Application Note

Inks and supplies

Pigmented inks in inkjet printing

Pigments are one of two types of colorants commonly used in inkjet inks. The other types of colorant are dyes.

Why use a dye?

Dyes are more stable in an ink formula because they dissolve into the ink's solvent. Chemists select solvent and dye systems so that the dyes stay in solution over a long period of time and a range of conditions. An analogy is to think of dissolving sugar into a glass of water. Once the sugar is dissolved, the water looks clear and will remain clear over a long period of time.

Pigments are not as stable in an ink formula because they are dispersed instead of dissolved. Instead of sugar in water, consider stirring in a spoonful of fine sand into water. If the water is stirred well, it will have a consistent brown look to it. However, if left undisturbed the sand will settle to the bottom of the glass and separate from the water. Pigments will also settle out of an ink in the same manner. This leads to a loss of color in the printed ink and also the settled pigment will clog filters and nozzles in the printer. Printers specially designed to run pigmented inks overcome this by constantly agitating the ink which keeps the pigment dispersed and the ink consistent.

Why use a pigment?

Despite the challenges of running pigmented inks instead of dye-based inks, pigments provide unique performance properties to an ink that dyes cannot match.

Durability: Pigments have much better stability when exposed to high temperatures or to sunlight. A pigmented ink can survive several months when exposed to outdoor conditions including sunlight. A dye-based ink in the same conditions may only last a few days before the code begins to fade. Similarly, a dye-based ink will begin to fade after about 1 hour when exposed to temperatures over 300 C. Pigments can survive temperatures in excess of 600 C for several hours and some pigments can survive over 1000 C indefinitely.

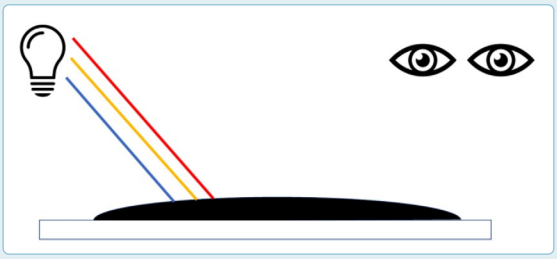
Transfer on plastics: Flexible plastics contain materials called plasticizers. They are used to keep the plastic flexible and can be thought of as a liquid within the solid plastic material. When exposed to heat or pressure, these plasticizers can come to the surface of the plastic and incorporate a portion of the dye in a printed code. If the plastic is stacked or rolled up, this will result in a mirror image of the code appearing on the plastic that is stacked on top of the printed code. This is seen when rolling up wire/cable or printing on the back side of a label roll and rolling it back up. It can also be seen on food packaging if it is stacked or rolled after printing. Since pigments do not dissolve into the plasticizer, they are not prone to the transfer issues seen with dye based inks.

Example of ink transfer on cable

Opacity of dyes versus pigments

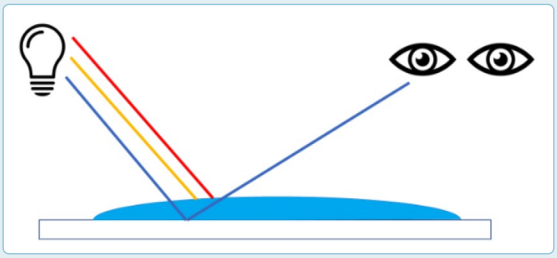
The most common reason to use a pigment is that it is opaque whereas a dye is transparent. The way we see color is that light bounces off a surface, which will absorb some of the wavelengths of light and reflect the rest of the wavelengths. A white surface reflects all of the wavelengths of light and a black surface absorbs all the wavelengths of light. When a drop of a dye-based ink is printed on top of the surface, the light will pass through the ink drop and bounce off the substrate surface. The color you see will be what is reflected after the ink AND the substrate have absorbed certain wavelengths.

If the ink is using a blue dye, for instance, the ink drop will absorb all the non-blue wavelengths allowing the blue wavelengths to pass through. If the drop is printed onto a white surface, the blue wavelengths will bounce off the surface and you will see a blue code. However, if the same blue drop is printed onto a black surface, the surface will absorb those blue wavelengths and you will not see the ink drop. Even though the ink color is different than the surface color, there will be no light reflected and you will not be able to see the code.



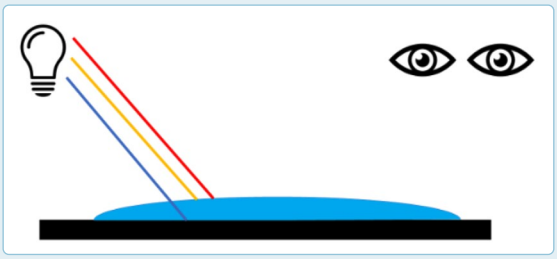
Black ink drop

The ink drop absorbs all the wavelengths, and nothing is reflected back to the viewer. The eye sees this as a black drop.



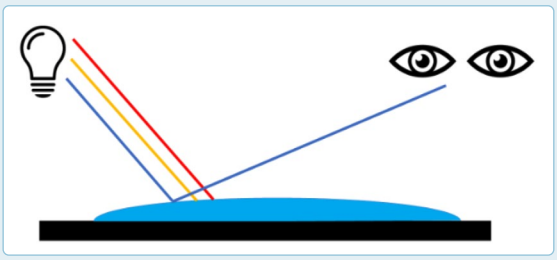
Blue ink drop on white substrate

The ink drop absorbs all the wavelengths except blue, which is reflected back to the viewer.



Blue ink drop on black substrate

The ink drop absorbs all the wavelengths except blue, but that wavelength is absorbed by the black substrate and nothing is reflected back to the viewer.



Opaque blue ink drop on black substrate

The ink drop reflects the blue wavelength back to the viewer. The light never reaches the black substrate to get absorbed.

To see the ink drop on a black substrate, the ink drop must be opaque. This means the light does not pass through the ink drop but reflects off the surface of the drop, and the color of the substrate plays no role in the light that is reflected. Pigments are opaque. The appearance of the code is affected only by the color of the pigment in the ink. Pigmented inks are the only effective way to print a visible code onto a black or very dark substrate.

The compromise – Soft Pigment

Dyes provide advantages for ink stability leading to better uptime, less maintenance, and simpler ink systems in the printer. Pigments provide performance advantages for durability, transfer resistance and opacity. A middle ground between pigment and dye is the soft pigment.

Pigments can be categorized as hard or soft. The difference related to performance is that hard pigments are more difficult to keep dispersed. The rate at which they settle out is much faster (1000 times or more) than soft pigmented inks. A soft pigment will still require some agitation to stay dispersed, but the intensity and frequency of the agitation is not nearly as much as a hard pigment. When used in a printer designed to run pigmented inks, uptime performance can increase by up to 50% with a soft pigmented ink compared to a hard pigmented ink.

Soft pigments do improve printer uptime and maintenance requirements, but in some applications a hard pigment is still needed. The main reason is that the only white pigments available are hard pigments. For customers requiring a white code, a hard pigment ink is the only option. White pigments are also brighter than soft pigments, so combining a white pigment with a soft color pigment can give a code that is brighter and with better contrast than using the soft color pigment by itself.

Also, in applications requiring extreme durability, hard pigments will outperform soft pigments. For instance, even though a soft pigment can resist fading to sunlight far longer than a dye, a hard pigment will last far longer than a soft pigment.

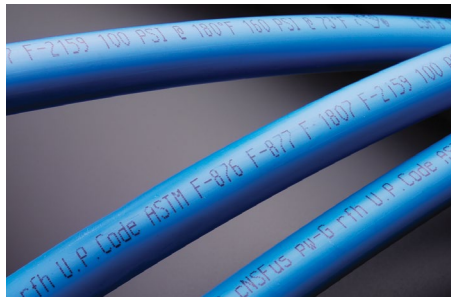
While hard pigments can outperform soft pigments, the uptime advantage of soft pigments means they should not be ruled out without sampling first. For instance, while a hard pigment ink may have better contrast on a black substrate, a soft pigment will still provide good contrast and be legible. In fact, for applications printing onto black and white substrates, a soft pigment provides much better contrast on the white substrate.

Videojet pigmented inks and printers

Videojet offers soft pigmented inks for the 1580C continuous inkjet (CIJ) printer and both hard and soft pigmented inks in the 1710 CIJ printer. When selecting an ink for a specific application, the soft pigment ink should be considered first to get the better uptime performance. Only when a soft pigment ink cannot meet the requirements of a specific application should a hard pigment be the ink of choice

1580C Inks			
Ink Number	**Color**	**Pigment Type**	**Primary Application**
V4225-E	Yellow	Soft	Plastic and metal
V4226-E	Yellow	Soft	Glass and condensation resistance
V4283-E	Yellow	Soft	Returnable glass bottles (caustic removable)
V4289-E	Black	Soft	Wire and cable (transfer resistance)

1710 Inks			
Ink Number	**Color**	**Pigment Type**	**Primary Application**
V480-C	White	Hard	Glass and condensation resistance
V482-C	Blue	Hard	Glass and condensation resistance
V485-C	White	Hard	Aerospace
V486-C	White	Hard	Plastic and metal
V488-C	Blue	Hard	Plastic and metal
V490-C	White	Hard	Plastic and metal
V493-C	Red	Hard	Wire, cable and plastic
V494-C	White	Hard	Plastic and metal



The Bottom Line

Videojet Technologies develops inks that are responsibly designed and manufactured to maximize contrast, adhesion, and uptime while meeting safety, environmental, and regulatory requirements. We offer a team of ink experts to assist and support manufactures with selection and implementation of inks that meet their packaging and regulatory needs.

For further assistance with ink selection, contact Videojet Fluids Support via phone at (65) 6444 4218 option #2, or email fluidssupport@videojet.com.

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