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The Effect of Temperature On Printing Performance

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As discussed in "An Introductory Guide to Rheology" (June 1995), Viscosity is one of the most important properties of a printing ink. This previous writing provided a basic understanding of Viscosity as the measure of a fluid's resistance to flow. When an ink chemist formulates a new ink, selecting the proper viscosity for a specific situation is one of his first considerations. The viscosity range chosen is based on a combination of factors such as the press inking system, (injector or open fountain), press speed, and ink delivery (bulk handling or pumped from containers). The formulating chemist also sets viscosity specifications at a temperature that is within the normal operating range of most web offset printing presses. However, since viscosity is dependent on temperature, it is important to recognize that a large fluctuation in temperature can change viscosity and ultimately the ink performance. **Figure 1** predicts the viscosity of a typical Web Offset Injector Ink over a range of temperatures. As you can see, viscosity decreases markedly as temperature increases. Therefore, the viscosity at temperature extremes can be significantly different from the range chosen during the formulation stage. The tack of an ink will also have a decrease as the temperature increases. The following will discuss the effect of temperature on ink performance.

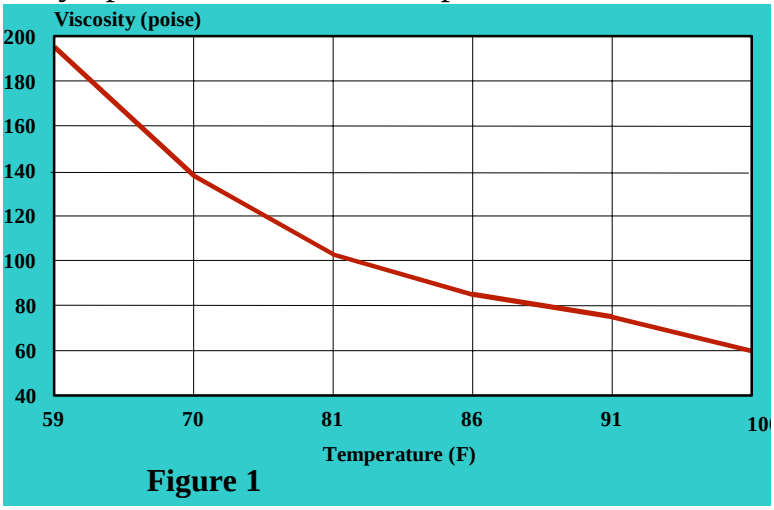

Figure 1

Printing with ink that is at a temperature lower than intended can lead to several different problems. First, delivery from a bulk handling system can become difficult as viscosity increases at lower temperatures. The pumps required to deliver ink within the system are rated for a specific viscosity. A significant increase in viscosity will restrict ink flow and can result in print density fluctuation or starvation because the correct volume of ink can no longer be delivered to press.

Print quality can also suffer as viscosity increases significantly. Ink transfer through the roller train can be impeded resulting in inconsistent or mottled print as seen in **Figure 2.** This effect will be magnified in large printed solids that cover the width of the entire page. An increase in viscosity may also contribute to excessive linting, especially on newsprint that has many loose fibers on the printing surface.

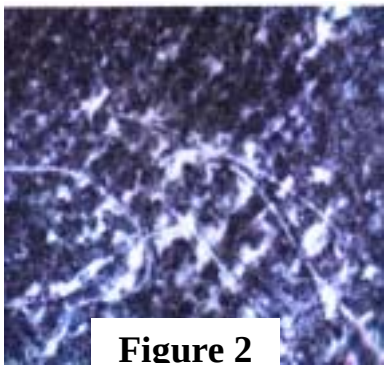

Figure 2

As seen in **Figure 3** an ink with significantly higher viscosity than intended, can contribute to fiber build-up on the plates and blankets resulting in poor print quality. High viscosity ink may also lead to problems with runnability. A dramatic increase in viscosity can inhibit ink penetration into the newsprint causing ink and fiber build-up on turning bars and former boards throughout the press.

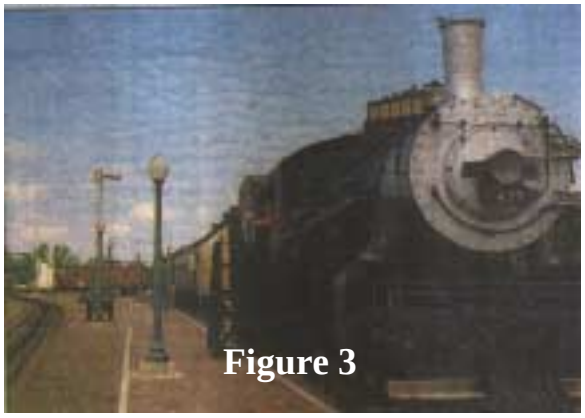

Figure 3

Ink with a low viscosity due to an extremely high temperature can contribute to a separate set of problems. One of the most important relationships within the lithographic process is the compatibility of ink and fountain solution. This relationship is considered by the ink chemist during the formulation stage. Extensive laboratory testing is performed to ensure that proper emulsification occurs between ink and the current fountain solution. If ink viscosity is decreased due to dramatically high temperature, over emulsification can occur. Generally, as ink viscosity is decreased an increase in emulsification rate will result. The increase in temperature will cause the fountain solution's conductivity to increase slightly. This increase in conductivity will also increase the emulsification on press. These changes could radically affect the ink and water balance on press.

There are many problems associated with over emulsification. Inconsistent solids, excessive dot gain and interpage setoff may occur as a result of over emulsification. If an excessive amount of water is emulsified into the ink film, dot spread in the halftones will result in loss of shadow detail and print contrast. In addition, over emulsification inhibits ink absorption into the newsprint contributing to page to page setoff.

A common problem in many pressrooms is ink dripping, misting, or spitting. The ink viscosity can be a factor in this. If the temperature varies in the pressroom, these characteristics will also vary from day to day. In many pressrooms where there is no temperature control, ink manufacturers have gone to so-called "winter or summer" formulations. What the ink manufacturer is doing is to increase the viscosity in the summer, so that due to the higher temperatures in the pressroom, the ink dripping or misting will be reduced. Conversely, when the cooler temperatures of the winter months return, the heavier viscosity summer formulations will be too heavy for the press conditions. The ink will tend to back away in the fountain and will be slower to penetrate into the stock. This will result in greater pipe roller build-up and inter-page setoff.

The temperature of the ink roller train is a critical measurement. The roller temperature can be measured simply and easily with a pyrometer. This can be a useful tool in diagnosing press problems. If the rollers are too hard or set too tightly, this will increase the friction on a unit. The result would be an increase in the temperature of the train.

The fountain solution is used on press for keeping the non-image area clean, but also plays another important role on press. As a press is running, fountain solution backs its way into the ink roller train due to emulsification. The fountain solution acts as a coolant in the process by evaporation. The evaporation of the fountain solution results in a heat loss on press thus cooling the roller train. The impact of not using a fountain solution can be seen on waterless presses. On these presses there is no fountain solution used and special plates are used. The ink train temperature is critical in maintaining good printability. The rollers in the press must be cooled to make the process work, if not the plate would start to print in the non-image area. Therefore the temperature of the fountain solution is critical in maintaining good printability on offset presses. It has been shown that cooling the fountain solution and maintaining a constant temperature help to maintain constant good printing.

Another often-overlooked factor is the delivery cycle of ink. The modern ink manufacturer produces ink in large volume. Batch size generally reaches 18,000 pounds and is transported via truck in 50,000 pound quantities. It is common

practice to maintain an elevated temperature of the printing ink while in the tank truck. Increased temperature reduces viscosity and shortens the time required to transfer the ink to the bulk storage tanks present at large metropolitan newspapers. For blacks in particular, temperatures can exceed 120°F. Therefore, a fresh batch of ink should be allowed to undergo a cooling process for a reasonable amount of time before printing. This aging process will help avert the problems attributed to high temperature.

All of these factors show that temperature control is an important step in providing consistency in the pressroom. If temperature control is not available, you must work with your supplier to maximize the performance of the product.