Not So Mellow—Textile Yellowing
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Yellowing in General
The yellowing of white and light shade fabrics is a serious and complex problem the industry continually faces. This problem is nearly as old as the textile industry itself. Numerous factors can contribute to yellowing:1-3 which fibers are used, which chemicals garments are treated or processed with, atmospheric pollutants, and others.

A Modern Conundrum
Perhaps the most common fabric yellowing problem, phenolic yellowing4 (also known as “storage yellowing,” “warehouse yellowing,” or “elusive yellowing”), has a relatively modern origin. Yellow stains, especially in creases or folds, can appear on white or light colored fabrics stored in certain plastic bags or in cardboard boxes before sale. This has been a problem throughout the industry for more than half a century. However, there are other potential causes of fabric yellowing that should be ruled out as well.

Why Phenolic Yellowing Happens
Fortunately, years of persistent research led to the discovery that the use of phenolic antioxidants in the packaging material, along with exposure to oxides of nitrogen (NOx) and alkaline pH of the garments were responsible for the yellow discoloration. These antioxidants include para-phenylenediamine (PPD) and butylated hydroxytoluene (BHT). NOx is a byproduct of combustion processes, such as car or truck exhaust, or direct heating in warehouses. By itself, NOx can yellow fabric or cause shade changes on certain fabrics in a process called gas fume fading. It was also discovered that phenolic yellowing could be reversed by exposure to sunlight. However, it would reappear if the garment were re-exposed to BHT and NOx.

How The Yellow Got There
Several important discoveries were made about the cause of phenolic yellowing. Phenolic antioxidants in plastic bags or phenolic lignin from cardboard were found to migrate from the packaging material to the garment. No yellowing was observed, however, until garment exposure to NOx. Another requirement was for the garments to have been left in an alkaline state after processing. The chemistry of this process has been explored. With this knowledge in place, remedies for phenolic yellowing became available.

Keeping The Yellow Away
Steps can be taken to eliminate the risk of phenolic textile yellowing. BHT-free plastic packaging material is available. Products can be stored in a location where no NOx fumes are produced. At the
end of fabric processing, the pH can be adjusted to a non-alkaline value with a nonvolatile acid such as citric acid.

**Test Methods**

Additionally, a test method can be used to determine whether the potential exists for phenolic yellowing in your fabrics. [ISO 105-X18:2007](https://www.iso.org/obp/ui/#iso:std:iso:105-x18:ed-1:v1:en), Assessment of the Potential to Phenolic Yellowing of Materials, test method is available. To test for gas fume fading, [AATCC Test Method 23-2010](https://www.aatcc.org), Colorfastness to Burnt Gas Fumes, is available.

**Get Help**

For assistance with your particular yellowing problem, check out the [AATCC LinkedIn group](https://www.linkedin.com). In the discussion section, search on “yellowing” or join and post your own question. There have been several recent discussions on this topic.

With proper planning and testing, you’ll wonder where the yellow went!

**References**