Ink Film Thickness and Its Relationship to Quality, Productivity, and Waste in the Sheetfed Litho Pressroom

John Ryan*

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Abstract: Not much has been published about ink film thickness and its effect on presswork. Indeed, most press operators that I talk to have no knowledge or the wrong knowledge about ink film thickness. They always assume that you run the least amount of ink you can. They are afraid if they run a good film of ink, they will cause picking or piling. Or if they run the job with a good ink film, the job will setoff or block, or the ink will cause slow drying. If the ink is formulated correctly, none of these problems will happen. Indeed, good ink run at a good thickness will ensure a trouble-free pressrun and produce a quality job as well.

Introduction

The importance of the ink film has been lost over the years when everyone discovered dot gain, a natural action of litho printing method. Zero dot gain was the rallying cry as if dot gain was evil, but that is a discussion for another paper. To achieve this "zero dot gain," the first thing everyone looked at was the ink. Most of the time, it is the ink that will suffer in the attempt to change the system. The next thing that was looked at to eliminate this "evil" called "dot gain" was printing pressures. The theory was that by reducing the pressure between plate and blanket and between blanket and impression cylinder, we would transfer less of the dot—and consequently have less dot gain. This assumption was correct, but in applying less printing pressure, the ink was not splitting correctly. Printing pressures should be determined using the manufacturer's specifications as a starting point, the type of blanket you use, and most importantly in this author's opinion, the tack of the ink you use. After all, tack is a measure of the force needed to split an ink film. The greater the tack of the ink, the more force required to split the ink film. You would be far better off to be 0.002 in. over on the pressures than 0.002 in. under.

Ink should split 50–50. Half remains on the plate; half is transferred to the blanket. If this split doesn't happen because there is insufficient pressure to split the film of ink, the press operator is forced to feed more ink to the plate building

*Wallace/Williams Printing Co.

up the amount on the plate to effect a transfer. This upsets the ink/water balance before the ink even gets to the blanket and substrate. The greater the ink film, the more water the press operator must run to keep the image from plugging. Of course this causes the ink to emulsify much more than it should, which in turn causes the very thing people want to avoid—dot gain. The same applies to the pressure between blanket and impression cylinder, which has the same effect on the ink film. Of course people chasing the demon dot gain also affected fountain solution, usually adversely. But back to the ink.

The first thing the "dot gain eradicator" would do is come to the conclusion that we will have to run less ink: if we run less ink, we will have less dot gain. This is true but, when the ink film was run too thin, we could not get the color strong enough to match the proof. What to do? We will make the ink stronger so we can run the ink film thin and still get the color we need. This is also true. Of course this will also increase the ink costs by quite a bit. Pigment is the most expensive of the many ingredients used to make a litho sheetfed ink. It will also cause the ink not to transfer properly from roller to roller, plate to blanket, and blanket to substrate.

Ink Film Thickness and Compensation for Dot Gain

The question, then, is "What to do?" One thing would be to make the ink weaker by half but also raise the tack by 2 or 3 points so we will still have the same dot gain. This will probably work as far as keeping the dot gain where it is.

All right, you have dropped the dot gain to where you think it needs to be, but you are experiencing more problems on your presses than before. You can match the proof better, but you can't run the thousands of sheets the job requires without having pickouts or experiencing piling when running light coverage. Your paper claims and lost press time are up.

You are also having more color variation than before, and the press operator is having a hard time balancing the ink and water.

Drying and scuffing problems are also on the rise, and although the press sheet matches the proof better, it is not exactly "right." It lacks the depth of color and gloss you are use to seeing.

These are some of the problems you will get if you do not pay attention to the ink film thickness you run on your presses. WHY?

What exactly does ink do besides provide the color we need on our plate, blanket, and, of course, the paper? First, let's talk about our rollers. If we run strong or heavily pigmented ink, we will have a thin film on our rollers. The

solvents used by the ink manufacturer to control tack, as well other characteristics, will be exposed to the friction heat and ambient air and will evaporate faster. This will cause the tack of the ink to increase. In addition, a thin ink film does not transfer well. If we were running a thicker film of ink, the thicker film of ink would be more stable on press with less evaporation and better able to ward off the effects of the friction and air simply because there is more ink to protect the solvents. This ink will exhibit good transfer characteristics. Remember that ink acts as a lubricant and keeps your ink rollers in better shape and helps to keep them cooler, if you run proper ink film thickness.

Another very valuable service it does is protect the image from the acid and other chemicals we use in our fountain solution. This protection, if not thick enough, will cause the plate to wear prematurely or cause the image to blind. The amount of ink we run will also help us control color. If our ink film is thin, the ink and water balance is harder to achieve and maintain. The more ink on the image, the easier it will be to control ink and water, and the less color variation we will have. When we have good control of the ink and water, we will not overly emulsify the ink. This will insure a good, smooth laydown as well as a good drying cycle.

Anyone who has ever run a matte stock will know the value of a good rub. With a thin film, the vehicle offers little if any protection to the pigment. There is not enough of it. Ink that can be run with a good film will protect the pigment therefore providing a good rub on any stock.

As far as quality, running an ink film thick enough to fill the hills and valleys present on all gloss coated papers will result in a more level surface that will have a greater gloss. Another very important characteristic of a good quality job is the ability of the ink to trap. How well one ink lays or covers the ink that is already printed will determine how well we match the proof. Although we will never achieve the trap an off-press proof can achieve, the better we trap, the better we will reproduce the secondary colors of red, green, and blue. Ink film thickness as well as ink rotation and ink tack plays a very important part of ink trapping.

Now let's talk about paper release from the blanket. The average press operator will assume the less ink you run, the less stress you will have on the substrate. This is quite the opposite of what is really happening on press. The less ink run to the blanket, the greater the effective or blanket tack will be. The greater the blanket tack, the greater the force needed to release the substrate from the blanket. This force should be kept to an absolute minimum. When you peel the paper away from the blanket you are stressing the surface as well as the body of

the sheet. This stress causes pickouts and stretching of the paper. Both of these can cause problems. Paper stretch causes register problems as well as causing the sheet to not lay flat in the delivery. A sheet that does not lay flat in the delivery can setoff. A sheet that is "wavy" or exhibits "tailhooking" is extremely difficult to feed and can cause misregister or wrinkles. To understand ink film thickness and its effect on printing we must understand Stefan's equation.

Stefan was a scientist in the late 1800s that studied the forces needed to split a thin liquid film. Without going into detail, what Stefan found was among other factors, the thickness of the film being split had a great effect on the force needed to split the film. The thicker the film, the less force necessary to split the film. For example, if you increase the ink film thickness by 5%, the force necessary to split the film would diminish by 14%. If increased by 15%, the decrease in force necessary to split will be 34%.

Considering that the amount of ink printed on a gloss coated sheet in offset litho process is about 30 microns if all colors are overprinted (about 5 microns of black, 7 of cyan, 8 of magenta and about 10 microns of yellow), an increase of even 15% should not cause problems if everything else in the system is correct. The benefits reaped by running a good ink film far outweigh any benefits of running a thin ink film.

Any compensation for dot gain can and should be made before press. To leave the press capable of running a good ink film thickness using a well formulated ink with the proper tack, viscosity, water pickup, and of course color strength will keep your quality up, productivity up, and waste down. Today in this business there is a great interest in printing using stochastic or FM screening. This method of printing requires even more attention to ink transfer. According to ink experts I have consulted with, it is more difficult to transfer the smaller or highlight dots from plate to blanket and from blanket to substrate than a larger dot. Given the fact that all the dots used in FM screening on very tiny dots, it is imperative that all transfer correctly. To insure correct printing of FM screening requires a lot more than a good ink with good transfer qualities. It also requires good blankets with a smooth surface as well as a good quality paper stock. The printing pressures must be enough to transfer the ink through the system, but the ink used will have a great effect on the final printed product. If the ink used is formulated with a heavy pigment load that ink might not have good transfer qualities. FM screening exhibits even more dot gain than conventional screening so people might have the mistaken impression that to print FM screens properly, they need to make the ink print sharper—that is, run a thinner film of ink. This will cause problems on press. Dot gain compensation must happen before the press to insure a good press run using FM screening. Remember, the thinner the

ink film, the greater the effective tack. The greater the effective tack, the more problems you will have on press.

In my current position as process engineer for the southeast region of Moore/Wallace, I evaluate the process used to reproduce our client's jobs. It is my responsibility to improve these processes and the first place I start looking is the press. One of the first areas I check is paper claims and waste. It is always the case when these areas are showing unusual amounts of claims and high percentage of waste, I look at the ink formulation and the average ink densities the shop runs. Talking to the press operators and asking what types of problems they have running when running different types of paper tell me all I need to know about the ink they use.

I will always run an analysis of the ink they use against a set of ink that has all the characteristics needed to perform on press. Then I work back up the manufacturing process making whatever changes are needed to each process to insure that the presses get what they need to produce the jobs with as little effort as possible. If your press department can consistently produce quality work with low paper waste, you make money. If not, you don't.

Summary

I have worked with most major ink manufacturers, and they all have been very willing to listen and make whatever changes are needed to their products to help improve your products. But, they need the correct information from the printer in order to improve the product. Unfortunately, in some cases, they don't get it.

It is not always apparent that the problems printers are experiencing are directly related to the ink film thickness they run on their presses. Lastly, It should not increase your ink cost to be able to run a good ink film. Pigment is the most costly of the ingredients used in ink. I am saying you don't need as much pigment as you think you do. What you do need is a good amount of a good vehicle to deliver that pigment to the substrate. There are other factors that have to be considered when evaluating the ink for splitting characteristics. Factors such as the blankets surface, and as mentioned before, the printing pressure. The fountain solution will also have an effect on the ink splitting but, when you have built your system that will allow a good ink film to be run on press, the benefits you will experience are well worth it.