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Considerations for Printing Direct Thermal Papers Using Offset Lithography

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Press Blanket Characteristics

The following characteristics should be considered when selecting a press blanket to be used on direct thermal papers.

Solvent Resistance – It has been proven that many blankets swell when in contact with certain solvents. These solvents include blanket and press washes, and some alcohols. Correct application of washes and a water wash of the blanket will minimize any harmful solvent interactions. Some solvents that should be avoided when printing on direct thermal papers include alcohols, ethers, cleaning fluids, gasoline, benzenes, ketones and esters. Another source of solvents that can adversely affect Direct Thermal images is from carbonless papers. It is recommended if the blanket has been used to print carbonless paper, that it be changed to a new one before printing Direct Thermal papers.

Surface Characteristics – Blankets that have a buffed or ground surface will release from the coated paper more efficiently thereby reducing coating damage.

Sticky Back Adhesive Quality – Dimensional stability of the blanket on press and its subsequent release from the cylinder are important characteristics for a sticky back blanket. It has been found that fabric back blankets are more stable than paper back blankets while on press since the fabric backs are less affected (distortion) by the fluids used in the printing process. It should be noted that some fabric back blankets do have fiber reinforcement to increase stability. Adhesive release is blanket specific and a matter of productivity. Cleaning the cylinder of undesired adhesive can be very time consuming. Choose a blanket with good cylinder release characteristics. The use of a sticky back blanket when printing direct thermal papers should not affect either the paper or the blanket characteristics.

Packing for Reel-to-Reel Blankets – It is important to have the proper blanket packing while printing direct thermal papers. Overpacking the blanket may lead to excessive pressure at the nip and may lead to increased plate wear.

Ink Characteristics

Choosing the correct ink when printing on direct thermal papers is critical to ensure successful imaging with the thermal printhead. The following characteristics are universal to all inks, however many ink manufacturers have “thermal” inks, specifically designed to be compatible with direct thermal chemistry and direct thermal printers.

Ink type –Specify only “direct thermal inks” to your ink supplier.

Pigment Selection - It is desirable to have an ink that carries a high pigment load. This will reduce the amount of ink required to achieve target density. If too much ink is required to reach density there is a risk of ink drying problems on the press and a reduction of the imaging potential of the thermal paper. This is because the ink film will reduce the amount of heat that reaches the direct thermal coating. Inks used to print direct thermal papers must not contain abrasive pigments. Abrasive pigments will damage the thermal printhead. In general, black inks have been seen to be more abrasive than other colors. Best Practice would be to minimize the amount of black ink printed on the Direct Thermal side of the paper.

Temperature Resistance – Direct thermal papers are designed to image using a direct application of heat. If the ink being used does not have a high melting point, it will not endure the heat generated from the printhead. If the ink film softens or melts it will potentially damage the thermal printhead. It is recommended that the inks are able to withstand 300°F and higher.

Special care should be taken when using UV-drying inks. These inks develop the high melting point through the UV-curing process. Simple ink tackiness tests for cure do not always give a good indication of the ink cure state below the surface film. Care should be taken to ensure these inks are fully cured.



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Excessive UV energy can cause some development of the direct thermal coating under the ink due to the heat absorbed by the ink for curing. This will affect the ink color giving it a darker shade.

Chemical Compatibility – All inks should be tested for compatibility with the direct thermal coating chemistry. Inks (or solvents) that are not compatible may negatively affect the thermal imaging capability of the paper. A condition called “gas ghosting” occurs when incompatible ink comes in contact with the direct thermal coating in the roll. A “ghost” image of the printed ink film appears in the thermal image area. This can be due to an ink printed on the back side of the thermal paper that comes into contact with the thermal side when run roll to roll. A similar problem is also seen when an incompatible ink is printed on the direct thermal side of the paper.

In addition, inks may contain materials such as plasticizers that will de-sensitize the imaging chemistry. During storage of the printed product these materials could migrate to the thermal layer and de-sensitize the coatings, reducing its imaging potential.

Ink Tack – The tack of the ink should remain at a level that will not disturb the direct thermal coating and still maintain image clarity. It is recommended that the tack of the ink should be no higher than 7 and remain stable on an inkometer for over seven minutes at 1200 rpm.

Viscosity – Tack and viscosity are not always related. The viscosity of the ink should be at a level that ensures ink/water balance. When the ink and fountain solution viscosity become similar, ink/fountain balance problems will occur. Heat builds up while a press is running. This heat may decrease the viscosity of the ink, bringing it closer to that of the fountain solution. Ink and fountain solution balance may be affected. If this is the case, contact your ink manufacturer. (Also refer to the fountain solution section that discusses chilling.)

Emulsification Properties – An emulsion is formed when one liquid holds another liquid in suspension. In this case, the ink must be able to suspend tiny droplets of fountain solution. This is sometimes referred to as “water pick-up.” This property will influence effective tack on the press and may cause picking problems. If problems occur, refer to the ink manufacturer for assistance.

Ink Volume – It is recommended that the amount of ink applied to direct thermal papers be kept to a minimum. Full ink coverage or heavy ink film thickness should be avoided to reduce potential drying issues.

Drying – There are several drying mechanisms used in printing inks. They are:

Absorption – the ink penetrates into the substrate

Oxidation – oxygen in the atmosphere chemically converts the liquid resin into a solid

Chemical – various chemicals can be added to the ink to convert liquid resin into a solid

Radiation – includes UV, infrared, electron beam, microwave, and radio frequency.

Regardless of which ink system is used, it is important that the ink dries quickly. Ink that is not dry may result in tracking, piling and ink build-up on press rollers. It may also result in offsetting and blocking while in the roll. Generally direct thermal coatings will not absorb large amounts of ink solvent. Therefore, inks that dry only by absorption are undesirable. Contact your ink supplier to obtain an ink that is specifically designed to work with direct thermal coatings, preferably those that dry by oxidation or chemical reaction. Non-Topcoated Direct Thermal papers have a very minimal ink absorption. Topcoated Direct Thermal papers have no ink absorption. The preferred drying method for Wet Offset printing of the thermal coating is UV.

Fountain Solution Characteristics

The following guidelines for fountain solution selection and performance have been found to improve press performance.

pH – Correct maintenance of the pH is critical for press performance and printability. Most fountain solutions now contain pH buffers to help stabilize pH over the press run. The buffers will react with any acidic or alkaline influences and keep the pH level consistent. Most fountain solutions perform at a pH of 4.0 – 5.0. Changes in pH can cause the following problems:

Too acidic:

Toning/scumming



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Retard ink drying
Emulsification of ink
Roller stripping
Excessive plate wear
Plate blinding
Ink color change due to pigment and fountain interaction

Too alkaline:

Excessive plate wear
Toning

Conductivity – Conductivity, or the amount of available ions present in the solution, will vary based on the water source, inks, fountain solution, and substrate being printed. Once the optimum pH and conductivity levels are determined, it is imperative that these are maintained throughout the press run. If coating is, unintentionally, removed from the paper and enters the water train, changes in conductivity may occur. Conductivity should be monitored every few hours to ensure that it remains in the desired range. It is also recommended that distilled or de-ionized water be used to reduce initial contaminants in the solution.

Surfactants – Many surfactants are used in fountain solutions to adjust the surface tension of the fluid to make it “wetter”. One of the most important of these has been IPA (isopropyl alcohol). IPA has been used to reduce surface tension so it will spread quickly and also increase viscosity for a thicker film on the plate. IPA evaporates quickly making the operating window of the system fairly large, or forgiving, to equipment problems or operator skill. IPA has long been a target for reduction in the pressroom due to health concerns.

Direct thermal chemistry is sensitive to the affects of alcohols, therefore the use of IPA is not recommended. Alcohol substitutes are becoming standard among printers. Alcohol substitutes include chemicals from the glycol and glycol-ether families. Addition of these chemicals reduces the fluid’s surface tension but does not affect the viscosity. Reduction in viscosity will change the feed rate of the fluid to the metering roll. Operator skill is required to work with this change to determine optimum feed. In addition, less alcohol substitute is needed compared to IPA. This means that the fountain solution is virtually all water (98%). This high level of water makes conductivity very important in maintaining the press “operating window”. Monitor any changes in conductivity to maintain an effective system. Consult your fountain solution supplier to ensure chemicals such as alcohols, ethers, benzenes, ketones and esters are either avoided or kept to a minimum.

Natural or Synthetic Gum Arabic – Affinity of fountain solution to the non-image areas of the plate is achieved using gum arabic, a hydrophilic colloid, activated with acid. It is also found in fountain solutions and is used to replenish the plate coating in response to wear. Also, if the fountain solution pH increases to approximately 5.5, gum arabic becomes inactive. Gum arabic is also a target for substitution in the solution due to supply issues. If the fountain solution contains a synthetic gum arabic, be aware that the operating window may again be altered. Operator skill will be needed to assure proper parameters are met when the fountain solution concentration and composition changes when a gum arabic substitute is employed.

Temperature – The use of IPA substitutes affects viscosity as stated above. One way to offset this reduction in viscosity is to chill the fountain solution. This will affect the feed rate into the system. Good control of chilling (50°F - 60°F) is required. If the fountain solution is chilled too far, picking, piling and an increase in ink tack may occur.

Printing Plate Characteristics

The majority of printers utilize aluminum printing plates. These plate surfaces are typically anionic (4.0 – 5.0 pH) and operate at their optimum with a low pH fountain solution. The following considerations should be noted for proper plate performance when printing the thermal coated side:

pH – the importance of pH control in lithographic printing is critical for plate performance. It is important to monitor pH and conductivity throughout the press run (see fountain solution guidelines for additional information on this subject). Any changes in pH may lead to picking, sensitivity of the anodized layer, ink drying, and scumming problems.

Anodized Layer – The plate surface is anodized with a layer of aluminum oxide. This layer helps to protect the plate



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from corrosion. The thickness of this layer will vary due to cost considerations. Corrosion of the layer will result in sensitivity leading to scumming or toning.

Exposure and Development – Performance will be affected if the exposure and development of the plate does not meet manufacturer's guidelines. Although the paper does not come in direct contact with the plate, any debris that is lifted off onto the blanket can reach the plate surface. If the plate is not developed correctly, the debris may act like sandpaper on the surface causing premature wear and sensitivity. Picking may also occur if the plate is not fully developed. Most manufacturers recommend exposure/development to 3-4 on the gray scale, achievable when using fresh chemistry and a well-maintained exposure unit. It is important to keep track of the square inches of plate surface that are developed with each batch of chemistry. Fresh chemistry will aid in accurate plate development.

Harmful Chemistry – The following will negatively affect plate performance:

Alkaline press washes – if alkaline press washes are not thoroughly rinsed from the plate, picking may occur.

Abrasive ink – metallics

Plate blinding may occur when the fountain solution or solvents contain components that become deposited in the non-image area (acid/alkaline, gum, etc.).

Pressure Related Problems – Excessive pressure (including ink rollers to plate) will cause premature plate wear. Mismatched packing will also create different surface speeds of the cylinders causing abrasion. Try to avoid these situations by following the press manufacturer's recommendations on press set-up and maintenance.