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Determining Differences in Quality Between the Gravure and Flexographic Process on Films

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Determining differences in quality between the Gravure and Flexographic process on films.

PAPR 486 – Senior Research Project

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Abstract

Quality is the goal of every printing company. Every day printing companies spend money trying to find ways to improve the quality of their product. Type of paper, ink, and even the types of printing processes are all characteristics looked at when determining the quality of a printed product.

In today's printing industry, there are two printing processes that have arguably jumped to the front in terms of the highest quality printing ability. The flexographic process and the gravure process have both risen to meet the standards of high quality. The gravure process has always been at the top. For many years, the quality that the gravure process was obtaining was unquestionably the best in the world. The flexographic industry, however, has made great strides in working to improve their printing process.

In the product packaging market, competition is fierce. The package is always the first part of the product that a customer sees. Printing quality in this market is not just wishful thinking, it is a requirement. Many different types of film are used extensively in the food packaging industry. The printing characteristics associated with film are very important, and should be studied to help determine how to obtain the highest quality output.

A direct comparison of the flexographic and gravure processes, printing on polyethylene and polypropylene films has given good insight into the differences between the two processes.
Introduction

The objective of this experiment was to determine the differences in quality between the flexographic and gravure printing processes while printing on a film substrate. A comparison of the two processes should help give insight into how each process obtains high quality printing. This experiment also allowed us to see what the production and process differences were between the flexographic and gravure processes.

Identifying differences between the two processes can happen during the press run, but also during the image analysis after the substrate has been printed on. Understanding the differences between the size and shape of the printed dots, and how the ink adheres to the substrate are important factors.

Differences between these two processes exist due to the methods of printing used. The flexographic printing process involves using photopolymer plates that are flexible. These plates have a raised surface that provides the image. The gravure process uses chrome plated cylinders that are engraved with the image. The two processes, raised and recessed, provide different ways for the ink to be transferred to the substrate. This is basically what we are comparing. Which process, printed on a similar substrate, provides the printer with the greatest ability to produce high quality work?
Experimental Plan/Procedures

To effectively carry out the experiment of comparing the print characteristics of the gravure and flexographic processes on film, I followed the set of procedures that were formed in the research design phase of this project. There were many factors that influenced the outcome of this experiment, and these factors are discussed below. It is important to note at this time, that this project was to be conducted in conjunction with a local print manufacturer. They were permitting me to observe their trial, and obtain enough samples for me to conduct my research. This fell through, however, and I was left to secure press time on my own, as well as making sure that substrates, and inks were available for use.

1. The Substrate  Substrates that were used in this project included Polypropylene and Polyethylene. These substrates were used in conjunction with a local ink manufacturer who was conducting studies on both presses. Ideally, using the same substrate on both processes would be used, but due to the time constraints, and lack of substrate identification, we used different substrates for each process.

   The polypropylene film was used on the Gravure Cerutti press. Polypropylene is a stiffer film than is polyethylene. This allowed for easier registration, because it didn’t stretch as much. The film was in good condition, and no baggy conditions were recognized. The film worked well with the press, and the tension was able to be maintained. The film did not seem to be a factor in the final quality of the print.

   A polyethylene film was used on the flexographic Comco press. Polyethylene is a more flexible film than is polypropylene. There were no baggy areas that were observed when the film had been webbed through the press. The tension control devices on the Comco are not as sophisticated as on the Cerutti, however, we were able to hold registration reasonably well. I did
notice that the film was not smooth all the way across width of the substrate. There was an area that would rise up, and move across the web until it reached the end, at which time it would jump, back to its original point and again travel to edge. This did seem to affect the print on right side. Densities were not as consistent on the side that corresponded with the raised film. It was brought to the attention of the press operator, but he was unable to fix this problem.

2. **The Ink**: Comparison were to be drawn from the cyan ink. We printed 4 colors on the Cerutti (Gravure) press, and 3 colors on the Comco (Flexographic) press. I was able to obtain ink through a local ink manufacturer. The ink used on the gravure process was solvent based, and the viscosity was held at 21 seconds. The ink performed expectedly. The density however, was lower than the target density, measuring on average at 1.08. It was noticed that there seemed to be some trapping issues with the cyan ink.

Through the recommendation of a contact with an ink company, I was advised to use the same ink that was used on the gravure press, for the flexographic process. This proved to be a fatal error in the project. Target densities for the cyan ink on both processes was set to be 1.20. Gravure inks are already less viscous than flexo inks, which means that the ink needed to be extended immediately. I was advised however, that the viscosity should be at 12-13 seconds using a Zahn #3 cup. This however, made the ink even less viscous than originally. Because the ink was lower in viscosity, the ink would spread out over the plate, making dot formations nearly impossible (see Fig. 2). In many of the sampled areas, there was a large amount of dot gain.
Fig. 1 - Gravure Image Analysis Sample

Fig. 2 - Flexographic Image Analysis Sample
After realizing that the viscosity was not correct, we attempted to fix the problem by removing all of the ink, and replacing it with virgin ink (adding no solvent). This improved the print marginally, but was still not viscous enough to provide good dots for conclusive analysis. No extender was used in the process to try and increase viscosity due to time constraints.

3. Securing Press time. As stated earlier, I was originally sharing press time with an ink manufacturer. When this fell through, there was little time to complete the project. Press time was scheduled immediately, and it was decided to use what materials we had available. No contingency plan was formed in case the ink manufacturer backed out. This was a mistake in the planning process. Although we were told that the trials would happen, planning should have included a back up just in case. This was a major blow to the project, because we were left with little time, and were relying on the expertise of the ink manufacturer to produce samples that would be provide conclusive data for comparison. If there was a bright spot, both the operators, and the presses themselves performed well.

4. Print Analysis. This area of the research provided us with little beneficial information about the processes. Because we were unable to secure quality samples off the flexographic press, there was no way to compare the two. Tests including gloss, ink density, rub resistance, mottle, and image analysis were conducted, but could not be compared enough to draw accurate conclusions.
Discussion

Although the substrates were different, they both handled expectedly through the press. Aside from the raised substrate issue on the flexographic press, there were no differences. Causes for the raised substrate are unknown. It should also be noted that whether the substrate was pre-treated to increase surface tension is unknown. Due to the use of solvent-based ink, the corona in-line treater on the flexo press, and the ESA on the gravure press were not used.

The use of gravure ink on the flexo press, and the lack of knowledge regarding how to best use it on a flexo press seemed to be the main issue that resulted in the lack of quality samples. Perhaps if I would have received more accurate information regarding its use, or used typical water-based flexo ink instead, a better, more accurate and fair comparison could have been made. As it stands, the processes were about even in density, both averaging well below the pre-determined 1.20. One possible reason for the low densities may be that the substrate was clear.

One of the telling differences came in the mottle results. The standard deviation of the gravure samples was lower than that of that flexo samples. This represents a greater unevenness in the flexo samples. This was expected due to the amount of dot gain, and poor dot structure of the flexo samples. The poor dot structure was verified by the image analysis testing. The flexo dots were hollow, and poorly formed. In the dense areas of the samples, dots were not discernible. Again, this is due to the speed of the gravure ink on a flexo press.

The ink was consistent on both substrates in relation to rub-resistance, and gloss. It performed evenly, and surprisingly better than expected. In many samples, there was no loss of ink after the rub-resistance test was conducted.
Of all the things learned in this experiment, the greatest lesson came in properly preparing for the desired results. Nothing should be taken for granted, and a contingency plan should have been in place. As a result of not anticipating our time problems, inks were used incorrectly, substrates were not identified properly, and the desired results were not able to be obtained.
Literature Reference

Books


Journals


Correspondence

Streets, Mark. 2000. Polyethylene. (see appendix)
Appendix