A PERIODIC PUBLICATION HIGHLIGHTING THE MERITS OF VINYL PERFORMANCE PRODUCTS

FOCUS on Flame Retardants

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In a fire, the time available to building occupants to escape or be rescued makes the difference between life and death. Today, designers can help control those outcomes by first understanding the mechanics of a fire, the components of modern building materials, and the products that can disrupt the normal fire sequence so that it doesn't become deadly.

Three components must be present in a fire – a solid material that serves as a fuel source, oxygen, and a source of heat that can ignite the fuel source. On its own a solid cannot burn. A flame forms when heat combined with oxygen releases a flammable vapor from the solid. Flame retardants added to upholstery materials can disrupt this process by delaying ignition, significantly slowing flame spread and removing the risk of deadly smoke inhalation.

HOW DO FLAME RETARDANTS WORK?

The best way to avoid fire is to not allow the heat source. But because ignition is generally the result of an accident (cigarette, cooking, electrical malfunction), flame retardant additives for specific fuel sources, such as furniture upholstery covering polyurethane foam, were developed. Once in service, flame retardants prevent the fuel source from contributing to the burning of other fabrics and building products in a fire, and extend flashover time, which is that point when all of the combustible materials in a room or compartment (such as in transportation applications) reach their ignition temperatures at the same time. Without flame retardants, flashover can occur in three minutes or less; with flame retardants, that window can expand to a lifesaving 10-15 minutes.

AREN'T VINYL COATED FABRICS FIRE RESISTANT?

It is true that the chlorine composition of the PVC resin comprising durable vinyl coated fabrics gives it a relatively high Limiting Oxygen Index, and the material is the only plastic used for upholstery that is inherently flame retardant at the start of its lifecycle. By itself, however, this isn't enough to meet the requirements of specific building and fire codes and standards for flame resistance for specific end uses. These codes and standards stipulate burn rates that are just high enough that vinyl coated fabrics cannot reliably meet them without added flame retardants.

HOW IS FLAME RETARDANCY ACHIEVED?

There are three possible approaches to preventing ignition and/or flame spread in a solid material, some of which may be combined in the product formulation:

- Make the fuel source non-combustible in the vapor phase.
- Form a char layer that insulates the fuel source and lowers the temperature.
- Quench the flame that does form by releasing water as the temperature rises, lowering the temperature and extinguishing the flame.

WHICH APPROACHES ARE USED IN VINYL COATED FABRICS?

The fire retardants that are commonly specified for vinyl coated fabrics include:

- Antimony trioxide inhibits combustible gases in the vapor phase. A small amount of antimony trioxide is all that is needed to meet most fire specifications.
- Phosphorous flame retardants are often used as a replacement or in addition to antimony. They also act in the vapor phase and as char formers, which both helps insulate the fuel from the flame and retards the flame.
- Intumescent flame retardants turn the burned surface into a char layer which insulates the material and the flame reducing the heat and retarding the flame. There are several types of these, such as phosphorous and melamine based.
- Alumina trihydrate and magnesium hydroxide are endothermic/heat sink flame retardants, releasing water when they reach a certain temperature, which in turn reduces the temperature of the flame and extinguishes or retards it.
- Zinc-based flame retardants are sometimes used as fire retardants and as smoke suppressants and char formers.

WHAT TEST METHODS UNDERLIE TODAY'S FIRE STANDARDS FOR UPHOLSTERY?

There are numerous fire standards covering individual applications, but a common theme among the test methods is applying a flame to a specimen to determine the burning behavior of that specimen in terms of flame spread and smoke development in upholstery cover fabrics. An example is California Technical Bulletin 117, which exposes a lighted cigarette to the seat and back of a miniature chair assembly. Other examples are FVMSS 302, which applies specifically to motor vehicle interiors; ASTM E84/UL 723, which compares surface flame spread and smoke development of material with that of a select grade red oak and reinforced cement board under specific fire exposure conditions; and NFPA 701, where a burner flame is applied to a vertically oriented textile fabric to determine its flame propagation.

CFFA CHEMICAL FABRICS & FILM ASSOCIATION, INC.

1300 Sumner Ave., Cleveland, OH 44115-2851 P: (216) 241-7333 F: (216) 241-0105
www.chemicalfabricsandfilm.com www.cffaperformanceproducts.org