

Maintain Colour Consistency with Autopilot Automation system from X-Rite for Paper Mills

Abstract: As the global leader in color science and technology, X-Rite delivers innovative color solutions through measurement systems, software, color standards, and services.

Keywords: Online Measurements, Color measurements, quality control



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Introduction:

X-Rite's inline spectrophotometers are mounted above continuous process manufacturing lines to measure color in real time, without stopping production. Real-time color information from an inline spectrophotometer enables production operators to make accurate color adjustments to increase color consistency and minimize costly production line errors.

Inline color measurement solutions enable manufacturers in a variety of industries to evaluate color accuracy and consistency throughout production and track ISO compliance. Inline systems monitor color while the product is being made and alert operators if it begins to move out-of-spec so corrections can be made before the product is wasted.

Adding ESWin CLCC software can create a continuous monitoring system to catch color drift immediately and make color changes before production moves out of tolerance.

Inline systems are turn-key, durable, and offer maximum instrument uptime for fast ROI, and correlate well with laboratory spectrophotometers.

Function:

Each Inline color measurement system uses a non-contact spectrophotometer and ESWin software. Although many devices also work as standalone laboratory units, a system may include a moving frame or robotic arm to position the spectrophotometer over the line.

Depending on application and needs, Inline solutions can communicate with process control systems to provide color measurement data and dye pump controls

for real time closed loop color corrections. A system may also receive signals about events such as reel/sheet changes, machine stops or meter counts. Networked data allows manufacturers to share color standards and measurements among systems and at different locations.

Paper Industry

To keep color and brightness constant throughout production, Inline paper color measurement systems span the entire process, from laboratory measurement to pulp, wet sheet, and measurement before reel up. The ColorXRA 45 (pulp color) or ColorXRA 45 Pulp (pulp brightness) spectrophotometer is mounted in a stainless steel box to measure color inline, while ESWin Closed Loop Color Control software records the quality of the run and alerts the operator of any deviation.

For laminated paper, a measurement on the wet paper is used before drying because the wet paper has a good correlation to the finished product, especially when the paper will be laminated on wood.

The most common measurement point in paper manufacturing is just before reel up, when the finished product is measured and compared to the lab results. If there is any color deviation from the standard, automatic closed loop color control will keep the color constant, plus help shorten startup and transmission times by approximately 50%

Specifications In-Line Color Measurement

With a ColorXRA 45 spectrophotometer, the following typical specifications can be expected on the paper machine:

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Name	Value	Description
Spectral range	330 nm-730 nm	Wavelength interval
Optical spectral resolution	1 nm	From 330 nm to 730 nm each 1 nm a reflectance value will be measured (= 401 measurements)
Absolute wavelength accuracy	< 0,1 nm	Not only will the intensity of the illumination be calibrated, but also the exact wavelength.
Dynamic measurement range	0 % - 250 %	Reflectance values up to 250% can be measured.
Reproducibility for ΔL^* , Δa^* , Δb^*	< 0,03	Standard deviation of 50 measurements from the white standard, CIELAB, D65/10°
Interinstrument agreement ΔE^*	< 0,3	Average deviation of the measurements of 12 BCRA standards from the production average, CIELAB, D65/10°
Reproducibility of CIE whiteness	< 0,23	Standard deviation of 50 measurements from the white standard, CIELAB, D65/10°
Reproducibility of ISO brightness	< 0,1	Standard deviation of 50 measurements from the white standard.
Compliance of ΔL^* , Δa^* , Δb^* values to the laboratory	0,2	Compliance of the In-Line measurement to the laboratory measurement after correlation of the In-Line measurements. This is also influenced by the measurement accuracy of the laboratory instrument. For mathematical reasons the CIE-whiteness is approx. 3 x higher than the deviation in L^* , a^* or b^*
Compliance of CIE-whiteness to the laboratory	0,7	
Compliance of ISO-brightness to the laboratory	0,3	
Oscillation of ΔL^* , Δa^* , Δb^* values with Closed Loop Color Control	0,2	This depends on the dosing station which is used; how accurate the dyes can be pumped as well as the general homogeneity of the paper and the stability of the production process. The response time of the machine and the used dyes will also influence this value.
Oscillation of CIE-whiteness with Closed Loop Color Control	0,7	
Oscillation of ISO-brightness with Closed Loop Color Control	0,3	
Settling time of the CLCC to reach ΔL^* , Δa^* , Δb^* values $\leq 0,5$ with CLCC in Automatic mode on constant, unbleached pulp	2 times the control time after the first control step	The production must run in a constant mode where the reflectance variations of the raw pulp must not be larger than 2%.

All data were collected from 50 single measurements (with 1 ms each, no averages!) with one-minute intervals. By averaging several measurements values the deviations can be further decreased.

The calculations are based on CIELAB, D65/10°. By using other color spaces like CMC or DIN 99 the deviations will be even smaller. The speed of the paper web does not influence the measurement.

Quality Assurance in the Lab

After the reel up, the operator can pull a sample to take to the laboratory for final product and color inspection using a benchtop spectrophotometer and quality control software. With a ColorXRA45 inline spectrophotometer installed on the line, and a ColorXRA Lab benchtop spectrophotometer in the lab, the color correlation from the production line to the line can be <0.5 dE, with the right tools and processes in place

Keywords: Colour control on paper, Online color measurement, Online color control

Quality Color with Less Waste for Better Market Acceptance

Papermaking has always been a complex process

The pulp is produced from wood or recycled paper as well as a variety of chemicals, dyes, and papermaking agents to achieve stability and remove impurities. Each of these raw and recycled materials impacts the color of the pulp and final paper, which must fall within tight color

tolerance or the customer will not claim the shipment. On a fast-moving paper line, even a slight color shift can ruin an entire run in no time.

In addition, today's consumers are also looking for a paper company that is focused on sustainability and recyclability. This important trend is encouraging mills to reduce clear cutting, water use, greenhouse gas emissions, fossil fuel consumption and clean up their impacts on local water supplies and air pollution.

ColorXRA 45 makes it possible for paper mills to achieve accurate color and meet sustainability initiatives to win the bid and secure future business. An integrated inline color measurement and control solution installed on the production line can measure and compare color in the laboratory and on the paper machine at multiple critical points to help pulp and paper-making companies stay competitive, reduce carbon footprint, and capitalize on industry growth.

Keep Color and Brightness in Harmony, From Pulp through Final Roll Up

ColorXRA 45 color measurement and control system spans the entire papermaking process. On the moving production line, it measures and evaluates color and brightness in the pulp liquid, between the press and dryer sections, and finally before reel-up for automatic closed loop quality control. In the lab, it evaluates final color before shipment and tracks quality according to industry standards.

Color Control on Paper Production Line

An inline color measurement and control system includes a non-contact spectrophotometer mounted on a custom frame over the production machine and closed loop color control software to monitor color throughout the run.

Test liner is often produced using recycled materials, which start as different colors but must be on target and constant at the end of the production process.

Conclusion:

With X-Rite ColorXRA 45 instruments, paper mills can:

- Take consistent spectral color measurements on the production line and in the lab
- Maintain 100% color control throughout production
- Reduce start-up time by up to 30%
- Shorten transition times by up to 50%
- Ensure reliable color measurement with <0.3 dE color correlation to the lab
- Save on dyes or optical brightener agents by up to 50%
- Avoid off spec production
- Minimize maintenance costs