



By Tim Nelson

You are about to clean a sofa but notice during pre-inspection that the white cotton fabric is showing very faint yellowing on the seat and back cushions.

The yellowing is not uniform, rather it is “blotchy” in appearance. You look for similar problems on other areas but can find no evidence anywhere on the base or frame of the sofa.

You show the client what you’ve found, but she has no idea what might have caused the problem. The sofa is a little over a year old, has never been cleaned, and in fact, is only occasionally used.

What is causing this discoloration? Is there any reason to do more than just clean it as usual?

Background



Residential, upholstered furniture is flammable. It can be both a starting point for fires and a substantial source of fuel for fires that originate elsewhere in the home. However, after several decades of study, California is the only state with a flammability standard for residential, upholstered furniture.

With no federal standard, California passed its own law in 1975. Technical Bulletin 117 (TB 117) specified mandatory test procedures for all residential, upholstered furniture. In the absence of a federal standard, and with California representing a substantial portion of their overall business, many furniture manufacturers chose to implement TB 117 for their entire lines. These decisions assured that furniture manufactured to the new standard would eventually be shipped throughout the U.S.

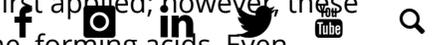
Flame-retardant chemistry

In addition to other requirements, TB 117 specified that any feather-type filling material had to be encased in a flame-retardant ticking. Ticking is the fabric “bag” that holds the filling material. “Down-proof” cotton ticking was already widely used in the furniture industry, so the standard was met by simply applying flame-retardant chemicals to these fabrics. To simplify, we will use the term “down” to mean any filling material made from down, feathers, or combination of the two.

Cotton, a cellulosic fiber, is easily ignited in any fire situation. It is also among the easiest to treat for flame resistance. In fact, the least expensive types of flame-retardant chemistries — often based on inorganic salts — tend to perform well when applied in moderate amounts on cellulosic fabrics. These inexpensive chemicals are nondurable (they are water soluble), but in certain, less-demanding applications, such as the ticking specified by TB 117, they are a very attractive solution.



Flame-retardant chemicals, based on inorganic salts, may be benign when first applied; however, these chemicals have at least one significant drawback: They decompose over time, forming acids. Even moderately strong acids can do serious damage to certain textiles, especially with prolonged exposure.



Cover fabric sensitivity

When a down-filled ticking is placed inside a cover fabric to form a seat cushion, the ticking and the cover fabric are in intimate contact. This is important because any chemicals (such as flame retardants) applied to the ticking are now more likely to transfer to the cover fabric. In the case of flame-retardant chemicals, the transfer is almost inevitable. The variable is the amount of flame retardant that moves and the time it takes to occur. Another variable, and part of what makes this problem so interesting, is the different sensitivities of upholstery fabrics.

Cotton is resistant to damage from alkaline chemicals but is susceptible to damage by acids. Acids cause hydrolysis of the cellulose polymer, resulting in a weakening of the fiber. This damage is often accompanied by yellowing or browning, especially on white or light-colored fabrics. It is not unusual to find the cotton ticking fabric also discolored in advanced stages of flame-retardant-induced damage.

The flame-retardant-induced browning of cotton may look like the “cellulosic browning” that sometimes appears shortly after cleaning cotton (and other cellulosic) fabrics. However, browning due to flame retardant is caused by actual fiber damage, like the yellowing and eventual embrittlement of old newspaper. It is not correctible or preventable with application of acidic chemicals such as those commonly used as rinse agents. If anything, fiber damage caused by acidic, flame-retardant byproducts is likely to be accelerated by acid rinses.

Interestingly — and for reasons we don’t completely understand — we have not seen damage that definitively can be linked to flame retardants on other cellulosic upholstery fabrics such as linen. Of course, synthetic fibers are resistant to acids, and this is why we have seen no damage on fabrics of this type.

Fiber-reactive dyes

Certain types of fabric dyes also seem to be particularly sensitive to the effects of acid byproducts of flame-retardant chemicals. What little literature there is on the subject suggests that these are primarily reactive dyes, though no detailed studies have been found.

Whatever the dye type involved the color changes can be remarkable. We have seen changes, such as blue/gray becoming orange, blue changing to pink, and green turning to brown. The typical scenario is a change that is noticed anywhere from a few weeks to a couple of years after the furniture is installed. In all cases, the problem develops gradually and grows steadily more pronounced with time.

Recognizing the problem



While flame-retardant treatments are the norm for ticking fabrics encasing down fill, our experience suggests that these chemicals are rarely applied directly to upholstery fabrics intended for residential installation. Among the estimated 150-200 instances of flame-retardant problems with which we have been involved since the early 1990s, we have seen perhaps only one or two where the discoloration was present in areas other than cushions.



Furnishings exhibiting flame-retardant ticking problems tend to share several common characteristics:

- *Cover fabrics are almost always cotton (or cotton blends).*
- *Cushions are affected but rarely other areas:* Again, because flame-retardant ticking is used almost exclusively within seat and back cushions, the problem is almost always limited to these items.
- *Blotchiness:* The discoloration will be uneven in appearance. As previously mentioned, color changes tend to be two different types: 1) dye-related changes, such as blue dye changing to pink, or 2) the yellowing/browning of light-colored fabrics.
- *Absence of discoloration in narrow areas directly adjacent to seams:* The small “flap” of extra fabric on the inside of a sewn cushion is called the seam allowance. Where this extra layer of fabric prevents the cotton ticking from contacting the cover fabric, it shows up on the outside as a narrow, unchanged area of fabric that runs along the seam. This is a hallmark of the flame-retardant ticking problem, indicating, with a high degree of certainty, that the problem originates underneath the cover fabric and not from anything done to the outside of the cushion.
- *Acid pH:* Flame-retardant ticking is often only mildly acidic, at a pH of 6 or so, when first created, but gradually it becomes more acidic as the flame retardant breaks down over time. In situations where damage has become noticeable on the cover fabric, the ticking inside the cushion will usually be found to have a pH no higher than 5 and will often be significantly lower, with a pH between 2 and 3 in more advanced situations.

By the time the cover fabric shows noticeable damage, there is almost always an identifiable change in pH between discolored and “normal” areas. This change in pH is typically 0.5 to 1 but can be higher in advanced stages of damage.

It is important to emphasize that migration of flame retardant from cotton ticking inside cushions can occur without any outside influence such as spotting or cleaning. Given enough time, exposure to atmospheric moisture is enough to cause the transfer of the flame retardant from the ticking to the cover fabric. Again, we have seen these problems start to happen anywhere from several weeks to a couple of years after the furniture is installed, with an average timeframe of 6-12 months.

For obvious reasons, problems tend to appear somewhat more quickly in areas of the country with high humidity.



Little chance of correction

In all but one or two flame retardant-related discolorations we have seen, corrective measures have been in vain. Raising the pH by neutralizing the cover fabric with alkaline chemicals might seem the most logical remedy, but this process has not been successful for the vast majority of these color changes. As mentioned previously, almost all flame retardant-related upholstery problems we have seen have been resolved eventually by replacement of the damaged fabric (and the offending ticking).

What about correcting the ticking itself? In theory, rinsing or neutralizing the flame retardant might avoid future problems or halt further damage if it has already become apparent. However, given that the treatment was applied to impart flame-retardant properties on the upholstery, this is generally not advisable. The potential liability is quite severe.

Wet cleaning + flame retardant = danger

Routine wet cleaning of upholstery often causes at least some wetting through to the back of the fabric, especially on lighter-weight fabrics. Any moisture that comes into contact with the cotton ticking will begin to solubilize flame-retardant chemicals. When these chemicals are solubilized, they easily move to the cover fabric.

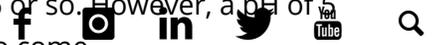
Normal wet-cleaning methods will not only tend to make pre-existing flame-retardant problems more pronounced, they will also shorten the timeframe for problems that have yet to appear.

Pretesting

Loose cushions on sofas and chairs should always be inspected for the presence of a cotton ticking. Open a zipper and see what materials are used inside the cushion. Cotton ticking is especially prevalent in high-end upholstery because of the use of more expensive down filling materials.

If a cotton ticking is found, it should first be carefully inspected for appearance. Any yellowing or browning is a red flag for possible acid damage occurring on the ticking fabric. The pH testing should be performed using a meter, pH paper, or pH strips. For many years, we have successfully used and recommended ColorpHast pH strips. The accuracy of these strips is suitable for most applications, and they are non-bleeding (unlike the roll pH paper), and easy to use (unlike pocket pH meters).

It is not unusual for a ticking fabric to be slightly acidic, with a pH of about 6 or so. However, a pH of 5 should be a concern, and 4 or lower is an almost certain sign of problems to come.



What about cover fabrics that do not contain cotton? This is a sticky wicket. Our experience suggests that most fabrics that do not contain cotton are safe, even with suspect ticking underneath. Out of an abundance of caution, however, you might want to assume that any cover fabric might react with the acid to cause a problem.

When this condition is found, immediately inform the client. Steps can be taken to safely clean the fabric, though future problems might still occur. Of course, a written disclaimer also can be used.

Cleaning upholstery containing unsafe flame retardants

Cleaning the cushion covers safely requires that the ticking be protected from moisture. This can be accomplished by removing the cushion covers and placing the ticking-covered inner cushion inside a plastic bag then placing the assembly back inside the cushion cover. This allows for normal cleaning without danger of wetting the ticking. After cleaning and thorough drying, the plastic can be removed.

It is not recommended that you clean loose cushion covers that have been removed from the cushion. Other problems could result from this process — the most obvious of which is shrinkage.

Conclusion

If you've never seen the phenomenon described in this article, you are fortunate but not alone. Flame-retardant ticking is used in a relatively small percentage of all upholstered furniture. And of the pieces that do use treated cotton ticking, problems only show up on those that are upholstered using acid-sensitive fabrics and/or dyes.

Still, when the problem does appear, it is almost always not correctible. And it usually costs somebody a significant amount of money. Armed with the information in this article, that somebody need not be you.

Tim Nelson is the director of research for Fiber-Seal Systems. A 38-year veteran of the carpet and upholstery care industry, his areas of expertise include chemical formulating, textile analysis, and the care of interior textiles. Nelson is also a technical writer and trainer and is a member of the American Association of Textile Chemists & Colorists. He can be reached at tim.nelson@fiberseal.com.

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