Smarter cure, better cure

UV curing technology has progressed to the point where operators can tailor curing parameters to the application, potentially saving money and enhancing environmental performance.

For years, UV curing of flexo print operated under a safety-first, "full power by default" principle: throw the maximum dose of energy at the print to ensure there was no likelihood of incomplete or under-curing.

It was deeply inefficient in terms of energy consumption, and consequently unnecessarily expensive in terms of operating costs.

Today's times are more enlightened. For a start, we have both UV arc and UV LED curing, with the latter – in comparison to the former – bringing much greater levels of energy and cost efficiency.

But we also have intelligent process control for UV curing, and it can be a real gamechanger, enabling flexo printers to operate smarter, optimising the output of their UV curing arrays depending upon a range of parameters.

"Intelligent control minimises variability by reacting to changes in substrate properties, ambient temperature fluctuations, or equipment warmup conditions," says Stacy Hoge, marketing manager of Excelitas, which sells the Phoseon LED UV curing technology. "As a result, manufacturers experience fewer defects, less scrap, and more consistent curing performance across different operators and shifts. This reliability is essential for maintaining high yield and reducing material waste – both core pillars of sustainable manufacturing."

Smart control

Much of the discussion in the industry today is around LED UV curing, and this technology certainly lends itself to the smart control approach. But as GEW observes, process control can also be applied to traditional UV arc curing technology.

"In the case of UV arc, process control is more complex due to the unpredictability of UV lamp output," the company said. "GEW's solution for this is DoseGuard, a new precision control system which measures UV output through inline monitoring, and automatically controls UV dose to ensure a consistent cure and optimal energy consumption."

DoseGuard consists of a scanning optic (ICAD unit) which is mounted underneath each of the lampheads on a UV system, whether conventional UV arc or UV LED. DoseGuard continuously measures the UV light that reaches the substrate, across the entire width of the system, and will issue a warning if the level of UV output delivered to the substrate changes during production, for any reason.

GEW said DoseGuard automatically adjusts the power of the UV lamps to maintain a target UV dose, independent of speed or UV lamp condition, even for multiple lamps on a single print or coating station. "This ensures that the product is cured to exactly the correct level, every time. Operational data can be exported so that compliance documents or certificates can be generated by the customer. "

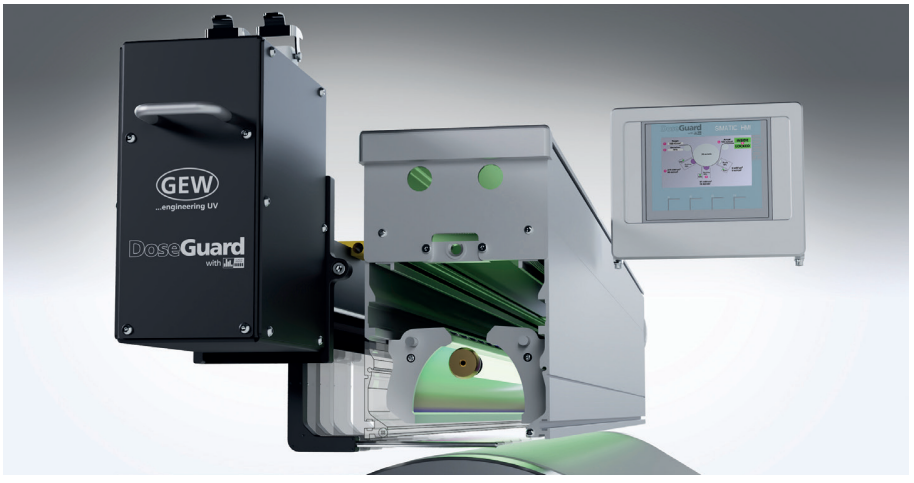
Substrate explosion

It is a fact that curing requirements vary widely, with substrate, ink, coating thickness and press speeds all potentially significant factors. The explosion in substrate development, which has led to many "next-generation" substrates coming onto the market, has only served to highlight the issue further. Such substrates can have narrow processing tolerances, being sensitive to heat or overexposure. One-size-fits-all curing performance is no longer appropriate.

"A thin ink film on paper does not require the same UV dose as a heavily pigmented ink on film or foil. Fixed output settings therefore lead either to excessive energy use or, if reduced too aggressively, to curing risks," says Jürgen Welle, managing director of Hoenle WebCure, which sells the LED Powerline Web curing system.

"Intelligent control of UV LED curing parameters enables printers to align UV intensity with real job requirements. Instead of curing with a constant safety margin, output can be adjusted during job setup to deliver exactly the dose required for complete curing – no more, no less. This approach directly improves energy efficiency while maintaining stable curing quality."

Clearly, a key advantage of intelligent UV curing control is that by automatically



GEW's DoseGuard offers inline UV monitoring and automatic dose control to optimise curing

optimising the lamp power to deliver only the exact power dose required according to parameters such as substrate and ink, a good quality product can be achieved, while reducing energy and maintenance costs.

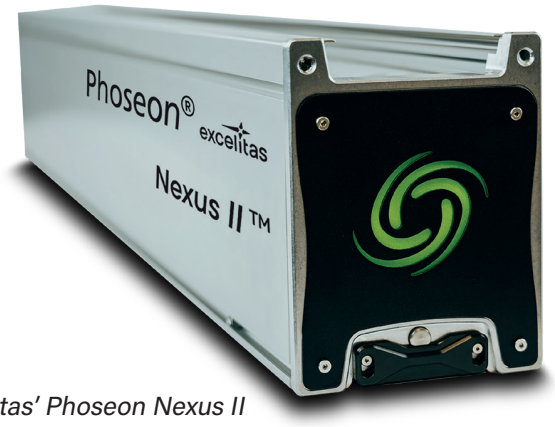
It also serves to improve lamp lifetimes and enables bulbs and reflectors to be used for longer – a not inconsiderable factor, even with the greater longevity and reliability of LED curing systems.

"Intelligent curing technologies enhance equipment lifetime and production uptime," states Stacy Hoge of Excelitas. "By reducing thermal and electrical stress on components, they extend system longevity and reduce maintenance frequency. Combined with features such as real-time monitoring and predictive maintenance, intelligent control aligns perfectly with Industry 4.0 initiatives and enables more efficient, data-driven operations."

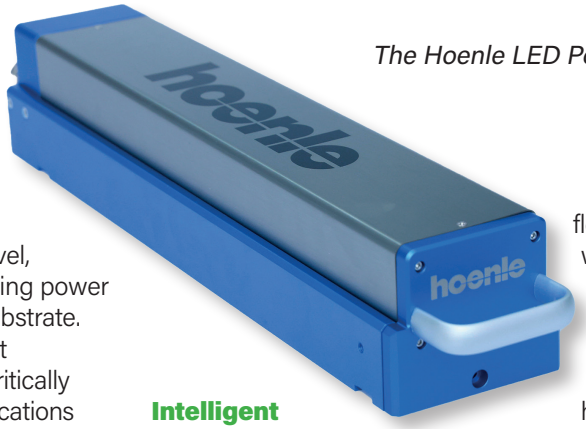
The company's TargetCure and ValidCure technologies work in concert to ensure precise, consistent and measurable UV output, says Excelitas, with selected segments of the light source able to be turned on or off as required. While TargetCure continuously monitors lamp performance, automatically adjusting for lamp aging and ambience changes, ValidCure complements this through real-time monitoring and validation directly at the substrate level, confirming the curing power delivered to the substrate.

"These intelligent technologies are critically important for applications involving sensitive substrates, which often have narrow processing windows and can be easily damaged by excessive heat or overexposure. Dynamic adjustment protects these substrates while ensuring complete curing of inks and coatings. The result is consistent electrical performance, strong adhesion, and high product reliability," said Ms Hoge.

In an Excelitas set up, these can be joined with Phoseon Nexus II closed-loop power management, which the company says delivers precise electrical input required for stable irradiance, as well as providing another layer of intelligence: detecting variability before it becomes a quality issue. Added to this, the software of Nexus DataHub provides real-time visibility of intensity, temperature and power conditions, all logged to allow operators to set up jobs correctly and satisfy audit or regulatory requirements.



Excelitas' Phoseon Nexus II



The Hoenle LED Powerline Web

Intelligent process

Fujifilm's LuXtreme LED curing system and Smartcure technology perform a similar intelligent process control job for its users. Ian Isherwood, segment manager for analogue packaging in EMEA, comments: "This AI-supported control system analyses production parameters in real time, automatically adjusts the LED output, and optimises energy consumption in line with current requirements.

"This not only saves energy and resources, but also ensures precise, consistently high curing quality. LuXtreme provides our customers with an LED UV solution that sets new standards in efficiency, helping to future proof their investments."

Hoenle says it understands intelligent curing as a "system concept", adding that "modern UV LED units allow precise and repeatable adjustment of output intensity across a wide operating range", which enables the creation of "job-specific curing settings matched to substrate, ink and press conditions".

"Equally important is transparency," adds Jürgen Welle. "Reliable UV dose measurement ensures that reduced power settings still achieve complete curing at the substrate. This combination of adjustable output and validated curing performance forms the basis for data-driven, repeatable production, which is a key element of digitalised flexographic workflows."

There are some practical limits and real-world constraints involved, however, Mr Welle continues. "Despite its advantages, intelligent curing control has limits. Not all ink systems respond linearly to reduced UV intensity, and process safety margins remain essential. Factors such as lamp aging, optical contamination and press-specific conditions must also be considered.

"For this reason, intelligent curing is not a fully autonomous process. It requires robust system design, reliable measurement and informed operator decisions to balance efficiency with curing security."

Powerful tool

This should not detract from the importance of intelligent UV curing control as a concept, nor from the very real financial, operational and sustainable benefits that flexo printers can accrue from taking a more proactive and considered approach to smarter curing.

The industry is evolving and in a wealth of ways intelligent curing can play a central role in helping flexo printers to better manage their environmental and production performance. In such a scenario, achieving consistent curing quality using only the UV energy actually required adds a new dimension of power to UV curing, putting a smart, future-ready process tool in printers' hands. ■