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What Causes Ink Misting?



What causes Ink Misting? Before we determine the causes of Ink Misting, a bit of clarification is necessary. Misting is a term often wrongly applied to ANY material ejected from the press. It is not. The term ink misting should only be applied to the small particles or droplets of ink which have been ejected from the inking train. Such airborne material remains suspended for some time and thus may travel a considerable distance and be deposited some distance from the press. The ink mist particles are typically less than 15 to 20 microns and are barely discernible to the eye. Larger particles that are ejected and settle in the immediate vicinity of the press are referred to as sling.

This paper will investigate the factors and reasons for ink misting and describe the impact they have on overall misting. The factors we will review are the following:

- **Droplet Formation during Splitting**
- **Ink Formulation**
- **Printing Speed (Separation Velocity)**
- **Roller Size**
- **Temperature**
- **Ink Film Thickness**
- **Roller settings**
- **Ink Water Balance**

Droplet Formation during Splitting

So how do those little droplets of ink occur? As the ink transfers from roller to roller on the press, the ink film is split. What this means is that a percentage of the ink is transferred from one roller to the next. As this ink film exits the nip, the film of ink is split or pulled apart. As this splitting is occurring the ink forms filaments or strands. These filaments elongate to the point where they rupture or break. Figure 1 which follows depicts the process of the ink splitting between two rollers. As these filaments break, they may not break exactly in half. The filaments may split in several spots, which will form small droplets which can become airborne. It is these small airborne droplets which will deposit on the press guards or pressroom floor and build up to what we call ink misting.

Ink film splitting :

- ◇ **Compression**
- ◇ **Shearing**
- ◇ **Cavitation**
- ◇ **String formation**
- ◇ **Elongation**
- ◇ **Filament rupture**

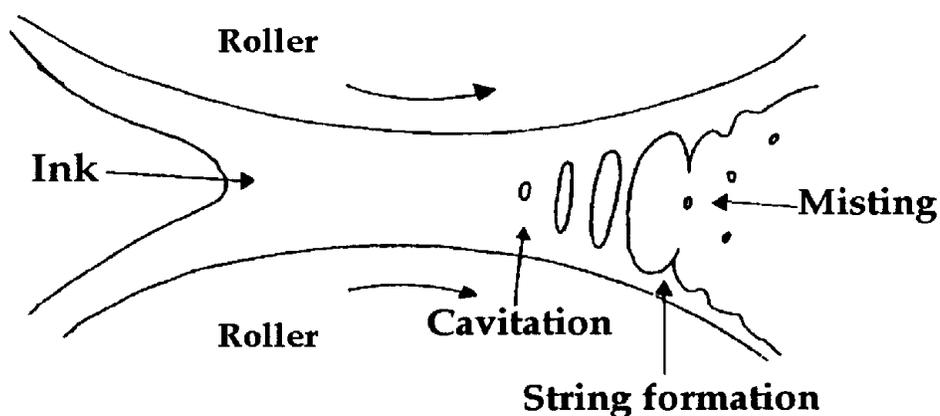


Figure 1

Ink Formulation

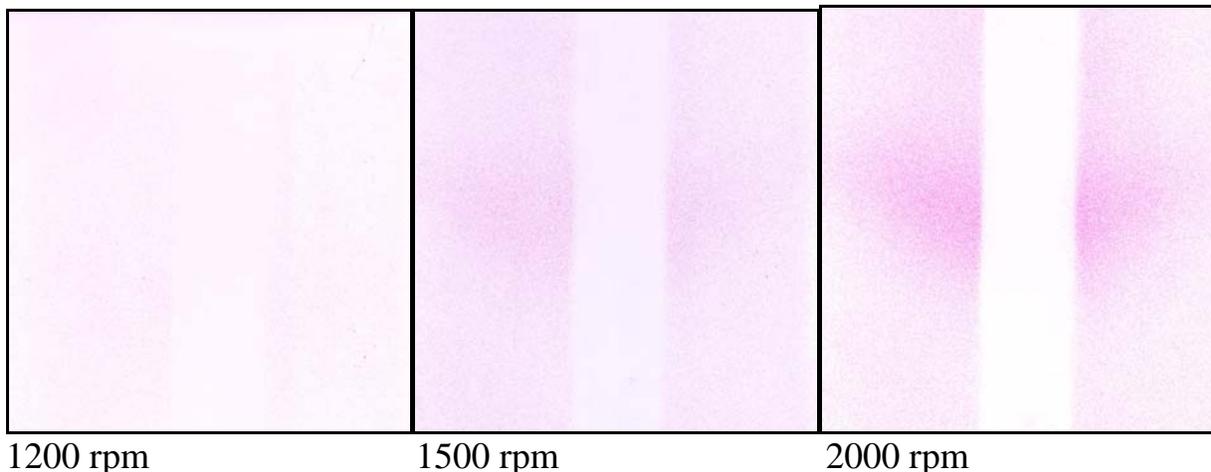
The ink formulation can have a major impact on the level of mist. A formulator will first look at the major components which are chemistry, body or rheology, and ink tack. Generally speaking, the higher the ink tack and viscosity, the lower the ink misting characteristics will be. These properties are determined by the requirements for the press type and/or inking system. For instance, inking systems that require the ink to be fluid or level out in the fountain will require longer flow inks. These types of formulations will mist more.

The ink tack is the force required to split the ink film, or basically how sticky the ink is. For the coldset market, we are printing on newsprint, so inks with higher tacks may have a greater tendency to pick or pull fibers. Therefore, a well rounded ink suited to the pressroom conditions will be the best to utilize.

Describing those factors and given a standard ink formulation, we have seen many instances where the level of mist will vary from pressroom to pressroom with similar ink and press conditions. The rest of this paper will study the impact of the variables that can be found in the pressroom.

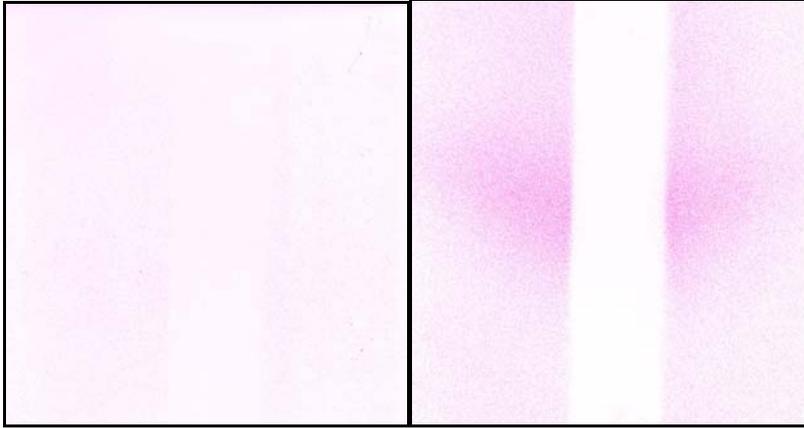
Press Speed

As we have discussed, the mist is created as the ink film splits. So it stands to reason, that as the press speed increases, the RPMs (Revolutions per Minute) of the rollers increases and thus the number of ink splits. The more times the ink splits the greater the mist creation.



The above images show the impact, under controlled conditions, of the level of misting that occurs during the same time period. One can easily see that as the RPMs increase so does the level of misting. One can look at the above example and may deduce that the higher RPM condition has more splits per unit time and that the lower RPM will create the same level of mist as the time normalizes.

Well, this is not so, the higher RPM roller will have a faster surface speed. As you see in the following example we compare two speeds for a similar number of revolutions and you can clearly see that the higher RPM condition still mists considerably more.



1200 rpm for 5 min. 2000 rpm for 3 min.
Both tests for 6000 revolutions

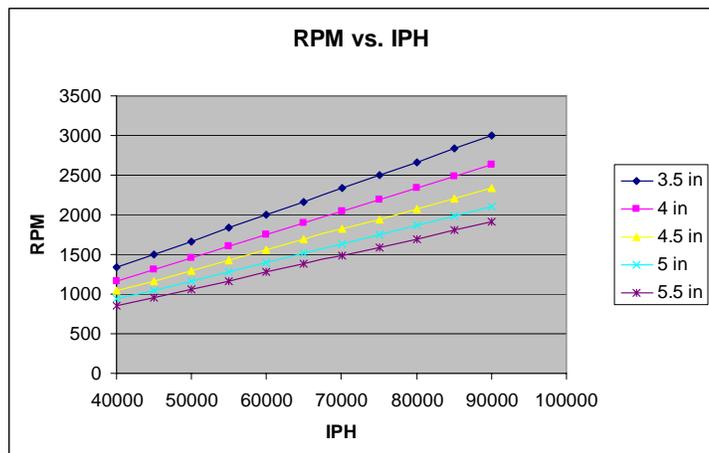
Rollers Size

The size of the roller will have a direct impact to the number of RPMs. In the table below, on the left side you can see the number of copies per hour or press speed in feet per minute. On the right side, depending on the diameter of the roller, the different RPMs needed to keep up with the press speed.

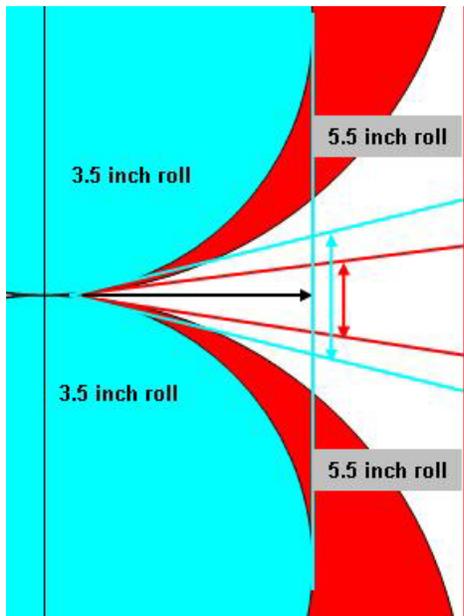
Copies per Hour	Feet per Min	Roller Diameter (inches)				
		3.5	4	4.5	5	5.5
		RPM				
40000	1222	1335	1168	1038	934	849
50000	1528	1668	1460	1297	1168	1062
60000	1833	2002	1752	1557	1401	1274
70000	2139	2335	2044	1816	1635	1486
80000	2444	2669	2335	2076	1868	1699
90000	2750	3003	2627	2335	2102	1911

The same concept can be shown in the graphic format:

Presses running the same printing speed with smaller rollers will have a greater RPM on these rollers. For instance, a press with 4 inch rollers running at 60000 IPH,



would have the same RPM as a press with 5 inch rollers running at 75,000 IPH. The smaller rollers then will yield more misting at similar press speeds.

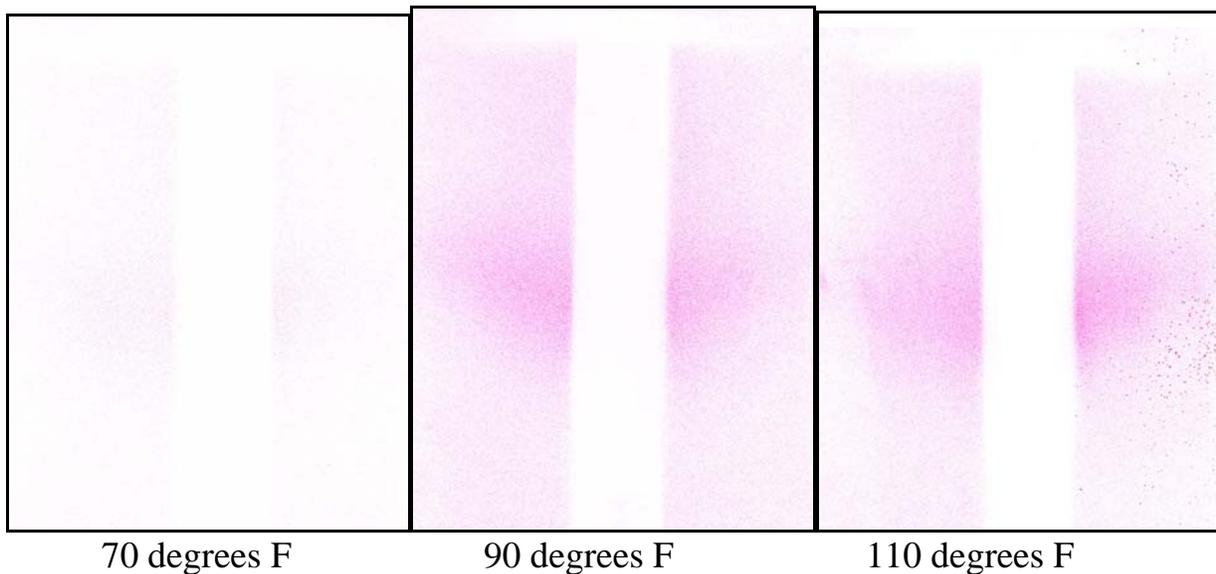


Another important factor to understand is that with smaller rollers the exit nip has a greater angle and shorter depth of the film splitting area. Figure 2 shows the roller splitting differences between a 3.5 inch and a 5.5 inch set of rollers. One can clearly see that the angle exiting the nip of the smaller rollers is greater than the larger rollers.

Figure 2

Temperature

Temperature has long been known as having a great impact on printing conditions. Some of the new high speed presses being sold today are being equipped with water cooling to try and maintain a lower roller train temperature.



As you can see from the previous page images, as the temperature is increased the level of misting over the same period of time is dramatically increased.

So the proper control of the ink train is critical to controlling the misting level in the pressroom. For more information on the effects of temperature see Technical Bulletin Volume XXXIII.

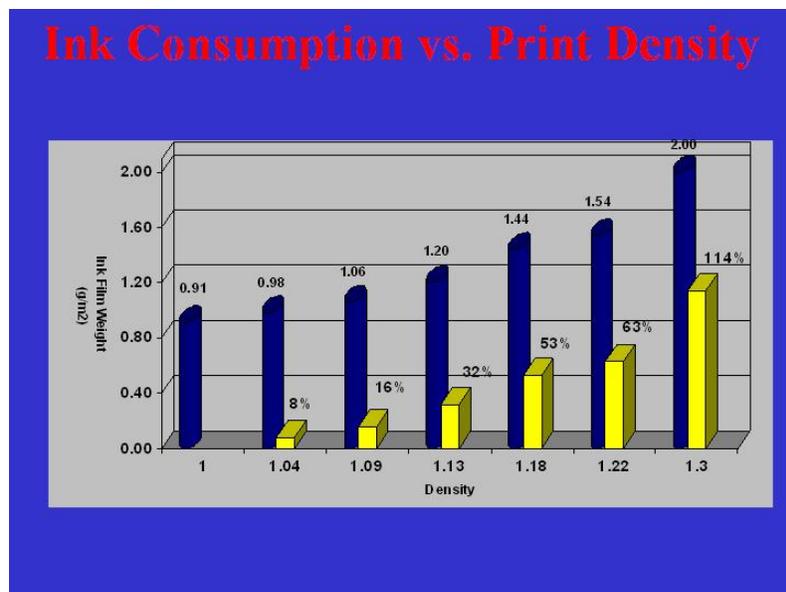
Ink Film Thickness

The level or thickness of an ink film is another critical area to control when looking at misting in the pressroom. Generally as you carry a thicker ink film on the roller train, the level of mist generated will be greater.

There are two factors to look at when controlling the ink film thickness on press:

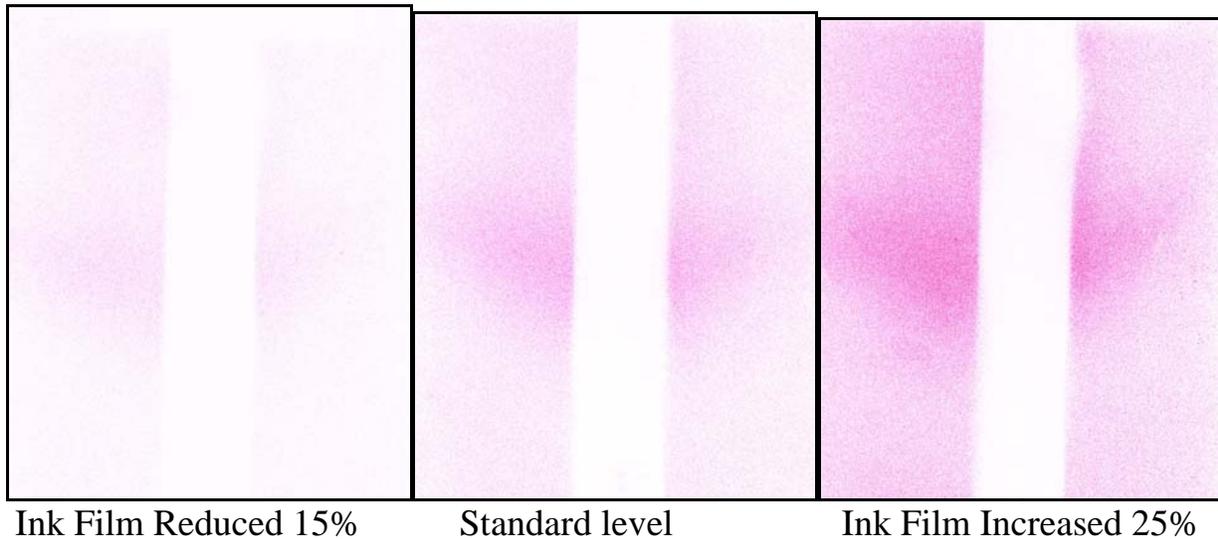
1. Proper density control

The use of a densitometer is an important factor to controlling the level of ink on the printed sheet. In the chart below you can see that as you raise the density from 1.0 to 1.3, this would correspond to a 30% change in density. However over a 100% increase in ink film would be required to achieve this on press. This is because density is a logarithmic function. For a more detailed explanation of this see Technical Bulletin Volume IX.



2. Pigment Strength

The material in an ink that will give you the optical properties on paper is the pigment used in the ink formation. So the level of pigment within a given ink formulation will directly impact the ink film thickness required on the roller train to achieve standard densities.



So from the above images, one can clearly see that the level of misting is greatly influenced by the ink film carried on the rollers.

Roller Settings

The setting of rollers on press is critical to how the ink transfers up the roller train. The key items to control here are:

- Roller Stripe
- Roller Hardness
- Roller glazing

To read more about these see the technical bulletin on Press Maintenance Volume XVII.

Ink and Water Balance

Ink and Water Balance has always been one of the most critical steps to proper lithography. As the Ink and Water levels are increased on press the ink film will increase. Thus, “LESS is BEST”. We have already described earlier how this will impact the level of misting created on press. For more information on Ink and Water Balance, please see Technical Bulletin Volume X.

Summary

What we have described here are the many factors that can influence misting in the pressroom. There is not an ink or press that does not create ink mist. If one wants to control misting, all of these items must be properly controlled.