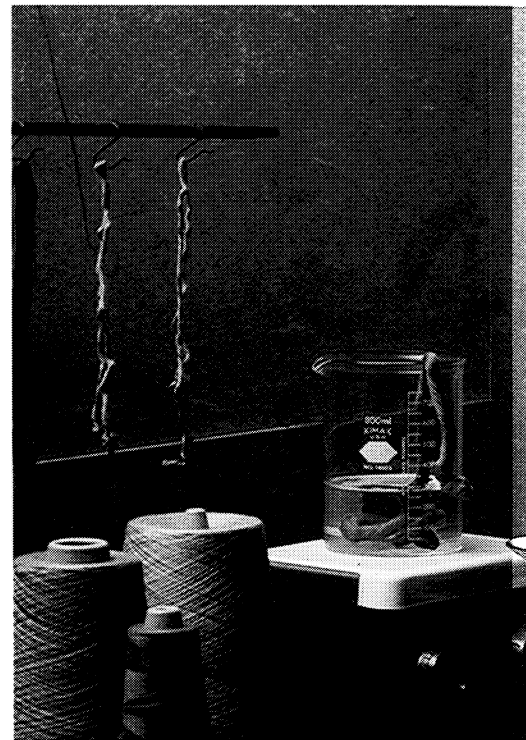


*A fire resistant textile ingredient highlights a sampling of spinoffs in the field of public safety*

Sometimes an aerospace spinoff product is a "late bloomer," meaning that its adaptation to civil uses may not happen until years, even decades, after the original development. An example is the fireblocking fiber known to chemists as polybenzimidazole and to everyone else as PBI. It was almost a quarter century ago that Celanese Corporation of New York developed PBI for NASA and the Air Force Materials Laboratory, but it was not until the 1980s that PBI's real commercialization began. Now PBI is a full-fledged commercial product in wide use and its range of applications is broadening rapidly.

PBI fiber emits very little smoke or "offgassing" at temperatures up to 1040 degrees Fahrenheit. Fabrics made from PBI are durable and comfortable, they do not burn in air or melt, they have very low shrinkage at high temperatures and they retain their flexibility after exposure to heat or flames. They also resist strong acids, solvents, fuels and oils. This combination of properties makes them attractive candidates for a broad spectrum of thermal protection and related applications.

PBI's development was originally intended to provide a flight suit material that would afford astronauts and military pilots maximum protection against fire. After successful development of the fiber, Celanese designed a manufacturing process and produced PBI in limited amounts for military and space applications; it was used, for example, in Apollo and Space Shuttle astronaut gear and in webbings and tethers on Apollo Skylab flights. But during most of the 1970s, PBI found no large-scale civil applications.



That changed in 1980 when Celanese moved to full commercialization and announced plans to build a new plant for PBI production. One reason for the company's decision was that a market had opened for an alternative material to asbestos. Another was stricter government anti-pollution standards; PBI's ability to resist corrosive gases and chemicals made it an attractive material for filtering stack gases. There were also applications in thermal protective wear for foundry workers, chemical plant employees, firefighters and others whose occupational activities expose them to flame and intense heat.

Located at Rock Hill, South Carolina, the Celanese PBI plant started production—in 1983—of fibers for conversion



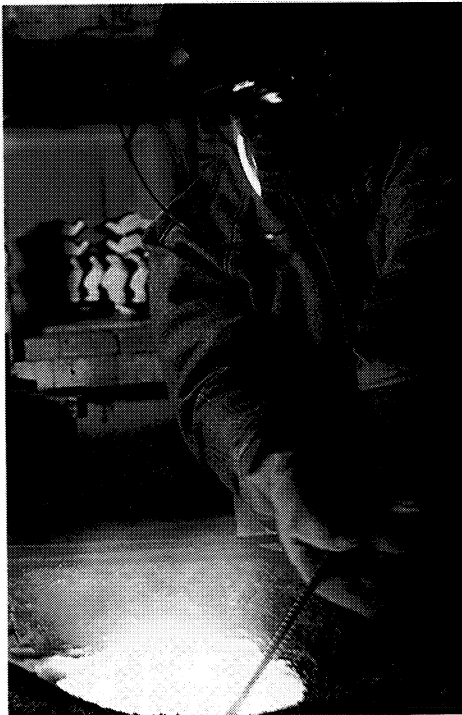
*At left, a Celanese Corporation laboratory technician is acid bath-testing a batch of PBI fibers. Originally developed as material for fire resistant flight suits, the fibers are now being used in a widening range of civil applications.*

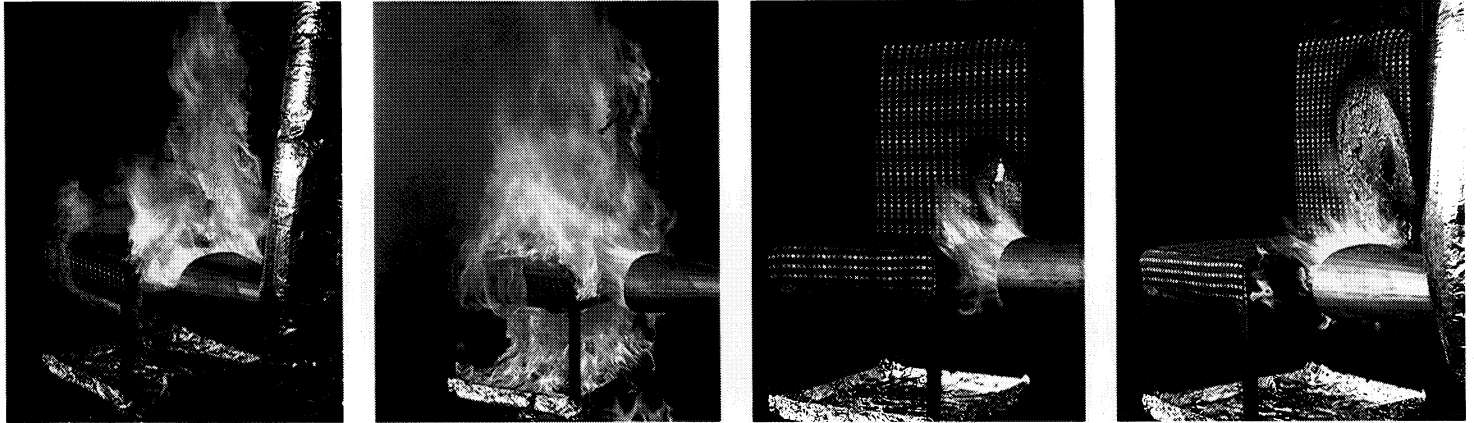


*The firefighter pictured above is wearing a jacket whose fabric incorporates PBI fibers. The fabric does not burn or crack, thus providing flame protection to its wearer, and it is lightweight, allowing greater maneuverability with less fatigue. These and other properties make PBI attractive for a variety of thermal protection applications, such as the gloves and outer garment worn by the foundry worker at left.*

into fabrics by other manufacturers for both military and industrial applications. The company has since increased production substantially and also expanded its market through agreements with Teijin Limited, Osaka, Japan to market PBI in the Far East and Hoechst A.G., Frankfurt, Germany for European marketing.

The range of PBI uses is similarly expanding. Last year, the fiber found a new application in fabrics for a new line of auto racing driver suits manufactured by Pyrotec, Inc., Minneapolis, Minnesota. And, since 1984, Celanese has been working on what could become the most important application from the standpoint of public safety: a fireblocking covering for the foam cushions in commercial airliner seats (see page 56).





In October 1984, the Federal Aviation Administration (FAA) issued new and more stringent flammability requirements for aircraft seat cushions, a source of flame and smoke propagation in the event of an aircraft fire. Designed to give commercial airline passengers an extra 40 to 60 seconds to evacuate a burning airplane by delaying the spread of fire, smoke and toxic fumes, the new rules required that airliners carrying more than 30 people must—within three years—install burn-resistant seats.

Just two days later, Celanese Corporation announced that fabrics made of its PBI fiber meet the FAA requirements: no more than 10 percent cushion weight loss and no spread of flame across the full width of the seat after

exposure—for two full minutes—to a temperature of 1900 degrees Fahrenheit. Prior to the FAA's issuance of the new guidelines, Celanese Fiber Operations, Charlotte, North Carolina, had set up its own seat burn facility for advanced research and testing of PBI in cooperation with airlines, seat manufacturers and fabric manufacturers.

PBI, which does not burn in air, is used in a fabric covering around the polyurethane foam seat cushion, creating a fireblocking layer between the seat's upholstery and the foam, thus all but eliminating the toxic fumes and fire-spreading gases emitted by burning foam. PBI fabrics have consistently displayed superior fireblocking performance in tests and additionally have impressed airline officials with their durability, ease of fabrication, comfort, weight and in-service maintainability—all big factors in selecting coverings for thousands of airliner seats. A range of PBI airline seat fabrics has been designed and a number of airlines have specified or are testing PBI fireblocked seats. ▲

*The first two photos show a seat burn test of a fabric that does not contain Celanese PBI; the far left photo shows the seat after 30 seconds exposure to a temperature of 1900 degrees Fahrenheit, the adjacent photo at 90 seconds. The latter two photos illustrate the dramatically reduced flame involvement, at the same time intervals and temperature, in seats incorporating PBI.*