The Journey to Closed Loop Color Control on Flexographic Presses

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As has happened in so many other industries in the past, the flexographic printing market is making the journey from human judgment being "good enough" to "process monitoring" to "process control" all the way to full automation for closed loop color control.

As stakeholders grew aware that color is critical to success and waste at any level translates to lost revenue, the industry evolved from subjective human judgment of color to objective device measurement. Eventually this evolution led to the handheld spectrophotometers we see today in the general print industry. Certain web processes, such as gravure, are currently using online real time measurements but so far the costs have been too high to penetrate the flexographic market. With improvements in computing power and the reduction of processing cost, today there exists the ability to measure at the speeds required for continuous web print processes at price points that are much more cost effective. While full automation is still a bit out of reach, there is hope for the future.

What can be done today?

Measuring the results of the flexo process is achievable through the use of inline spectrophotometers. These devices have the ability to measure the media at nearly unlimited rates of speed, allowing print providers to monitor process output in real time.

To drive the full value of monitoring color on the press, the inline spectrophotometer must be capable of making spectral measurements, calculating color computations, and reporting results to the press operator. At a minimum, it should have the following performance characteristics:

- Report 31 spectral bands from 400nm to 700nm
- Compute L* a* b*, LCH, and status T&E densities while press is running at full speed
- Avoid media contact and allow for height variability of 0.5mm minimum

Mounted on a traverse arm the measurement instrument is able to measure at any point across the web. This motion control makes it possible to measure and ensure the uniformity of color across the width of the web.

Typically this would require a color bar printed on the media along the direction of the press run, likely on either side of the web such that the results of the plate pressure can be monitored. The bar consists of solid and tint patches of each process color as well as overprints and gray balances. There may also be one or several (possibly all) spot colors included in the color bar to ensure that special colors such as those used for company logos are reproduced accurately.

The color bar though, is only an approximation of the actual colors in the field, and sometimes sheet and image size restriction don't leave any room for bars. A significant benefit of horizontal motion control of the spectrophotometer is that the operator can periodically measure, monitor, and, if necessary, correct spot colors and special process colors (logos, etc.) in the work. It can be compatible with on-press visual inspection system cameras to allow press operators to identify the places of critical color locations to be monitored in the work.

Likewise with a press synchronization system there exists the ability to position and time the measurement in such a way to measure in a field of print as long as the area is large and consistent enough for a valid measurement. Just like coordination with a camera based system this enables the measurement of specific elements of the printed page such as solid spot colors in a logo or critical solids printed by means of process color.

Using the measurements

Using an inline spectrophotometer is only the beginning of what is needed to ensure that printing process results are meeting expectations. A system of instruments networked to a centralized computer and sophisticated process monitoring software is needed to display the information in a useable manner.

What are the variables that can be measured? Nearly all of the variables and the results of the process

can be measured. They include:

- Ambient temperature
- Ambient Humidity
- Ink viscosity
- Ink PH
- Drier temperatures (if applicable)
- Media temperature

Measurement is only the first step of process control. The next phase is to take the real-time color measurement data and the data received from the other print variables and feed it into a centralized computer system that collects organizes and displays all the resulting data. The ability to simultaneously monitor both the real-time color measurement data and the other print variables allows the press operator to prevent color problems before they occur. The additional benefit is that it also gets the press to color faster.

A comprehensive process monitoring system needs to provide:

- Real time reporting of the process variable data
- Real time reporting of the process output data
- The ability to set control limits on the data such as density, delta E, dot gain
- The ability to compare results with reference colors
- The ability to alert the operator if the process is going out of control

Real time data can ensure that the process is working as it should, but the operator also needs to know how the print process is trending. Is the color data on a trajectory to go beyond the acceptable limits? This can only be determined by examining trend data. Trending allows the operator to view the process output over time. This is where the power of process control really pays off. Being able to spot a continuing decrease in density or other result trend BEFORE the process is out of control avoids costly waste. The system needs to allow the operator to see the output in familiar formats and in easy to read graphs that facilitate continuous monitoring.

The next step in the full process control loop is an intermediate one that can be implemented today. Beyond presenting the operator with the trends in real time, this step is one where the system starts to suggest changes to be made to improve the quality of the process. This is accomplished currently through the use of Ink Check, a predictive system that tells the operator how many density points to increase or decrease for each color to achieve better results. This and other process suggestions could be made by the system to improve performance.

This is not yet full automation, since the system is only telling the operator part of what needs to be done. The operator may still have to go off and add extender or adjust printing pressures or decrease heater temperature.

The Closed Loop

It is the final step in the journey and one that still seems elusive in the flexographic world. In a full automation, closed loop system, all adjustments are made by machines, motors and pumps that turn and tweak the press. With this system in place, the operator sits in a room with air conditioning, music and a padded chair, controlling the process from a central computer while multiple presses go about their business printing. This vision may currently be out of reach, but it's certainly not out of sight.

But there is no reason to wait for that vision which may not come. Print providers today have the technology and capability to maintain continuous, consistent high quality color. Using today's spectrophotometric technology, print providers can produce color that is reproducible on any flexographic press, color that is consistent throughout a run, and process results that are documented.

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