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An Overview Of Ballistic Protective Clothing

*Pooja Kumari, **Dr. Lalit Jajpura , ***Neetu rani,
Department of Fashion Technology B.P.S Mahila University, khanpur kalan (sonepat),Haryana,India.
Email - sain.pooja22@gmail.com , lalit.jajpura@gmail.com , neetu.1987@yahoo.co.in

Abstract
Ballistic protective clothes are of great importance depending on the rapid developments in military area. Ballistic protection is one of the main functional characteristics of military textiles. Ballistic protective clothes protect the body by the absorption of the kinetic energy of the bullets and shrapnel. High strength fabrics are used in many industrial areas in connection with ballistic protection such as body armors, inner parts of plane or vehicles. The main parameters that affect the energy absorption are the fiber type, fabric construction, tightness and mass per unit area of the fabric and the number of the fabric layers used in the clothing material. The fibers used for this purpose should have high tenacity, high modulus and lower elasticity properties. Recently, para-aramid fibers are the most used fibers for ballistic protective clothes. Along with para-aramids, high molecular weight polyethylene fibers also are of importance commercially. Also, there are fibers for ballistic protection such as wholly aromatic polyester fibers, PBO and PIPD. Also, carbon nanotubes and spider silk fibers are thought to have great potential applications for ballistic-resistance materials with their remarkable properties. This article presents information about the ballistic protection mechanism of textile materials, the fibers used in those fabrics and the method, which is used to compare ballistic resistance of textile materials.

Key Words: *Ballistic protection, high modulus, energy absorption, para-aramid fibers, high molecular weight polyethylene fibers*

Definition

BALLISTIC protective cloths does not mean the same to every one. As in most discussions of technical clothing products, we must first define our concern.

While all cloths are protective to some degree, our concern is not with daily needs, such as clothing for warmth, rainy wear, or daily or routine work clothing. Our main focus is on more sophisticated requirements , protection in situations where hazards or risks of life are present that have the potential to be life threatening considerable potential for injury or physical damage to the person working in and around the hazards situations . In some of cases, such as clean rooms, we may be equally concerned about protecting the product we are working with as well as the worker.

So then, our definition involves cloths , or textile related products that are worn, that prevents a person (or product) from coming into contact with, that protects from, and/or reduces the maximum risk of exposure to hostile elements or environments.

Protective Clothing Categories

Over the years, ITA has divided the market for PC into the following segments. This has become, as generally, how the market and industry as a whole looks at the market.

- Protection from extreme cold.
- Ballistic and mechanical protection.
- Protection from radiation.
- Protection from harmful particulate matter.
- Bacterial/Viral protection.
- Clean room - Protecting delicate items in manufacture.
- Protection from harmful chemicals.
- Protection from extreme heat and/or fire.

There are other areas, high pressure for instance,

but the above said list covers most of those concerns where cloths or products have been, or are being developed. We'll look at BALLISTIC protective clothing.

Ballistic

Defence personnel face multiple threats from different quarters, like terrorist groups and rogue nations, who own not only advanced lethal weapons but also chemical and biological warfare weapons. The present day BALLISTIC protective clothing system used by the defence sector is vulnerable to modern weapons and also have some inherent weaknesses like high cost, bulkiness and discomfort in wearing.

This area of discussion may includes soft body-armor, cuts and/or slashs hazards, such as chain saws, sheet metal, glass, knives or other sharp edge weapons , and stab and puncture resistant materials.

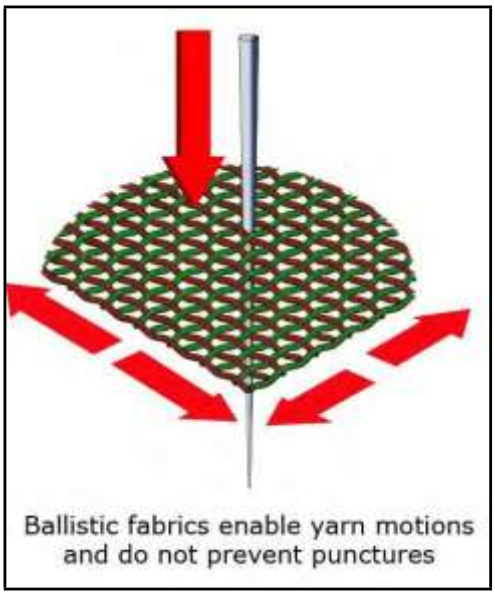
The most significant advances in the ballistic areas has been the developments and use of para- aramids, such as DuPont's Kevlar, to replace nylons as a ballistics barrier. This very high strength- thread, the same as used in tire cord, composite, and the alike, is used in soft body armor by loosely stacking layers (16+) of (usually) filament aramid fabrics, each providing coverage & progressive resistance to bullets or fragment penetration. Similar technology with rigid composites results in superior lightweight "hard" armors as well, for uses such as helmets and replacement of heavier steel armor plate areas such as vehicle and aircraft armors .

This STUDY explores only one facet of man's effort to survive— BALLISTIC protective clothing. Specifically, this report focuse on the design, materials, and testing of the fabrics-based, BALLISTIC protective cloths, namely soft body armor, used for ballistic protection.

Design Criteria

Body armors must be worn to be effective. Weight, mobility, and comforts therefore are vital to ensuring their uses; the armor must be conform to the wearer body, properly distribute their weight over the body to minimize wearer fatigue, provide sufficient breathability for extended use—especially during high temperature, and must not interfere with or restrict the wearer's movement. The significant challenge is to balance the levels of protection required for specific threat types against weight, comfort and flexibility, cost, environmental exposure (heat, ultraviolet light, moisture, etc.), and services life.

The principal factors that dictates the designing of body armors is the types of threats for which protection is required (that is, ballistic, fragment, blast, stab, slash, chemical, fire, etc.). Armors optimized for protections against threats type may not, however, be suitable for other threat types. For examples, textile designed for ballistics protections required sufficient yarn mobility within the weave to avoid premature failure and will not perform well for stab protection. Textile designed for stab resistance require dense weaves to prevent yarns from being pushed aside from the tip of sharp-pointed objects such as bullets knives, needles, awls, and ice pick.



Densed weaves that prevents puncture can lead to prematured or punch-through failure in

ballistics impacts. Design parameter for optimizing both the ballistics defenses & stab defense often worked against each others, as shown by figure 1. Multithreaded armors are commonly designed by integrating separate armoring solutions—all processes that achieves only minimal synergistic efficiencies at best. Armors that combines multiple defeats and elements are often categorized as "in-conjunction" armor in which each components provided enhanced levels of protections for a given threat or multiple threat types.

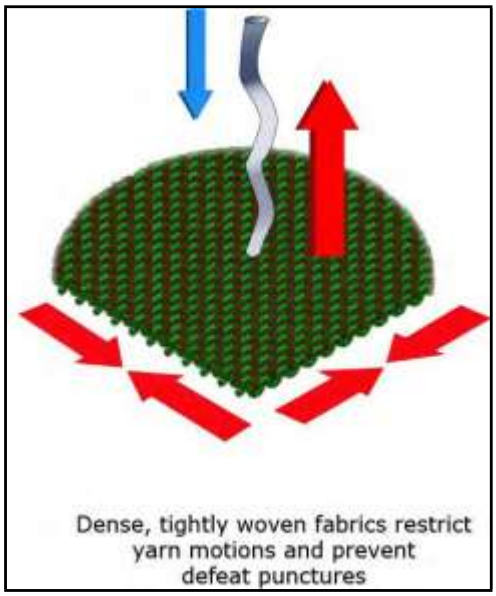


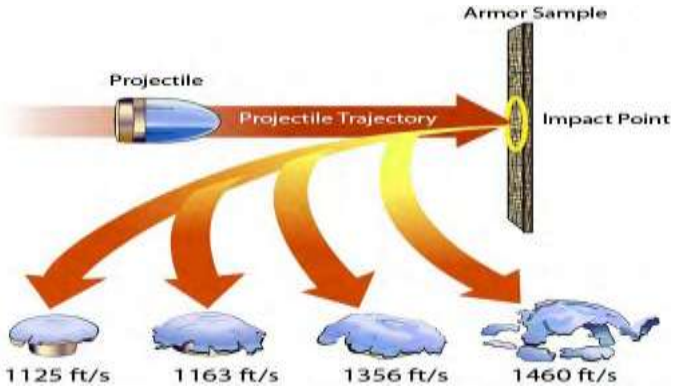
Figure : Puncture Behavior of Ballistic Versus Stab-Resistant Woven Fabrics

Traditionally, soft body armor for ballistics protection are manufactured using layers of woven fabric stitched together ; but now they include laminate stacked with non woven, uni directional (UD) layer and combination of woven/nonwoven laminates.

Description Of Bullet Resistant Soft Body Armor Vests

Today's body armors vests are often constructs with light weight, breath-able nylons or cottons outer shell that includes ballistic pack or panel contained within carriers (pockets). The ballistic pack are assembled from woven, nonwoven, or combine woven/nonwoven fabric or threads

Figure . Formation of Blunting Deformations



and Petal Fractures in Bullet

can prevent penetrations by NIJ threat categories IIA, II, and IIIA with a sufficient numbers of layers. For example, 20 to 30 layers of fabric may be used to arrest deformable projectiles fired from handguns (see figure).

Fibers Used In Bulletproof Vests

Ballistic nylons (until the 1970) or Kevlars or Spectras (a competitor for Kevlar) or the polyethylene fibers could be used to manufacture bullet proof vests. The vest of the time were made of ballistic nylons & supplemented by plate of fiber-glasses, steel, ceramics, titanium, Doron & composites of ceramic and fiberglass the last being the most effective.

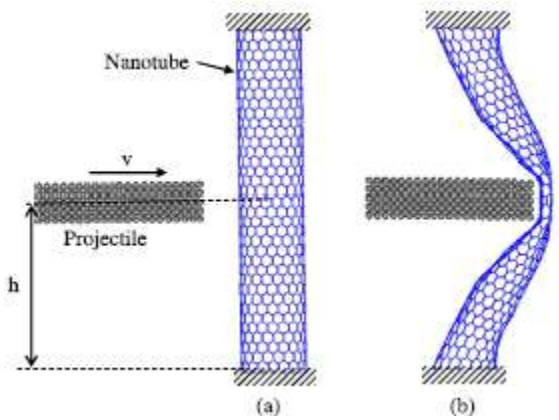
Ballistic Resistance Capacity Of Carbon Nanotubes:

Carbon Nanotube is a beehive shaped tube that has a diameter measuring of the nanometer scale. Even though each nanotube seem alike to the others, its electrical characteristics are determined by structures; they have different lengths, thickness, and number of layers.

Carbon nanotube has unique combination of stiffness, strength, and tenacity compare to other

fiber materials which are lack of one or more of these properties. Carbon nano tube also has a high thermal and electrical conductivity.

Carbon nano tube is very light yet very strong that is considered to make useful materials such as artificial muscles and skins, sports equipments, and bullet proof vests.



The molecular dynamics model of a carbon nanotube subjected to ballistic impact. (a) Initial model, (b) A deformed (18, 0) nanotube at its maximum energy absorption

Conclusions

Soft body armors have evolved into highly sophisticated protective devices delivering unprecedented protection levels against some of the harshest physical threats facing mankind.

Yet ballistic and fragment threats remain a primary concern for the military and law enforcement communities. Continued effective protection of these communities requires further evolution of body armor; that is, the development of improved fiber materials, manufacturing processes, and relevant mechanics that outpace future increases in weapon effectiveness levels.

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