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The History of KevlarKevlar is an organic fiber in the aromatic polyamide family. It has unique properties and a chemical composition that is its own, which distinguishes it from other man-made fibers. Kevlar is a combination of high strength, high modulus (resistance to extension), toughness and thermal stability.

Kevlar has a wide range of uses. In the 1960s nylon and polyester opened the door for man-made fibers. They were cutting edge fibers in their time but to achieve maximum break strength and initial modulus, the polymer molecules needed to be in an extended-chain configuration and almost perfect crystalline packing. With flexible-chain molecules, such as nylon or polyester, this could only be done by mechanically drawn in after spinning.

This required chain disentanglement and orientation in the solid phase of it. Therefore the strength and modulus levels were far lower than theoretically possible values. In 1965, scientists at Du Pont discovered a new method of producing an almost perfect polymer chain extension. The polymer poly-p-benzamide was found to form liquid crystalline solutions due to the repetitiveness of its molecular backbone.

The key for the structural requirement for the backbone is para orientation on the benzene ring, which allowed for rod-like molecular structures. This technology was used when Du Pont released Kevlar aramid fiber in 1971. What is it? Kevlar is an aramid, a term invented as an abbreviation for aromatic polyamide. The chemical composition of Kevlar is poly para-phenyleneterephthalamide, and it is more properly known as a para-aramid. Aramids belong to the family of nylons. Common nylons, such as nylon 6, do not have very good structural properties, so the para-aramid distinction is important.

The aramid ring gives Kevlar thermal stability, while the para structure gives it high strength and modulus. Like nylons, Kevlar filaments are made by extruding the precursor through a spinneret. The rod form of the para-aramid molecules and the extrusion process make Kevlar fibers anisotropic– they are stronger and stiffer in the axial direction than in the transverse direction. In comparison, graphite fibers are also anisotropic, but glass fibers are isotropic. The tensile modulus and strength of Kevlar 29 is roughly comparable to that of glass (S or E), yet its density is almost half that of glass. Thus, to a first approximation, Kevlar can be substituted for glass where lighter weight is desired. Kevlar 49 or 149 can cut the weight even further if the higher strength is accounted for.

Of course, Kevlar's weight savings does come at a price. Kevlar is significantly more expensive than glass. Kevlar has other advantages besides weight and strength. Like graphite, it has a slightly negative axial coefficient of thermal expansion, which means Kevlar laminates can be made thermally stable. Unlike graphite, Kevlar is very resistant to impact and abrasion damage. It can be used as a protective layer on graphite laminates. Kevlar can also be mixed with graphite in hybrid fabrics to provide damage resistance, increased ultimate strains, and to prevent catastrophic failure modes. Like all good things, Kevlar also has a few disadvantages.

The fibers themselves absorb moisture, so Kevlar composites are more sensitive to the environment than glass or graphite composites. Although tensile strength and modulus are high, compressive properties are relatively poor. Kevlar is also very difficult to cut. You will need special scissors for cutting dry fabric, and special drill bits for drilling cured laminates. Cutting of cured laminates without fraying is very difficult.

Kevlar is used both as a raw fiber and in composites. Today, there are three grades of Kevlar available: Kevlar 29, Kevlar 49, and Kevlar 149. The table below shows the differences in material properties among the different grades. If you purchase Kevlar cloth, it is most likely Kevlar 49.

Kevlar PulpKevlar pulp is a highly fibrillated form of the fiber. The fibrillation results in a high surface area of 7m2/g to 10m2/g. Kevlar pulp is non-brittle, so standard mixing and dispersion equipment wont affect the fiber size.

Kevlar pulp is available in wet-form, 50% moisture for dilute and dry form, 6% moisture for solvent-based dispersions and dry mixes. Various sizes and lengths are sold to meet the needs of the buyer. Kevlar pulp enhances the performance of elastomers, thermoplastics and