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Design with Ultra Strong Polyethylene Fibers

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Abstract

Ultra strong polyethylene fibers can be made by gel-spinning of Ultra High Molecular Weight Polyethylene (UHMWPE).
Such fibers exhibit extraordinary properties. They show very high tensile strength and stiffness and low density. On the other hand, the axial and transverse compression strength is low. This is a large difference with other advanced fibers like glass and carbon fibers. Additionally, the fibers are chemically inert and the bonding strength to other materials like resins is weak. Moreover, the coefficient of friction is very low, so the fiber is extremely slippery. Another property is viscoelasticity; the fiber elongates due to creep at higher loads or temperatures. This exceptional combination of properties explains why gel-spun UHMWPE fibers are not always applied in straight forward ways, e.g. like glass and carbon fibers in composites. On the other hand, weaknesses like the limited compression strength are related to very damage tolerant behavior on a micro scale. This opened application areas like providing of cut resistance. This paper describes some established applications and shows the relationship between the properties and the applications. Furthermore, some emerging applications are discussed and it is demonstrated how weaknesses can be turned into advantages.

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