Inherent vs. Treated: The Building Blocks of Flame-Resistant Fabrics Matter

By Dominique Adams
Development Engineer, Industrial Safety

Clearly defining certain words is important to this discussion. Here are two definitions one can easily find by putting them into a search engine or opening up a dictionary:

Inherent
/inˈ her ant/
 adjective
Existing in something as a permanent and inseparable element, quality, characteristic or attribute. The inherent dangers of mountain climbing.

Treated
/trēt ed/
 verb, past tense of treat
To subject an object to a process (especially chemical) to alter it, often temporary. Treat the cloth with bleach.

These two words get used a great deal in the flame-resistant fabric industry. Knowing exactly what each means explains the essentials.

The flame resistance in inherent FR fabric is “permanent and inseparable.” Even with a scrap of fabric, it remains flame resistant for all time. If one removed the flame-resistance from inherent fabric, the material no longer exists in usable form. This is not necessarily true with chemically treated fabrics.

Treated FR fabrics begin with cotton fiber, which is inherently flammable. Sometimes to make the cotton more durable and cheaper, it’s blended with nylon or polyester — a plastic-based fiber that’s also inherently flammable that could melt to the wearer’s skin if exposed to a flash fire. Often these blends are with 88 percent cotton and 12 percent nylon or polyester, which is from where the term “88/12” comes.
Once the cotton or cotton blend fabric is made, it’s treated with a chemical flame retardant to prevent the flammable fabric from going up in flames. That chemical additive may not be permanent.

Many chemically treated fabrics say the protection lasts for the “life of the garment with proper care.”

Notice those two statements: “life of the garment” and “proper care.”

Anyone specifying FR clothing for personal protection equipment should ask the question what “life of the garment” specifically means. Is it a certain number of washes? It is a particular amount of time? How are wearers to ascertain what the “life of the garment” with any treated fabric is, exactly?

With inherently FR fabrics, any and all pieces and parts of the fabric remain flame resistant. If it’s buried and dug up a hundred years from now, it would still be flame resistant.

Now consider the phrase “proper care.” One will find variations of this phrase for all chemically treated fabrics because proper care is imperative. Because the FR treatment is applied to the fabric, failing to follow the care instructions could put the wearer at risk of degrading that invisible protection.

Certain ingredients commonly found in a home laundry (like chlorine bleach and boosters using hydrogen peroxide additives) can interfere with the fire extinguishing properties of the flame-retardant treatments.

A survey of more than 800 workers found that less than a third used a laundry service to properly clean and care for FR clothing. The remaining workers washed their FR garments at home or on the job site. If chlorine bleach, a non-compliant detergent or the wrong temperature is used with a cotton or cotton-blend fabric, the invisible chemical protection could be degraded without the wearer ever knowing.

That puts the wearer at risk.

As for inherently FR fabrics, the flame resistance remains and will not wash or wear out, although proper care is always encouraged. For example, using chlorine bleach with an inherent FR fabric might fade the appearance and reduce strength, but the fabric remains flame resistant.

Going a little deeper in the process, it’s important to understand that inherent fabrics begin at the polymer level from which the fiber is formed.
Huge bales of fiber — from 400 to 700 pounds each, depending on the fiber — are delivered to a yarn plant for processing.

Inherent fibers like DuPont™ Nomex®, DuPont™ Kevlar®, Protex® Modacrylic, Lenzing FR® and others are flame resistant right now. Try to light the fiber on fire and nothing will happen. The fiber will not ignite. It is, in and of itself, flame resistant.

Some manufacturers use cotton at this point, which is highly flammable.

The next process depends on the type of fabric being made. For example, the image shows a largely white fiber, which happens to be DuPont™ Nomex®, with some yellow (DuPont™ Kevlar®) and a bit of gray specks (anti-static fiber).

The “lay down” process here takes the fiber and sends it into a blending machine. Again, at this point, everything is flame resistant.

As for the treated fabric, cotton fibers might also be blended with other flammable, plastic-based fibers like nylon or polyester to create the 88/12 blend.

After fibers are blended, they are sent to the drawing process. A series of machines with rollers orient the fibers to make sure that they are parallel to one another so they can then be spun into yarn. Again, at this stage of production, inherent fibers are flame resistant. Cotton and cotton blends remain flammable.
The spun yarn is then properly conditioned and wound onto large packages. As you might imagine, inherently FR fibers make inherently FR yarn. The yarn itself is flame resistant. Yarns made from cotton and cotton blends are still flammable at this point.

The yarns are then put made into a warp where hundreds of yarns come together to form the right number of ends in preparation for weaving. This is a rather detailed process as all the yarns are aligned and, through a series of processes, put onto a beam that will then be placed onto the loom.

Using looms that make several hundred insertions per minute, the fabric is produced.

Fabric made with inherently FR fibers and yarns is flame resistant right off the loom.

Cotton and cotton blends like 88/12 are still flammable after weaving has been completed.

In this final stage, fabric is dyed.

For inherently FR fabrics, the process is basically done. The finished fabric is inspected by quality assurance experts and provided to garment manufacturers.

For treated fabrics that use cotton and cotton blends, a flame-retardant chemical is now applied in the finishing stage. It is a complex process to apply the invisible layer of FR protection and cure the fabric so that the flame retardant chemical is properly applied.
Once the chemical FR treatment is completed, the textile is ready to be inspected and sent to a cut-and-sew operation to be made into garments.

Whether purchased by individuals, supplied by the company or leased through a laundry service, FR clothing arrives for wear. No matter whether it’s inherent or treated, if a job puts a worker at risk of arc or flash fire, wearing FR is imperative to their safety.

Dominique Adams is the Research & Development Engineer for Industrial Safety flame-resistant fabrics that protect utility linemen, oil & gas workers, electricians, miners, welders and others.

TenCate Protective Fabrics creates and manufactures only inherent flame-resistant fabrics. Be sure to examine the incredibly comfortable and protective inherent FR fabric, Tecasafe® Plus with Coolderm™ Technology.

Tecasafe® Plus with Coolderm™ Technology provides utility linemen, oil & gas workers, electricians and others who need protection from multiple hazards (like arc flash or flash fire) with the following:

- **Inherent FR protection**: The flame-resistant protection never washes out or wears away; it’s built right into the fabric.
- **Soft and comfortable**: Tecasafe® Plus arrives soft and comfortable, not requiring a break-in period.
- **Active moisture wicking**: Any perspiration or wetness is pulled away from the skin and spread out to dry more quickly.
- **Evaporative cooling effect**: As any moisture evaporates, in warm environments it cools the wearer as air flows through the fabric; in cooler environs, the wearer’s temperature is better regulated because the fabric dries more quickly.
- **Hypoallergenic fabric**: Tecasafe® Plus doesn’t include any chemical treatment for flame resistance.

Consider trying out TenCate Tecasafe® Plus with Coolderm™ Technology in a wear trial by visiting http://tencatefabrics.com/tsp-trial.