PBI vs PBO

UNDERSTANDING THE DIFFERENCES BETWEEN PBI and PBO

PBI and PBO are acronyms for the fiber chemistry each represents. PBI is the trade name for polybenzimidazole, a fiber made by PBI Performance Products, Inc. in Charlotte, NC. PBO, with the trade name of Zylon®, is a Polybenzobisoxazole fiber made by Toyobo in Osaka, Japan. PBI and PBO are used in some of the same applications due to their ability to resist degradation from high heat and flame. One such application is the outer shell fabric of firefighter turnout gear. Listed below are the most common outer shell performance characteristics and how PBI and PBO perform.

PROTECTION

Flame and thermal protection are the blocks from which any outer shell is built. An important factor in the ability of a fiber to protect against high heat and flame is its stability when subjected to these exposures.

**Thermal Protection** – Fibers that are highly conductive will increase the rate at which heat is transferred into the composite and through to the wearer. The chart on the right illustrates the thermal conductivity values for various fibers, including stainless steel as a point of reference. Note that Zylon® transfers heat through the fiber more rapidly than stainless steel – a problem firefighters feel while fighting a fire versus engaging in non-firefighting activities.

**Flame Protection** – The ability of a fiber to protect against flame impingement is its resistance to melting, shrinking, and charring. The decomposition temperature is the temperature at which the fiber begins to break down. Fibers with higher decomposition temperatures create fabrics with better break open resistance to heat and flame. These higher decomposition temperatures help PBI and Zylon® provide superior break-open protection.

COMFORT

Comfort and flexibility of the outer shell are very important characteristics for the firefighter. When fighting fires, the wearer should have the least amount of stress caused by the gear since stress is one of the top causes of line-of-duty deaths. The comfort of a fabric can be related to the modulus and moisture regain of the fiber.

**Modulus** – The fiber’s resistance to bending. Higher modulus fiber translates into a less flexible fabric. High modulus means a stiff material.

DURABILITY

Durability of the outer shell is usually measured via tear and abrasion resistance. The tenacity of the fiber characterizes strength. Note that the durability of the fabric can be affected by UV light. UV light affects the performance of para-aramids and PBO fibers.

**Tenacity** – The higher the tenacity, the stronger the fiber. Since PBI is not a strong fiber, it’s blended with para-aramids, e.g. Twaron® and DuPont™ Kevlar®, to provide strength in the fabric. An independent study concluded that PBO’s tensile properties decreased more rapidly than those of p-aramid fibers when exposed to UV.

**Tear Resistance** – The industry test commonly used is the trapezoidal tear, which measures the pounds of force required to propagate a 1/3 inch tear in a fabric.

**Did you know?**

- PBI fabrics have been used in the fire service for over 30 years and continue to be used in other markets such as industrial/electrical, aerospace, military, and motorsports.
- Since its introduction in the late 1990s, Zylon® has been utilized in various markets including the fire service, but has been discontinued in several markets including military and police ballistics, sail cloths, and rope.
- From the time PBI was introduced to NASA for the Apollo missions in the late 1960s, it has been regarded as the best protection available for high-heat and flame applications.