Ryan Paul
Chemist
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Emissions from Fabric Treatments

Many fabrics manufactured for use as clothing, furniture, and carpeting are treated with chemical finishes to impart certain benefits, like increased softness or resistance to wrinkles, stains, water, mildew, and fire. However, these fabric treatments can also be sources of volatile organic compound (VOC) and formaldehyde emissions, which decrease indoor air quality and can have potentially-harmful health effects (Franke et al., 1994, p. 496-499).

Among other chemicals, fabric treatments may contain and emit fluorocarbons, sulfur dioxide, acetone, and brominated hydrocarbons (Franke et al., 1994, p. 499-500). In a study by Martin et al. (1998), 12 synthetic and natural fabrics treated with 14 different commercial finishes were tested for VOC emissions via Drager direct reading tubes and static headspace testing. The study found that four of the fabric treatments (acrylic handbuilder, DMDHEU, melamine resin, and wax water repellent) gave formaldehyde emissions at median concentrations of 1-2 ppm (p. 16). Furthermore, the wax water repellent fabric treatment also emitted acetone (median value: 100 ppm), ethylene glycol (20-40 ppm), and methanol (50 ppm) (p. 17). In 2005, growing environmental concerns led to the Canadian environmental protection agency (Environment Canada) putting a two-year-minimum ban on the use of three fluorinated polymers used to make stain repellents (Renner, 2005, p. 56A). It was believed that volatile fluorotelomer alcohols were emitting from treated fabrics and eventually converting into perfluorocarboxylic acids, which had been found bioaccumulating in Arctic animals in rising levels over time (p. 56A).

DMDHEU (1,3-dimethylol-4,5-dihydroxyethylene urea) is of particular interest, because it is a common formaldehyde-based treatment used in durable-press and wrinkle-free cotton fabrics (Chen et al., 2005, p. 7921; Holme, 2007, p. 60). One would think that simply washing these treated fabrics would remove VOC or formaldehyde-emission concerns, but this is not necessarily the case; in a study of durable-press cotton fabrics treated with DMDHEU, Reinhardt and Andrews (1987) found that washing the fabrics in slightly acidic deionized water caused formaldehyde release to decrease (p. 896-897). However, when washed in New Orleans tap water that was slightly-to-moderately alkaline, formaldehyde release from the cotton fabrics increased substantially, possibly due to hydrolytic degradation of the finish (p. 896-897).

Interestingly, there are chemical treatments that have been commercially produced (and/or are currently still being developed) in which VOCs are **intentionally** emitted from fabrics; microencapsulated polymer spheres filled with fragrances (peppermint, lavender, chamomile), skin-care products (moisturizers, aloe vera, natural oils), chemicals causing skin cooling or heating effects, insecticides, and antimicrobial agents are bound to fabric fibers and slowly release their contents over time (Holme, 2007, p. 65-70).

Whether intended or not, VOC and formaldehyde emissions from treated fabrics remain as a relevant part of our understanding of air quality.

References

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