

Fighting Fade: How Long Will Color Last?

Understanding color fade of different inks.



By Chuck Schonert,
Director of Research and
Development, Idealliance

The printing industry today uses a vast number of inks, pigments, and dyes, all of which have their specific functions and purpose. But the life span of the printed piece and the need to retain vivid color — to keep it from fading over a certain time period — should be in direct correlation to its intended end use. The need to invest in a high-quality colorfast ink for a weekend sales ad wouldn't make sense economically, but more so for the reproduction of a piece of art that will hang on someone's wall that will span years. A protective ultraviolet (UV) coating will often be used, not only

to protect a printed piece from fading, but to create a surface that will resist handling and maintain its quality when being displayed or sent through the mail. Utilizing an additional coating will give some additional protection from the elements for outdoor usage and handling.

Using fade-resistant printing inks will normally hold color for up to three months of exposure to direct sunlight. In order to predict how well an ink will resist fading, there are two approaches. One is to submit samples to actual sunlight and monitor the color change, or fade, over a period of time. This could be



amanu purviti, Getty.

for days, weeks, months, or longer, and turn into a lengthy process. The other approach is to utilize a daylight simulator, known as a fadeometer, that simulates sunlight and can accelerate the analysis process by using high-powered lights. Ninety-six continuous hours of fadeometer testing is equal to roughly 24 days of direct sunlight, or nearly three months of exposure at eight hours per day. This type of equipment is

well accepted as an industry standard for its accuracy in testing the fading potential of inks on a given substrate.

Photodegradation and Its Causes

The action of color fading over a given amount of time is known as photodegradation. This effect is the direct result of a combination of UV exposure, type of medium, and the carrier it's printed on. Combining

these will contribute in varying amounts to how fast color will fade. It is basically a photochemical reaction. Photodegradation is the process in which photons from sunlight break down the molecules in pigments and dyes. This creates a physical change, which affects the way they reflect light. The human eye will interpret this change, which is usually most apparent in saturated colors, as seeing the image faded. Normally, this process — depending on the type of ink and coating being used — can be very subtle. Unless there is an identical copy that has been stored in a cool, dark place, in a condition that resists fading, and is placed side by side with the print that was subjected to exposure, one would never know the difference.

But out of all of these, the No. 1 culprit in colors fading over time is the UV (invisible) rays that bombard everyone every day. With printing produced for outdoor viewing, the biggest concern is the amount of direct sunlight that the printed piece will be exposed to. Since direct sunlight carries the highest amount of UV energy, the life of the original color will be based on the type of coating applied to it.

In the world of offset and web printing, conventional or UV inks are the most widely used. Conventional inks are solvent based and not as eco-friendly as UV inks. Because conventional inks rely on oxidation to dry, atmosphere becomes a consideration. The drying time of conventional inks can hamper production, such as in placing the paper on the press to print on the reverse side, or moving the job on to finishing. An aqueous coating, or another coating of choice, is usually put down last for production purposes to reduce drying time.

UV offset inks depend on UV lamps to cure the inks. This ensures the sheet comes off the press completely dry, whether using additional coatings or not. UV inks are the best choice for retaining color over longer periods of time, and though they are water resistant, they are



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not waterproof. This makes them a great choice for outdoor signage and handling, and reducing the chance of a significant change in colors fading.

Evaluating Coating Options

The following outlines the types of common coatings used in printing.

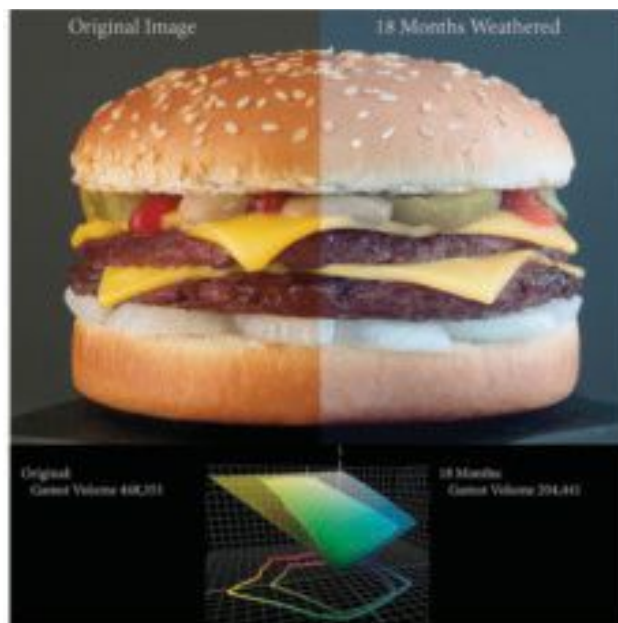
Varnish Coating

Varnish is a widely used print coating because of its low cost and variety of uses. Varnish coating can be a spot treatment applied to only certain elements of the project, or can be an all-over coating, or flood coating. It also comes in different varieties:

gloss, matte, and satin. Although varnish is a great option for its price, it does have its drawbacks. This coating is less protective than other print coating types, and tends to yellow over time.

Aqueous Coating

If the name isn’t obvious, aqueous coating is a water-based variety that is most common in today’s industry. This type of print coating has protective sealants preventing smudges and fingerprints from showing on a printed piece. Aqueous coatings are typically glossy, but also come in matte formulations. Aqueous coating dries faster than varnish coatings, enabling a quicker turnaround at the printer. They are also excellent for



This series of images highlights the effects of long-term fade. The image at the top right shows the original graphic, while the bottom right image shows the graphic after 18 months. The image at the top left compares the two graphics side-by-side to showcase the difference between the two.

Courtesy of Nazdar Companies.

Get G7 Certified

G7 is Idealliance’s industry-leading set of specifications for achieving gray balance, and is the driving force for achieving visual similarity across all print processes. For more information on G7 and upcoming Idealliance standards trainings, visit idealliance.org.



These photos depict a graphic's fading process, with the right half having been exposed. Below is the original graphic, while the remaining images from top to bottom show how it appears after one month, a year, 18 months, and then two years.

rub resistance and determining the downstream functionality through a specified coefficient of friction.

UV Coatings

UV coatings are liquid based and cured by UV lamps. This coating type dries instantly with high gloss and a hard finish. Print service providers can choose to have a flooded coating or spot cover with raised effects, which are a possibility when using UV coating. Added perks of UV coating include it being chemical and abrasion resistant, and also solvent free. When using UV coating, there are a few requirements and specifications. The inks used on the piece also need to be UV, should have no micro crystalline wax, and must be heat- and chemical-resistant to prevent discoloration and bleeding. UV coatings come in many varieties, including high gloss, matte, and satin, along with other specialty finishes like orange peel and pearlescent.

Laminate Coating

Laminate coatings are unique in that they come in two different types: film-based and water-based. Both are strong finishes, but liquid lamination is less expensive. Film laminate coatings are slow to apply, making them a more costly option. They also don't support

spot treatment; the coating is applied across the entire piece. But film laminate does have its perks in that this coating protects the piece from water, and has a strong, washable finish with high gloss. It won't yellow or flake over time, and is scratch-resistant. Like the other print coatings, laminates come in a number of varieties, including gloss, satin, and matte, along with a variety of tints, texture, and even lenticular.

Pigment and Dye Inks

These inks are very different in their physical makeup, even though their uses are fairly similar. Dye-based inks are water soluble, which makes them a poor choice for outdoor signage. Colors also seem to fade more quickly with this type of ink. The main benefit of this type of ink is that it is usually much more economical, and provides a wider color gamut. Pigmented inks, on the other hand, are more resistant to water and fading. But with this comes a smaller color gamut and higher cost. Although there have been great strides ▶



improving both dye and pigmented inks, the substrate being used will have a bearing on the longevity of the image. If archival printing is required, ink and substrate pairing can become critical. There are claims that these types of prints can resist any significant fading up to 100 years and beyond.

Latex Inks

These types of inks are generally used for outdoor applications. The materials they are usually printed on are made to resist the elements. Latex ink is dye based, but more environmentally friendly than solvent-based inks. It is claimed that the color, with a laminate, can resist fading up to five years. If displayed in an indoor environment, it could be up to 200 years!

With the maze of inks available in the printing industry, whichever ink and coating is used for whatever the end purpose may be, there is one strong consideration. By utilizing color management with ICC profiles combined with G7 methodology, prints made from both pigment and dye inks will have a similar visual appearance on whatever output platform is chosen.

A Deeper Dive into Pigments

Providing some additional context is Sumathy Ganesh, technical manager/R&D chemist, Toyo Inks. “Cyan and black are already considered permanent ink,” she shares. “Yellow and magenta are the main concern, along with the blending pigments to make reds, purples, violets, greens, browns, and some blues. (Reflex, for example, will lose its red cast if it fades.)” According to Ganesh, these pigments will show fading in a fadeometer test in as quickly as 20 hours versus hundreds of hours for black and cyan pigments.

“We feel an informative angle discusses the end use of a printed product since it can dictate one of many fade-resistant pigments,” says Ganesh. Starting with magenta, the standard pigment used in many inks has excellent strength and a pleasing color, however, this same pigment has poor fade, water resistance, and chemical-resistance properties. “We offer some choices for a replacement pigment depending on

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the end use,” she adds. “When we ask what the end user is trying to achieve while requesting “lightfast” inks, we are almost always confronted with crickets. Many simply don’t know what questions to ask.”

Ganesh breaks it down starting with the two main magenta fade-resistant pigment offerings:

Red Pigment A

- High fade resistance (300-400-hour fadeometer test results)
- Poor water and chemical resistance

Red Pigment B

- High fade resistance (200-300-hour fadeometer test results)
- Moisture resistance
- Chemical resistance, which is very important for cosmetic, pharmaceutical, and chemical packaging

According to Ganesh, yellow pigments are similar in that there are several to choose from depending on end use. Knowing that they need to be fade resistant to begin with is even more critical than the reds. They have the least fade-resistant properties and the susceptibility of sublimation (gassing). The standard yellow pigments do offer some moisture and chemical resistance. Here are the characteristics of three fade-resistant yellow offerings:

Yellow Pigment A

- Improved fade resistance
- Improved chemical resistance
- Improved moisture resistance, but not when combined with heat

Yellow Pigment B

- Even better fade resistance
- Worse chemical resistance than standard yellow pigments

Yellow Pigment C

- Excellent fade resistance

- Excellent moisture resistance
- Excellent chemical resistance
- Very high demand across all types of printing, both offset and digital

The downsides of these pigments must be taken into consideration, says Ganesh, who shares some generalizations for both the magenta and yellow pigments.

- They are more expensive, typically starting at 200% higher cost (double), to 300% for the higher end versions
- They are weaker; mileage will be reduced, and some coverage/density may be prohibitive
- They have slightly dirtier visual and spectral characteristics.

Keeping this information in mind, the first step when evaluating the longevity of the job is determining if the additional cost for fade-resistant inks and additional coating are actually needed for the color preservation of what’s being printed. Coatings are not only for protection of the ink and handling, but they also provide visual effects for design and functional purposes. Dye inks are water-based and color will fade before pigmented inks. But UV exposure will always be the main contributor to the fading of any ink. ■

Chuck Schonert creates content for educational and outreach platforms that serve the global marketplace, and is part of the Alliance’s team of worldwide experts and trainers. He guides development of best practices and standards domestically and globally through a community of working groups, industry groups, and ultimately ISO. With an extensive background in print production, print management, and color management, he also supports new print technology testing and development, training, and implementation. Schonert is a G7 expert and active member of Idealliance’s Print Properties Committee.