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THE COLOR OF LEADERSHIP
SHEETFED | HEATSET | FLEXO

TECHNICAL BULLETIN #1

Coated Paper vs Uncoated Paper
Ink/Paper Interactions in Drying

The mechanisms by which ink sets and dries on coated enamel as opposed to an uncoated sheet are very different; however the reasons behind the differences are not as obvious as may first appear.

In order to come to a better understanding of the dissimilarity of the stages of ink drying on the two types of paper, it is necessary to have a basic understanding of what makes a "quickset" ink quickset. It is the constituents of the varnish that ultimately give an ink its setting and drying characteristics, so a quick lesson in varnish construction will help.

The "typical" quick set varnish will have the following basic constituents which are blended in varying proportions to yield the desired properties:

Hard Resin — Modified Rosin Ester
Soluble mainly in drying oils

Drying oil — Linseed, Tung, Castor, etc.

Petroleum oils — "Magie" oils
Generally not good solvents for Modified Rosin

The hard resin is dispersed and cooked into the drying oil initially, to "dissolve" the resin. Then the petroleum oil is added as a diluent to adjust tack etc.

The hard resin/drying oil mixture without the diluting affect of the petroleum oil is, at room temperature, so high in viscosity that it is nearly solid (this becomes important later).The viscosity of the petroleum oil compared to the other components is extremely low and is of comparatively low molecular weight. (This also becomes important later).

Now a simple ink is made with this varnish. Pigment, waxes, driers, "snake oil", and tack adjusters are added to make an ink of desired color, tack, etc. We have an ink now which is made of about 18% pigment, 30% resin, 22% drying oil, 5% "snake oil", and 25% petroleum oil. What makes it "set" on coated paper?

Although a sheet of coated paper looks smooth to the eye, it is not. When viewed under magnification of 1000-2000 X, there are micro pores evenly distributed (hopefully) over the surface. It is this "micro-porosity" that allows a quick-set ink to "set".

The micro pores exert a capillary suction action which works initially on the low viscosity, low molecular weight petroleum oil, drawing it down out of the ink, into and through the coating. The remaining portion of the ink consists of a blend of the mainly hard resin/drying oil part of the varnish along with the pigment, waxes etc. A second reason why the capillary action works primarily on the petroleum oil is the fact that the resin/drying oil mixture have a limited compatibility with the petroleum oil and this helps to "force" the petroleum oil out. Here is where the extreme viscosity of the resin/drying oil mixture comes in to play. It is so high in viscosity that very little of it penetrates the coating pores and as the petroleum solvent drains out this remaining portion takes on the characteristics of a near solid. The ink now is "set" and feels "dry" to the touch. The remaining ink now oxidizes and polymerizes to form the dried ink film. This last stage will normally require 36 - 72 hours to complete, depending on the levels of drying oil and driers.

It is the combination of 1) limited compatibility of the resin and petroleum solvent, and 2) the extreme viscosity differential of the components that induce the "setting" phenomenon. By varying resin properties, ratios, etc a wide variety of "set speed" can be obtained.

Uncoated papers do not have the same kind of porosity as enamels. The pore sizes are much, much larger. In fact so large that there is, for all practical purposes, no capillary suction. Consequently, the petroleum oils tend to stay in the ink film for considerably longer time periods. These petroleum oils are totally neutral as far as any oxidation/polymerization reaction is concerned, so in effect, they act as plasticizers of the ink film, keeping it soft rather than allowing the film to harden completely. Eventually, the film forming actions will "squeeze" the solvents out of the film, but this takes time and it is in the stage where the film is still plasticized that problems with back cylinder "pick-off" and other similar problems occur.

Looking at these mechanisms, it is fairly easy to see why the ultra quick setting inks, which are relatively high in solvent content and low in drying oil, sometimes give problems with drying on uncoated papers, even though they might work and turn on enamel in five minutes.

In general practice, most inks sold for general purpose work are somewhere in the middle as far as oxidizing components and solvent content and are suitable for most work, but there will be situations where an ink at one extreme or the other will be required.