

GLOSS REPLICATION TECHNOLOGY REVIVES POWDER-SET INK CURING

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Abstract: Gloss replication is simple in concept and practice. It presents the possibility of eliminating heat set pressroom ovens when combined with Powder-Set. The actual working equipment and process mechanism are both described.

Summary of 1975 TAGA Paper

Powder-Set was originally presented as an alternative method for curing ink without using solvent. A reduction in the use of heating energy was also suggested. Prior to May 1975, a 7 micron (0.007 mm) resin powder had been applied to solventless ink on a crude web press. The web was then heated to fuse the resin with the ink. The powder coating chamber included an air knife to remove powder from the non-image area. Various levels of powder application and air knife removal were investigated and it was determined that the minimum amount of powder that would cure the ink caused gloss reduction. A polished metal belt was suggested as a means for regaining gloss. Installation of Powder-Set equipment on a New Era label press had begun.

Subsequent Developments

New Era: Throughout 1975 and 1976, Powder-Set was operated on a New Era press in Long Island. This web letterpress operation produced pressure sensitive labels. Powder-Set served to cure the ink and to provide good product resistance to cosmetics. A valuable insight on the relation of powder coating resin to ink was obtained when film and foil labels were printed. Using the resin and ink that we had settled on for paper, there was a great loss of color intensity on film and foil. Microscope examination of the film labels showed a build up of color intensity around each powder particle.

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The resin powder was more easily wet than the film or foil substrate. As a cure for this problem, resins were chosen that were increasingly more soluble in the ink. This resulted in regained color intensity, but then the ink would not dry. This effect helps to understand that a major factor in the mechanism of Powder-Set curing is due to incompatibility (insolubility) of the resin powder and the ink. The resin coating cures separately from the ink and there must be a distinct interface.

The overall result of work on the New Era press was that the salesman just did not sell many Powder-Set jobs, although some labels looked very nice.

Goss 35: In May 1976, we conducted a press trial at Brown Printing In Waseca, Minnesota. A 17-inch web of coated paper was printed with four colors on one side. This web passed through a powder coating chamber that was placed between the last printing station and the oven. The Nordson Company furnished powder coating equipment to apply the resin powder to the wet ink. After the powder coating, the web passed through the oven and chill rolls to a cutter-folder delivery.

Make-ready was conducted using heat-set inks, but all four colors were replaced with sheet-fed inks which are solvent free and would not ordinarily dry on a heat-set press. The press was run at 1,000 feet per minute and proofs shot out into the delivery stack completely dry, and would have been ready for the bindery if lack of gloss had not been objectionable.

A gloss enhancing experiment was conducted during this trial. I held an ordinary piece of 1/2-inch plumbing pipe against the web as it passed under the row of flames in the oven. The paper slipped nicely until I moved the pipe about ten inches downstream. At that point, the pipe was nearly torn out of my hands. This indicated how quickly the powdered ink had dried. Examination of proofs that had been "piped" showed beautiful gloss, but the ink was smeared.

Since the resin that had been used was resoftenable or thermoplastic, these proofs were useful for further process development. The smearing technique served to show that the system had inherent gloss.

It was proven that Powder-Set was a practical means of curing ink under actual pressroom conditions, but the gloss problem caused the project to be put on hold.

Understanding the Gloss Problem

A photo from my 1975 paper is reproduced in Figure 1. This shows printed half-tone dots that have received the Powder-Set treatment. What should be noted is that a globule of resin sticks up from the paper substrate above each dot.

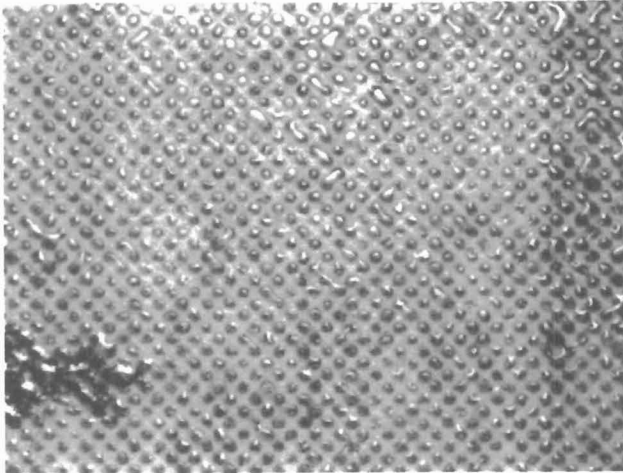


Figure 1. Printed half-tone dots that have received the Powder-Set treatment.

Further work with the microscope has revealed that each globule consists of about 6-10 resin particles that have been fused both together and to the ink. This is good news because it indicates that different rates of powder application can actually result in a change in the number of particles on each half-tone dot. The bad news is that these globules reflect light in all directions, which cause the full intensity of the incident light to miss the eyes of the observer and thus appear dull, as illustrated in Figure 2.

DIFFUSION

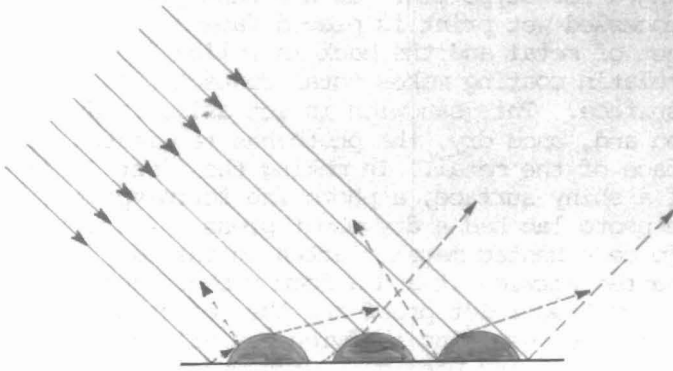


Figure 2. Diffusion of light by resin globules.

Fortunately, there is more good news. The molten resin that was smeared in the pressroom oven to bring out the gloss is thermoplastic. This means that proofs made in 1976 can still be resoftened and smeared while hot to demonstrate the inherent gloss. These proofs or freshly prepared proofs can also be used to demonstrate gloss replication.

REFLECTION

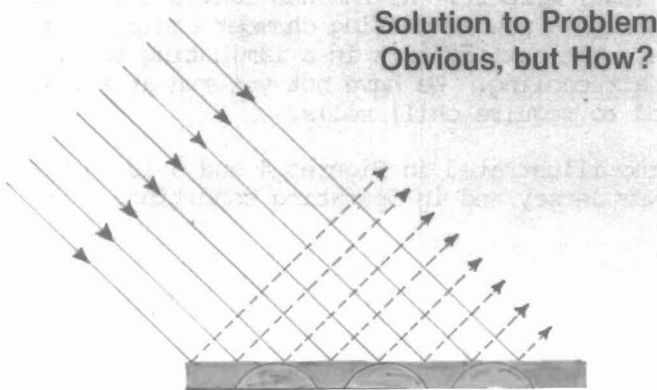


Figure 3. A level surface will reflect light.

The best way that we have found to obtain a level surface has been through gloss replication. The principle is simple and familiar to anyone who has made glossy photo prints using a ferrotype tin. In the photographic instance a fully processed wet print is placed face down on a chrome plated sheet of metal and the back is rolled fairly hard so that the gelatin coating makes total contact with the polished surface. This sandwich is set aside to dry by evaporation and, once dry, the photo has replicated the shiny surface of the metal. In making the first Powder-Set replica of a shiny surface, a photo lab ferrotype tin was used. The photo lab had a dry mount press which used a lever to force a heated metal platten against any flat object inserted between it and a foam rubber backing. The insert was our Powder-Set proof and the ferrotype tin. Upon removal, the resulting sandwich was allowed to "dry" by cooling, and, lo and behold....the proof stuck to the tin, but the little bit that pulled off without being torn had good gloss. It was clear that a release coating and/or a modified resin was required. A quick solution to the sticking problem was to laminate the Powder-Set proof against release paper used as the backing for pressure sensitive labels. This produced amazingly good gloss and allowed us to turn our attention to other developments.

Every printer that we had worked with had a great interest in the cost of materials. We needed a working press to conduct these investigations as well as to get a feel for gloss replication as a continuous process. We found a used Didde-Glaser web press which is now set up as a permanent installation in our plant, five minutes from Newark (EMR) Airport. As the web leaves the press, it passes through a powder coating chamber equipped with an air knife. The next station is a laminating roll, followed by air cooling. We have not yet run at sufficiently high speed to require chill rolls.

Everything illustrated in Figures 4 and 5 is in place in Newark, New Jersey and in operating condition.

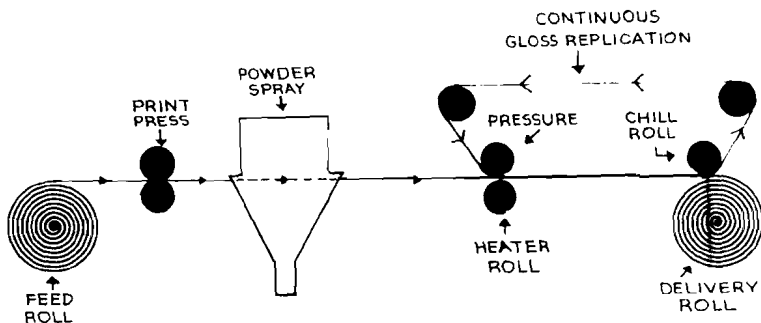


Figure 4. The overall process.

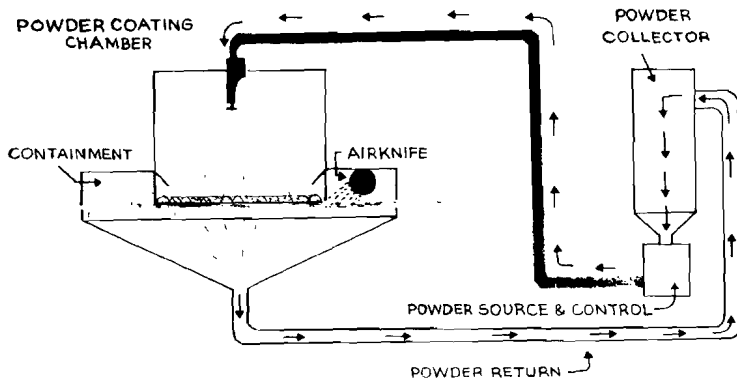


Figure 5. The powder chamber.

Figure 6 represents a concept of how gloss replication can be developed as a technology having the capability to run faster than any press, reduce energy consumption by eliminating the heat required to evaporate solvent, and produce unparalleled gloss.

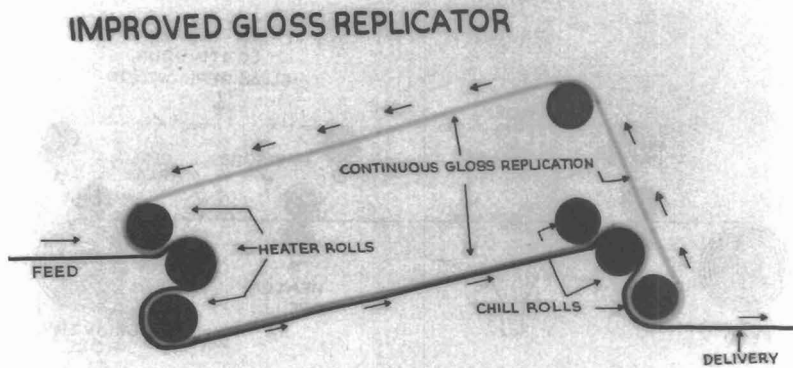


Figure 6. Improved gloss replication.

As to the subject of cost of materials, the process requires the use of resin powder which is approximately the same cost as overprint varnish. Some of the cost of resin powder may be absorbed by replacing a portion of the ink resin with something less expensive such as mineral oil. In any case, the pigment is the greatest portion of ink cost and the new process may permit the use of less pigment by drawing this material away from the paper substrate and toward the resin interface, as we observed in the New Era work.

We have investigated the use of different inks and powders and are equipped to continue these investigations for our own interest or that of those who would like to become involved. We have investigated various release backings and are likewise equipped to continue.

Conclusions

We have used existing equipment to produce proofs which are available for the asking. We have demonstrated the feasibility of continuous gloss replication as part of the Powder-Set ink curing process.