact. When used as a woven material, it is suitable for tactical and other under water applications.

Kevlar is synthesized in a solution from the monomers 1, 4-phenylene-diamine and telepathology chloride in a condensation reaction yielding hydrochloric acid as a by-product.

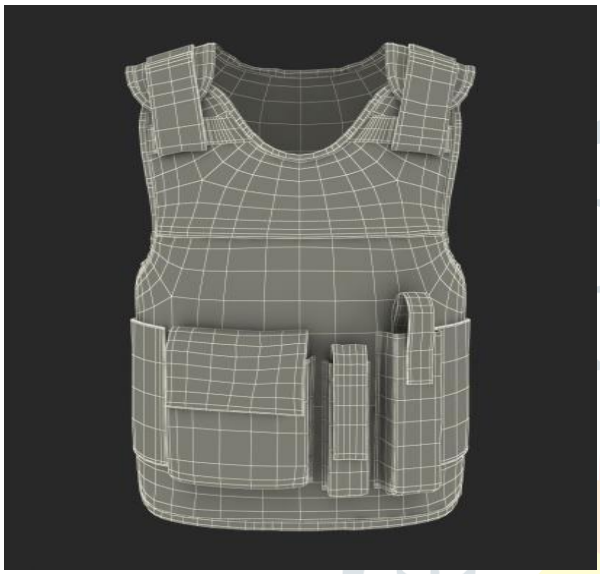
The ultraviolet component of sunlight decomposes and degrades Kevlar, a problem known as UV degradation and so it is rarely used in outdoors without protection against sunlight.

As we have to analyse the composite material for bullet-proof material, we will now give a brief introduction regarding ballistic material. The purpose of the ballistic protective materials is not to just stop the speeding bullets but to protect the individual from fragmenting devices as well, i.e. from grenades, mortars, artillery shells, and improvised explosive devices. We should note that the injury caused to the civilians is mainly due to two factors:

• High velocity bullets from rifles, machine guns which are mainly shot from a long range. • Low velocity bullets from hand guns which are shot from close range.

DESIGN

The bulletproof vest is designed in autocad itself. Two sections are considered in the vest. The section where bullet penetration is considered, were the mesh size is decreased and another portion were mesh size is increased since effect of bullet impact is less. This helps in reducing the process time as well as increases the accuracy of the result.



FRONT VIEW

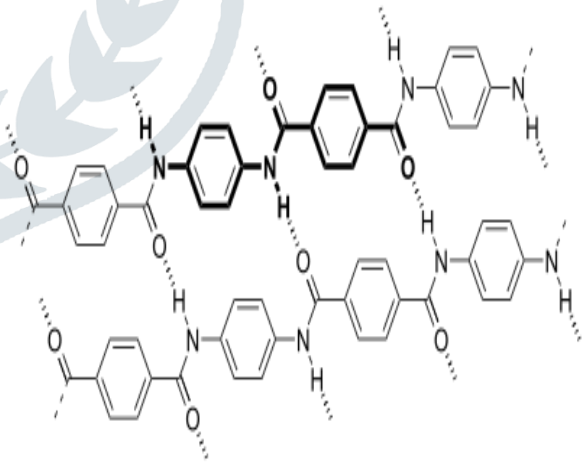
BACK VIEW

COMPONENTS

1.KEVLAR

1500 Denier; 1000 Filaments. Kevlar K-29 yarns are used in ballistic applications, ropes and cables, protective apparel such as cut-resistant gloves, in life protection uses such as helmets, vehicular armoring and plates, and as rubber reinforcement in tires and automotive hoses.

STRUCTURE OF KEVLAR



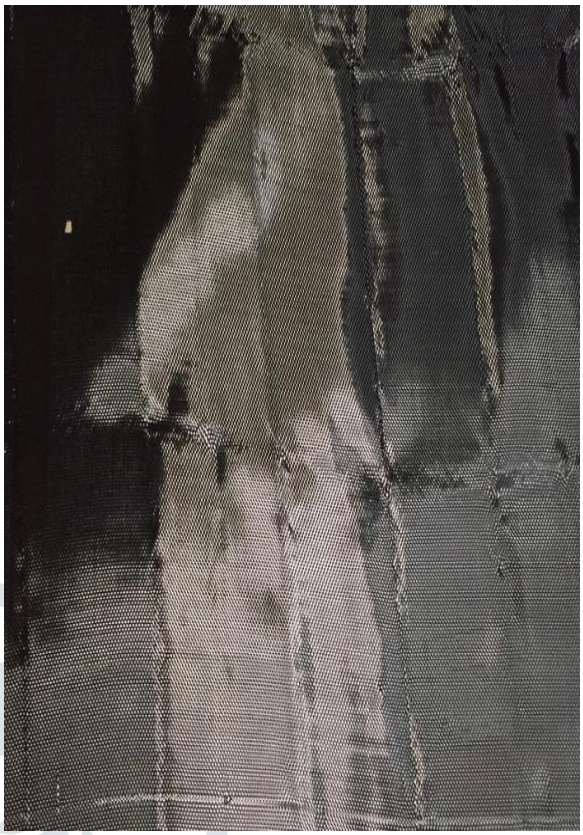
Molecular structure of Kevlar: bold represents a monomer unit,dashed lines indicate hydrogen bonds.

When Kevlar is spun,the resulting fiber has a tensile strengthof about 3,620 MPa, and a relative densityof 1.44. The polymer owes its high strength to the many inter-chain bonds.

These inter-molecular hydrogen bondsform between the carbonyl groups and NH centers.

Additional strength is derived from aromatic stacking interactionsbetween adjacent strands. These interactions have a greater influence on Kevlar than the van der Waalsinteractions and chain length that typically influence the properties of other synthetic polymers and fibers such as Dyneema.

The presence of saltsand certain other impurities, especially calcium,could interfere with the strand interactions and care is taken to avoid inclusion in its production. Kevlar's structure consists of relatively rigid molecules which tend to form mostly planar
sheet-like structures rather like silkprotein



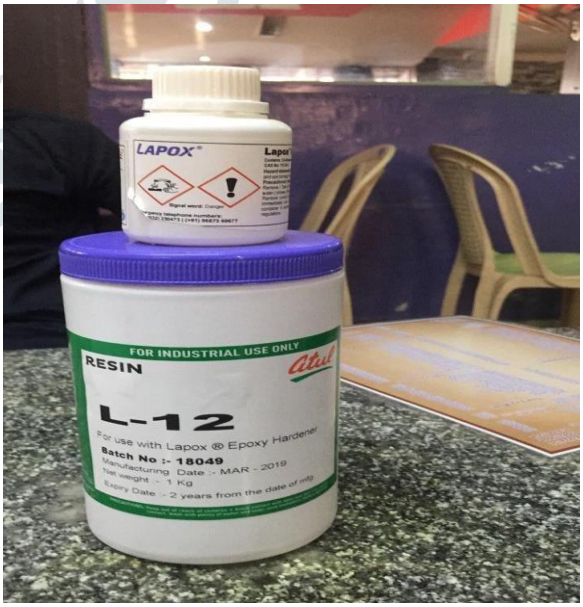
2.CARBON FIBERS

Carbon fibers about5-10 micrometers in diameter and composed mostly of carbon atoms. Carbon fibers have several advantages including high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and low thermal expansion. These properties have made carbon fiber very popular in military, aerospace, civil engineering and motor sports, along with other competition sports. However, they are relatively expensive when compared with similar fiber such as glass fiber or plastic fiber.

Carbon fiber are usually combined with other material to form composite. It gives more strength and reducing the weight.

3.EPOXY

Epoxy is used to laminating the carbon and Kevlar. It takes more time to compete the process. In this epoxy mix with 10:1 ratio. Example like resin L-12 250g and hardner (lapox) mix 25g.



PROBLEM DEFINITION

In the bullet proof vest normally having more weight and less impact strength. If bullet hit the vest that time vest will be stop the bullet but internal damages or pain is occurring. In this problem sometimes affect the human organs.

PROJECT OUTCOME

Compared to the previously existing products of the bulletproof vest, our developed model is lighter in weight with less Impact strength.

ADVANTAGES

- The main advantages are high strength and low weight. like graphite, it has a slightly negative axial coefficient of thermal expansion, which means aramid laminates can be made thermally stable in dimensions.
- Unlikegraphite,it is very resistant to impact and abrasion damage. It can be made waterproof when combined with other materials like epoxy.
- It can be used as a composite with rubber retaining its flexibility.
- High tensile modulus and low breakage elongation combined with very good resistance to chemicals make it the right choice for different composite structural parts in various applications.

CONCLUSION

We coordinated with current and former military personnel in multiple branches of the armed forces. We are yet to receive detailed consulting from paramilitary forces and mercenary units to hone our vest down to the most utilitarian design while still implementing the most useful tactical achievements that integrate seamlessly and perform in both the lab and on the field.

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