Olney Medal Address

Obstacles to the Satisfactory Performance of Nylon Carpets in Your Home

By J. LEE RUSH, 1989 Recipient of The Olney Medal

I have spent most of my career investigating what causes carpets to fade or spot and what can be done to reduce or eliminate them. Dyestuff selection has been an important factor in resisting fading. As a general rule acid dyes are more resistant than disperse dyes and premetallized dyes are more resistant than acid dyes. There are also significant differences between dyes in the same class, such as acid dyes.

There are several obvious things which cause carpets to fade or lose their colors such as sunlight and atmospheric contaminants like ozone and "acid rain." Acid rain is primarily a product of nitrogen dioxide and sulfur dioxide. Some other agents which cause carpet discoloration are chemicals readily available in most households. These so-called mysterious color changes are caused by chemical destruction of the dyes used to color the carpet. In most cases the color change is irreversible and does not occur immediately after a spill. These chemicals usually lie dormant until their destructive powers are triggered by heat and moisture in the form of high humidity. I will describe what the carpet manufacturer and the consumer can do to minimize the loss of carpet color.

Fastness to Sunlight

The carpet mill has an obligation to use the dyes which have the very best light resistance, which most of them are doing. The consumer has the same obligation to close

J. LEE RUSH, an authority on the dyeing of nylon and the effects of atmospheric contaminants on dyes used on nylon, is the forty-sixth recipient of The Olney Medal, AATCC's highest recognition for achievement in textile chemistry. The award was presented to him at the association's International Conference & Exhibition last month in Philadelphia by Christine W. Jarvis of Clemson University, the 1989 chairman of the selection committee for the award. Before his retirement earlier this year, Rush was a senior scientist in dye application and dyeing technology in the fibers division of Allied-Signal Inc. at Petersburg, Va.

the drapes when the sun is shining directly on the carpet. I am sure many of you have stayed in motels or hotels where the carpet near the window is one color and it gradually changes the further you get from the window. The only other thing the consumer could do is pick colors which are less prone to fading. The lighter shades tend to fade easier than dark, while reds are the most prone to fade followed by blues and yellows in that order.

Atmospheric Fading

The choice of proper dyes by the mill is of the utmost importance when it comes to resisting ozone fading, oxides of nitrogen and sulfur dioxide. There are also additives which the mill can add to the dyebath during dyeing. This has been discovered during years of research and today the consumer is getting the best product that carpet technology can produce.

Ozone is produced by the photochemical reaction of sunlight on hydrocarbon exhausts from automobiles and factories. It has also been reported that ozone is produced by trees, particularly pine trees.

The consumer can minimize his risk by keeping the amount of outdoor air brought into the house to a minimum and keeping the indoor humidity as low as possible. With today's air conditioned homes, ozone fading usually occurs as an overall discoloration rather than in spots, unless something has been spilled on the carpet to accelerate ozone fading.

The nitrogen dioxide contaminants are produced primarily by auto exhaust and gas powered forklift trucks. Since this is an oxidizing agent like ozone, the same dye selection and dyebath additives still apply at the mill level.

Sulfur dioxide, which is a component of acid rain as is nitrogen dioxide, is caused by the burning of high sulfur coal and other industrial gases. The only tool the mill has to minimize sulfur dioxide fading is critical dyestuff selection.

With President Bush's current push to clean up the environment and reduce acid rain, fading from atmospheric contaminants should be less of a problem in the future than it is today.

One might ask whether the addition of fluorocarbons and stainblockers would eliminate atmospheric fading. The answer is definitely not, but they will significantly increase the time before the fading occurs. While the addition of fluorocarbons and stainblockers are not cure-alls, they definitely do help and they are well worth the small extra cost.

In the case of atmospheric fading, the importance of humidity cannot be exaggerated. If the relative humidity remains lower than 50%, as it is in many air conditioned buildings, then atmospheric fading is not a factor. Heat is less of a factor, except as in any chemical reaction it proceeds faster as the temperature increases. The most insignificant factor is the gas concentration. It only takes a small amount of ozone or nitrogen dioxide at high humidity to produce a fade on nylon carpets.

Sources of Atmospheric Contaminants

- Ozone: Photochemical reaction of sunlight on hydrocarbons.
- Nitrogen Dioxide: Auto exhausts and gas powered fork lifts.
- Sulfur Dioxide: Burning of high sulfur coal and other industrial gases.
- Acid Rain: Nitrogen dioxide and sulfur dioxide.

Spills

Let us now turn to spills or things that are controlled mostly by the consumer. The worst thing about spills is that most of the time the effect is not visible immediately unless they are highly colored. The spills are usually latent bloomers and do not become visible for weeks or months. The latent intruders normally require heat and humidity to help them destroy the dyes, hence we notice them most in summertime. The most common intruders are acne medication whose active ingredient is benzoyl peroxide. These products used on the face are not easily washed from the skin or fabrics. An extremely low concentration (0.02%) will destroy the dyes and leave a bright yellow spot. Sometimes this has been seen in the form of a hand print on the carpet.

Chlorine Bleaches and Cleaners

Concentrated chlorine spots develop very quickly and are usually seen close to a bathroom door. I am sure you have seen these small yellow spots in or near the bathroom in hotels or motels. Even though the containers for these products have so-called dripless spouts, one or two drops frequently manage to get on the carpet. They also destroy the dye in an irreversible manner. These chlorine based chemicals produce a light yellow spot not too dissimilar from benzoyl peroxide discoloration.

Sources of Spots Caused by Consumers

- Acne Medications: Benzoyl peroxide.
- Chlorine bleaches and cleaners.
- Pesticides: Organophosphates.
- Plant foods.
- Tile cleaners and mildew fighters.
- Dandruff shampoos.
- Coffee.
- Red wine.
- Miscellaneous: Pool chemicals, oven cleaners, furniture polish.

Pesticides

Pesticides such as those used to control ticks and fleas contain organophosphates as their active ingredient. The red dyes in the carpet formulation are the most vulnerable to the organophosphates. Often they will destroy the red in a beige shade, resulting in a green spot. Chemicals no longer active to control pests will still destroy the dyes.

Plant Foods

Plant foods are fertilizers used in homes and offices. No one sprays them on a carpet intentionally, but they do spray plants sitting in pots on carpets. The active ingredient again is often an organophosphate and the results are similar to pesticides. The best advice is to take your plants outside to spray them.

Tile Cleaners and Mildew Fighters

Tile cleaners and mildew fighters contain strong acids or bases and often chlorine as well. These may cause color shifts which can be reversed, but where chlorine is involved restoration of the color is not likely. Please try to remember, your carpet is a textile material—not marble—and harsh chemicals should be kept away from them.

Dandruff Shampoo

Products used to control dandruff usually contain sulfur compounds. The color will change to blue or green and darken as the sulfur ages. Sometimes these chemicals will turn into a brown spot on the carpet. Again this is a chemical that no one would purposely put on a carpet but it does find its way there.

Coffee

Coffee seems to be one of the worst offenders, even on stain resistant carpets. A study was made to determine why coffee is such a bad stainer compared, for example, to tea. It was discovered that hot coffee is many times worse than cold coffee. We all know that hardly anyone spills cold coffee on a carpet. If the coffee contains cream and sugar, the stain is more difficult to remove. Very little difference was found in the staining of cold coffee and cold tea. Coffee is one of the most difficult stains to remove, so we should be extra careful around carpets.

Red Wine

Red wine is another difficult stain to protect against and to remove. It has a tendency to dye the carpet. In attempting to remove it, you can make the carpet look worse than doing nothing. As always, time is the important element, so one should get the spill up as soon as possible.

Miscellaneous

Pool chemicals, oven cleaners and furniture polish are also harmful to carpets. They are not our everyday spills, but they can destroy the dyes in the carpet and the color cannot be readily restored.

Formaldehyde

Carpets normally do not contain formaldehyde but they can be scavengers of odors and chemicals as can other textiles. The primary source for formaldehyde in carpets is particle board or plywood. The adhesive used to bind the particle board or plywood usually contains formaldehyde. Urea-formaldehyde and resorcinolformaldehyde are the most common resin binders used. They are latent bloomers and can destroy the dyes in the carpet.

Butylated Hydroxytoluene

BHT is a good economical light stabilizer for polyolefins. It used to be found in all primary polypropylene carpet backings but it has been eliminated from most primary carpet backings because it causes the nylon to yellow and results in a change of carpet shade. It can also cause the dye to be applied nonuniformly.

Clean-Up Procedures

- Blot or vacuum any visible spills.
- Use only cold cleaning solutions.
- Use household ammonia cold with very little rubbing; blotting is preferred.
- Use cold white vinegar to neutralize the ammonia and remove stains not removable with alkaline ammonia.
- If the stain is known to be oily or greasy, clean with a cold drycleaning solvent.
- The reason for blotting rather than rubbing is that vigorous rubbing will cause pile distortion which changes the physical condition of the tufts and will not look like the remaining carpet.

If you feel you can restore the carpet yourself, proceed with caution. However, do not be reluctant to call a professional for carpet restoration.

This paper is not meant to scare you when you walk on your carpet, but only to make you aware of some of the pitfalls to complete enjoyment. You should want your carpet to last until you get tired of looking at the same color.

The Olney Medal

Established in 1944 in honor of Dr. Louis Atwell Olney, the founder and first president of AATCC, The Olney Medal is presented in recognition of outstanding achievement in textile or polymer chemistry or other fields of major importance to textile science. In addition to the medal, the recognition includes a scroll and an honorarium. Presentation of the medal each year is a highlight of AATCC conferences. Following is a list of the 46 medalists and the names of the organizations they were with at the time the medal was awarded.

1944: Louis Atwell Olney
1945: Milton Harris, Milton Harris Associates
1946: William A. Cady, U.S. Finishing Co.
1947: Edward A. Schwarz, Massachusetts Institute of Technology
1948: Harold M. Chase, Dan River Mills
1949: Charles A. Seibert, The Du Pont Co.
1950: George L. Royer, American Cyanamid Co.
1951 Raymond W. Jacoby, Ciba Co.
1952: Werner von Bergen, Forstmann Woolen Co.
1953: Roland E. Derby Sr., The Derby Co.
1954: William D. Appel, National Bureau of Standards
1955: Miles A. Dahlen, The Du Pont Co.
1956: Walter J. Hamburger, Fabric Research Laboratories
1957: P. J. Wood, Royce Chemical Co.
1958: Henry E. Millson, American Cyanamid Co.
1959: Emery I. Valko, Lowell Technological Institute
1960: Arnold M. Sookne, Harris Research Laboratories
1961: Fred Fortess, Celanese Corporation of America
1962: Charles F. Goldthwait, North Carolina State University
1963: Guiliana C. Tesoro, J. P. Stevens & Co.
1964: Richard O. Steele, Rohm and Haas Co.
1965: Herman F. Mark, Polytechnic Institute of Brooklyn
1966: Wilson A. Reeves, U.S. Department of Agriculture
1967: Edwin I. Stearns, American Cyanamid Co.
1968: Harold P. Lundgren, U.S. Department of Agriculture
1969: D. Donald Gagliardi, Gagliardi Research Corp.
1970: Paul L. Meunier, The Du Pont Co.
1971: Ernest R. Kaswell, Fabric Research Laboratories
1972: Victor S. Salvin, University of North Carolina at Greensboro
1973: Herman B. Goldstein, Sun Chemical Corp.
1974: Henry A. Rutherford, North Carolina State University
1975: R. Lee Wayland Jr., Dan River Inc.
1976: George L. Drake Jr., U.S. Department of Agriculture
1977: James E. Straley, Tennessee Eastman Co.
1978: Dmitry M. Gagarine, Milliken Research Corp.
1979: Joseph W. Gibson Jr., The Du Pont Co.
1980: Roland E. Derby Jr., The Derby Co.
1981: Mathias J. Schuler, The Du Pont Co.
1982: Stephen B. Sello, J. P. Stevens & Co.
1983: Theodore F. Cooke, Textile Research Institute
1984: Ralph McGregor, North Carolina State University
1985: Stanley P. Roland, U.S. Department of Agriculture
1986: Melvin D. Hurwitz, University of North Carolina at Greensboro
1987: Ludwig Rebenfeld, Textile Research Institute
1988: Martin K. Lindemann, Consultant
1989: J. Lee Rush, Consultant