Shedding New Light on UV and Fading

Damage-weighted transmittance is emerging as more accurate measure to assess fade resistance offered by various glazing options

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Fading of interior building components and furnishings is a growing concern in today's construction industry. More and more architects are looking at the issue when they set out to choose the most appropriate glass for both residential and commercial projects. Window manufacturers also want to provide greater assurance to homeowners that large window areas will not lead to problems with fading.

In assessing the potential fading risks associated with the glass they are specifying, most architects look at a single measure on the performance data sheet: ultraviolet (UV) light transmittance. While useful, this measure fails to present a comprehensive view of solar radiation risks—since light outside the UV range can also cause significant fading. As a result, many experts are turning to a lesser-known measure—damage-weighted transmittance—as a far more reliable indicator of potential fading, because it considers both UV and visible light.

Contributing Factors

There are three key factors contributing to today's growing concerns about the potential fading of fabrics, finishes, carpeting and artwork in homes.

Supported by the outstanding energy efficiency levels of today's low-emissivity glasses, current architectural designs favor a large number of windows—and feature clearer glass than ever before. Homebuyers have also driven this trend, with their increasing demand for large, open interior spaces flooded with natural light.

While this trend has brought more and more light into homes, another trend has simultaneously made interior fabrics and finishes much more fragile: the emergence of new environmentally friendly materials.

Driven by new pollution laws, the fabric dyes, wood stains, paints and other coatings found in modern homes have been formulated to have a more benign impact on our environment. Many may be less stable than their predecessor materials, however, which were typically solvent-based. Today's water-based products have a number of obvious environmental benefits, but their primary drawback is that some are more susceptible to fading over time.

In addition, because of ozone depletion, higher levels of UV light now reach the surface of the earth. This has the effect of increasing the rate of fading.

These three trends—more natural light transmittance, more fragile interior components and a higher concentration of UV light—have resulted in a much greater awareness of fading issues, both among architects and homeowners.

UV Light Transmittance

When considering the potential for fading, most architects focus on just one measure on glass manufacturers' performance data sheets: the UV light transmittance level. UV light, however, represents only 3 percent of the sun's total radiation. And this measure is an extremely limited one considering that light in the visible spectrum, which accounts for 47 percent of total solar radiation, also causes fading. The remaining 50 percent of solar radiation is in the infrared spectrum, which is associated with heat gain, not fading.

Since UV light is only one of several components that cause fading—and it is not weighted—assessing a glass based only on its UV transmittance level does not provide a true indication of its ability to protect against fading. The 2003 edition of the Laminated Glazing Reference Manual, published by the Glass Association of North America, recognizes that UV light transmittance is an insufficient measure and advises architects to look beyond the UV spectrum:

Because of its high energy level, ultraviolet radiation—radiation below 380 nanometers (nm) wavelength—is a very significant contributor to material deterioration and color fading. However, damage can also be caused by visible light… [and those specifying glass should] account for damage in the visible spectrum, as well as that caused by UV.

Despite its limitations, architects have traditionally relied on UV light transmittance to assess the risk of damage to interior components. That is slowly changing; however, as the architectural glass and window industries are discovering that there is a much more realistic assessment tool readily available.

Damage-Weighted Transmittance

To account for the fading damage that can result from radiation in both the UV range and the much larger visible spectrum, European researcher Jurgen Krochmann created a more accurate measure called damage-weighted transmittance. Krochmann's original measure, Tdw-K, covers the UV and visible parts of the spectrum from 300 nm to 500 nm. However, a more accurate assessment of damage-weighted transmittance can be calculated using Tdw-ISO, a function recommended by the Commission Internationale de L'Eclairage (CIE). Tdw-ISO covers the solar spectrum from 300 nm to 700 nm.

While not yet standard information on glass performance data sheets, the damage-weighted transmittance rating for a given glass product can be requested from the manufacturer, or easily calculated using Window 5.2 thermal analysis software, provided free of charge by Lawrence Berkeley National Laboratories. Window 5.2 allows users to calculate damage-weighted transmittance using both Tdw-K and Tdw-ISO functions. Tdw-ISO is generally considered to have greater validity, since it covers the visible range all the way to 700 nm.

Fading Potential:
Two Very Different Views

Glass Type	UV Light Transmittance (300-380 nm light range)	Weighted Transmittance (300-700 nm light range)
6 mm Clear Monolithic	0.62	0.80
6 mm + 6 mm Clear IG unit	0.46	0.69
6 mm Clear Laminated, 0.76 mm PVB	<0.01	0.62
6 mm Clear Laminated + 6 mm Clear, IG Unit	<0.01	0.55
6 mm Green	0.30	0.63
6 mm Green + 6 mm Clear	0.24	0.55
6 mm Clear Low-E (2) + 6 mm Clear	0.31	0.53
6 mm Clear Low-E (2) + 6 mm Clear Laminated	<0.01	0.44

Table 1— Values determined using Window 5.2 software with Tdw-ISO function used to calculate Damage-Weighted Transmittance. Low-E glass data shown is for AFG's Comfort Ti-AC 36.

As Table 1 illustrates, the difference in fading potential can be dramatic when the traditional UV light transmittance measure is compared to the more comprehensive damage-weighted transmittance measure. Based on UV light transmittance alone, a laminated glass lite may seem the best choice to minimize interior fading. But when damage-weighted transmittance is used to compare glass choices, it is evident that low-E and tinted glasses can be just as effective in preventing fading, when the full 300-700 nm light range is considered.

With an excellent damage-weighted transmittance of 0.44, the data further shows that the combination of a high-performance low-E coating with a laminated interior lite results in an attractive glass option for many applications. This glass option will not only protect against fading, but reduce infrared energy to a very low level—minimizing solar heat gain while still allowing high levels of natural light into a building's interior.

Best Glass Choice
Whatever the specific concerns associated with a home or architectural project—whether they center on energy efficiency, appearance, fading or all of these issues—it is imperative that architects and window manufacturers work with the best and most comprehensive performance measures available.

While an increasing number of windows, less stable fabric dyes and interior finishes and higher levels of UV light have made fading a growing concern, the good news is that the glass industry has responded with new technologies that protect against fading, while also maximizing other performance elements.

Low-E and tinted glasses are often outstanding choices for protecting against fading, and also offer excellent year-round energy efficiency. Yet, these options may be overlooked if only the UV transmittance level is considered.

Working with damage-weighted transmittance—which provides a look at the overall solar radiation protection provided by a given glass configuration—window manufacturers can help architects, builders and homeowners make an informed choice that will protect fabrics, furniture and other interior design elements, while also meeting the entire spectrum of their clients' performance needs.