Anilox Roll, Doctor Blade, Ink Selection Guide

Are Your UV Inks Spitting?

Minimize by Selecting & Using Proper Doctor Blades

Bill Warner

UV inks are known for their remarkable printing characteristics that lead to better graphics and rich colors. Unfortunately, the same inks are also known for the problem that is commonly referred to as "spitting." Spitting is a condition where the UV ink will get past the doctor blade in an uncontrolled manner and ultimately be transferred to the printed web. The result is commonly seen in the form of lines or other odd shapes on the printed web; they can vary from just a few to too many to count (See *Image 1*).

So what are the causes of UV ink spitting? Many studies have been conducted over the years to try to determine the cause without a definitive answer. Fundamentally it is a characteristic specific to UV ink, as water and solvent based inks rarely exhibit the same spitting phenomenon. So what makes UV inks prone to spitting? There are two leading contributors:

UV inks are much more viscous than water based inks, typically five times or more. The higher viscosity puts more pressure on the doctor blade and can cause the blade to flutter or otherwise deflect and allow ink to get past the blade if it is not set or chosen correctly.

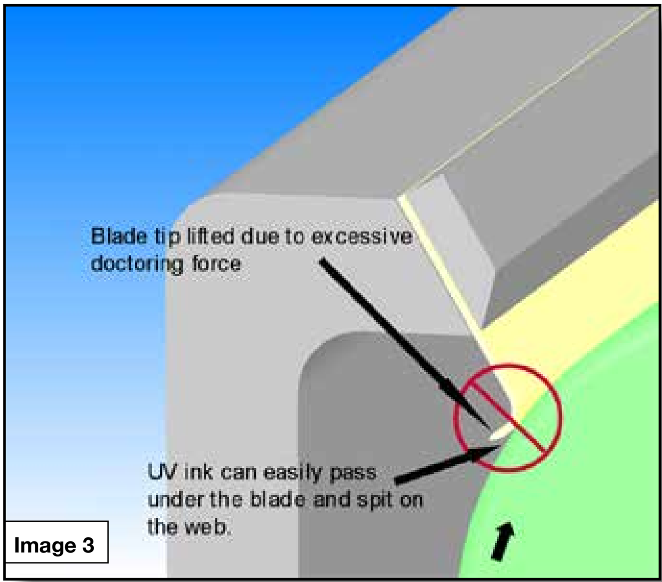

Image 3

The second contributor to UV ink spitting is the thixotropic nature of UV inks. The dictionary defines thixotropic as a fluid or gel "having a viscosity that decreases when stress is applied, as when stirred." The stress applied to the UV ink is a result of the shearing forces that occur when the ink comes in contact with the doctor blade. The drop in viscosity at the doctor blade/anilox roll interface can allow some ink to flow under the doctor blade. The shear forces on the ink are reduced when the ink moves past the doctor blade and the viscosity again increases, giving the ink the tendency to either spit or spray

> **Generally accepted doctor blade contact angles for flexographic printing will fall into the range of 25 degrees to 42 degrees with a desirable angle being near 30 degrees. Testing has shown that for UV inks, the contact angles should be at least 30 degrees or more to minimize UV spitting issues.**

away from the blade or accumulate on its back side. Any ink that collects on the back of the doctor blade will build up and eventually flow off of the blade and ultimately transfer to the web.

FQC UV INK DISCUSSION

The Flexo Quality Consortium (FQC) assembled a team of experts from various fields relevant to the flexo process to explore the problem of UV ink spitting. Their findings were assembled by Sean Teufler from Harper Graphic Solutions and published in the February 2012 issue of **FLEXO**® magazine. The findings of the FQC team were not conclusive, due to the unpredictable nature of the problem, but some interesting points were presented that are worthy of repeating.

The chart shown in *Image 2* was presented by Sean as a summary of various factors that contribute to spitting. The chart lists the various elements studied and an "up charge" value was assigned to each element. An up charge value greater than zero indicates a larger potential for the element to contribute to spitting and the larger the value, the greater the potential. The chart as presented shows the elements with the greatest potential to contribute to spitting in dark blue.

Let's examine the chart and interpret what it is indicating for some of the categories specifically related to the doctor blade. One of the elements considered is the operator, with two categories of "harsh" and "not harsh." It is not surprising that a harsh operator is more likely to cause problems. But what is meant by a "harsh operator"? One could expect a harsh operator would be someone who applies excess doctor blade pressure, has poor housekeeping and setup habits as related to doctor blade installation and blade to anilox alignment. In general, all of these practices are detrimental to doctor blade performance but are particularly troublesome for UV ink performance.

Another element compared the contribution of blade material to spitting issues. Trials indicated that typical carbon steel doctor blade materials were more likely to spit than the higher quality, long life tool steel material. Carbon steel doctor blades will wear faster than a tool steel blade. As the blade wears,

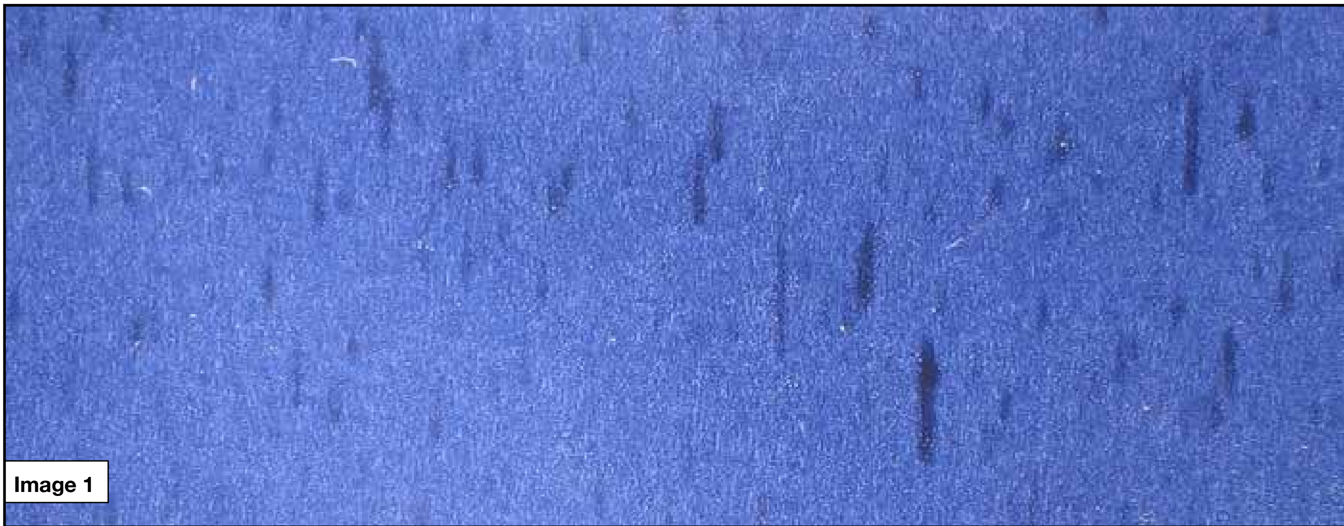

Image 1

the footprint—the area of steel in contact with the anilox roll—will increase, thereby increasing the potential for ink to get past the doctor blade. Although not indicated in the chart, the material tested was a long life tool steel with a laser hardened working edge. The extra hardness provided by the laser further reduces blade wear and helps to prevent the working edge of the blade from over deflecting.

The next element for comparison is the width of the blade. The blade width should be what the chamber OEM specifies, since running wider blades was shown to increase the likelihood of spitting issues. A wider blade will extend further in the chamber. It will also deflect more under load—due to more of the blade being unsupported—and contribute to the spitting problem. The data in the chart also suggests a beveled blade is less likely to contribute to spitting than a lamella blade.

Of the beveled blades, the sharper 15 degree bevel was preferred, followed by the longer 4 degree bevel angle. The lamella edge, by nature, has more difficulty dealing with high viscosities and higher blade loading pressures. The 15 degree bevel angle will provide a more firmly supported working tip for the doctor blade than either the 4 degree bevel or the lamella edge. The extra support provided by the 15 degree bevel will help to resist blade tip deflection and fluttering due to the higher viscosity.

CONTACT ANGLE & APPLICATION PRESSURE

Generally accepted doctor blade contact angles for flexographic printing will fall into the range of 25 degrees to 42 degrees with a desirable angle being near 30 degrees. Testing has shown that for UV inks, the contact angles should be at least 30 degrees or more to minimize UV spitting issues. The sharper contact angles will allow the doctor blade to cut through the film of ink and clean up the surface of the anilox roll, leaving the desired matte anilox surface appearance. Contact angles less than 30 degrees will tend to leave some surface ink on the anilox and contribute to the spitting problem. In extreme cases, a harsh operator will create a severely flat contact angle, due to excessive application pressure that can cause the tip of the doctor blade to lift off the anilox roll. The lifted tip will provide an easy path for the UV ink to get past the doctor blade (See *Image 3*).

In chamber and most single blade reverse angle applications, the blade angle is fixed by the geometry of the equipment. If a blade analysis indicates that your contact angles are less than desirable, they can generally be improved by applying less blade loading pressure. Contrary to the practices of a harsh operator, always run with the least amount of application pressure possible while still obtaining a clean wipe, indicated by a matte appearance on the anilox roll. If you can't lower your pressure, investigate and determine if something is preventing from operating at a lower pressure. Areas to look at would be:

- Improper end seals for the application
- Excessive ink flow rate
- Chamber or blade holder actuating mechanisms that need maintenance

Category	Option	Up Charge
Cell	800	0.0
Cell	500	1.2
Operator	Not Harsh	0.0
Operator	Harsh	1.0
Viscosity	Low (less than 800)	0.0
Viscosity	Medium (800-900)	0.4
Viscosity	High (1000-1200)	0.9
Viscosity	Very High (1920)	1.0
Blade Material	Tool Steel	0.0
Blade Material	Carbon Steel	0.5
Blade Width	28 or 30 mm	0.0
Blade Width	32 mm	0.4
Blade Tip	Standard 15 deg	0.0
Blade Tip	Lamella	0.4
Blade Tip	Long Bevel 4 Deg	0.2
Speed	150 fpm	0.0
Speed	300 fpm	0.3

Fig. 2 - Elements that influence UV ink spitting

Image 2

BLADE ALIGNMENT

Proper blade to anilox alignment is very important when using a chambered inker setup to minimize the amount of force needed to meter cleanly and maintain desired contact angles. Both blades should contact the anilox roll at the same time and evenly across the face of the anilox roll. If there is any misalignment in any axis, extra pressure will need to be applied to get the blades to seat properly and provide a good wipe. Extra pressure leads to flat contact angles that contribute to increased potential for spitting to occur.

BLADE THICKNESS

A general recommendation regarding the blade thickness is that you want to run the thinnest blade possible while still being able to achieve the desired wipe quality. For typical flexo water and solvent based inks, a blade thickness of 0.006-in. or 0.008-in. is effective in most applications. When coatings or adhesives are being applied, a thicker blade is generally used to withstand the increased hydraulic forces applied to the doctor blade by the more viscous fluids. The same practice applies to UV inks. Blades that are 0.008-in., 0.010-in., or 0.012-in. thick are commonly used with UV inks with great success. Even though the base of the blade material is thicker, you still need a thin working edge to successfully doctor the UV ink. An initial working edge between 0.002-in. and 0.003-in. thick is needed to minimize spitting issues and is readily available with the 15 degree or long beveled blade.

UV ink spitting is a common issue that can be successfully managed by following good operating and housekeeping practices. To minimize the potential for UV ink spitting, use a long life, tool steel doctor blade with a laser hardened beveled profile and thin initial working tip. Of course, it shouldn't need to be said, but it is a common problem: Make sure the blade is installed correctly. The blade is always installed with the bevel facing away from the anilox roll. If you still have spitting issues with your normal blade thickness, a thicker blade should perform better. In general, work with your doctor blade, ink and anilox roll suppliers to determine the best overall solution for your application to minimize the potential for UV ink spitting. ■

About the Author: *Bill Warner is the vice president of Allison Systems Corporation and is responsible for all operating, manufacturing and engineering functions. Throughout his 26 year career with Allison, he has been involved in the application of doctor blades and doctor blade related components for various printing processes. Specific areas of experience include doctor blade sales, tech support, training and R&D as well as the design of custom retrofit doctor blade holders and systems. He has a BS in mechanical engineering from Drexel University. Bill can be reached at 856-461-9111 or wjwarner@allisonblades.com.*