

Adoption of UV LED Curing: Trends and Benefits for Industrial Printing

Why end users are retrofitting with UV LED curing to upgrade existing print operations.

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Introduction

Technology and market trends are prompting industrial print production managers to consider UV LED inkjet printing to improve their product identification and decorating operations. The combination of digital inkjet printing and UV LED curing offers many benefits to existing in-house print operations in a wide variety of manufacturing plants. Many production managers simply retrofit their existing line to enjoy a quick return on their investment. In this article we'll discuss the technology and market trends driving adoption, along with the benefits of using UV LED digital inkjet for industrial printing.

Industrial printing, a print operation used during the manufacture of a finished subassembly or product, is commonly used for many kinds of products from automotive interior parts to pharmaceutical packaging, promotional items, home appliances, and consumer electronics. Many of these print operations are simple marking or coding of required identification data such as UPC bar codes, serial numbers, etc. and already use thermal inkjet or have/are upgrading to use a UV LED digital inkjet printer, most often offered by the UV LED ink supplier.

What is more interesting and the focus of this article are industrial print operations which print more complex identification or even decoration directly onto the part, and are not currently using an inkjet printing process or are already using inkjet printing with traditional UV curing. For example, manufacturers using pad printing or silk screening to decorate or mark a part are now primary candidates for UV LED inkjet printing. Likewise, anyone already using inkjet printing with traditional UV curing on their manufactured part should evaluate upgrading to UV LED curing.

Converging technology and market trends

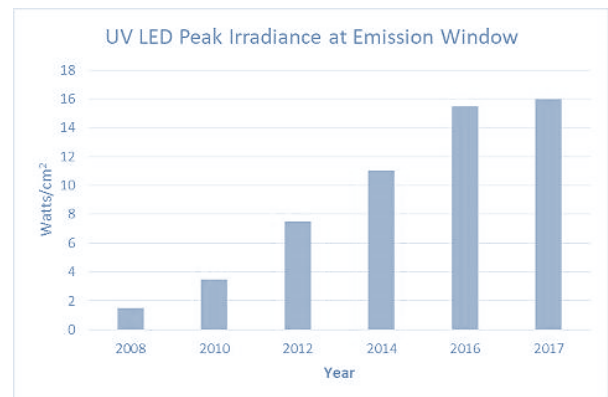
Let's start by understanding some of the key technology and market trends. On the technology side, advances in digital inkjet printhead and UV LED curing technology make it economical to retrofit UV LED inkjet printing into existing industrial printing operations.

Digital inkjet technology advances

Digital inkjet printing has already made significant inroads into many traditional analog print processes (wide format, flexo, and other graphic arts printing) due to its inherent advantages of being easy to print variable data and almost no set-up time with near or equal print quality. Drop-on-demand, DoD, printheads, specifically piezo greyscale printheads are able to precisely print millions of drops per second on a micro scale to produce high-quality print more economically (faster printing with fewer printheads). Most industrial printing operations such as pad printing or screen printing already use single-pass, fixed printing, so it's easy to retrofit single-pass inkjet printheads in the same space on the production line.

UV LED curing advances

UV LED curing, in commercial use since the mid 2000's, has advanced rapidly. The UV energy output, or peak irradiance in W/cm^2 , for air-cooled systems increased from about 1.5 to 11 from 2008 to 2014. Today it is common to find air-cooled UV LED curing systems with peak irradiance of 12 to 14 W/cm^2 and even 16 W/cm^2 . These advances are due to the historically rapid advancement of UV LED chip technology which has seen 10 – 20% increases in efficiency every 9 – 12 months.



And even more important to end users, UV LED system manufacturers have made significant advances in cooling techniques and optics, enabling tighter packaging of LED chips into arrays and significantly improved optical control resulting in higher UV energy onto the substrate. This makes high-speed printing processes like industrial inkjet printing feasible. Today we are seeing UV inkjet ink formulators develop UV LED-curable inks for a wide variety of non-porous substrates typically used in industrial printing applications such as plastics and metals.

Customization and flexibility are top market trends

The top market trends impacting industrial printers include:

- Increasing need to economically print shorter runs
- Easier customization
- Flexibility to print on different part sizes and materials

Mass personalization is a continuing trend that means industrial printers need the ability to print custom designs such as logos, dates, languages, or custom art onto a smaller number of products. At these lower volume production runs traditional industrial print processes like pad and screen printing, which require longer set-up time, are not as economical or as fast compared to digital inkjet.

Many industrial printing operations need the flexibility to print onto a variety of parts that may vary in size and materials. For example, in a medical device plant the same print operation may be used for different size variations of a device or different types of plastics. Or an automotive supplier may need to print interior components specific to each automotive OEM customer and vehicle type. With inkjet printers, the inks are formulated for specific substrates and UV inks typically offer excellent adhesion to a wide variety of materials.

Also, since the ink is jetted onto the product, the printhead won't damage fragile substrates like glass and the printheads can be configured to accommodate different print areas and different sizes of parts.

Benefits of adopting UV LED inkjet

UV LED inkjet offers many advantages and benefits for industrial printing operations. The biggest benefit is being able to quickly deliver customized, lower volume product runs at lower cost than is possible with pad or screen printing. Typically there is also less waste with UV LED inkjet because it is a consistent process, so there is a much lower scrap rate due to a bad print on the finished product. This has a big impact on lowering costs. Industrial printers also get more flexibility to run a wider variety of substrates without damage to heat sensitive or fragile parts.

Benefits of UV LED Inkjet for Industrial Printing

- Lower Costs for Short Runs
- Quicker Turnaround
- Lower Scrap Rates
- Easier to Run Customized Specialty Products
- Increased Flexibility

Benefits even for existing UV inkjet industrial printers

For industrial print operations already using traditional UV curing and inkjet printing, upgrading to UV LED curing provides lower operating and maintenance costs, less downtime, a safer work environment since there's no mercury or ozone, and even less heat onto the substrate. For example, most cable marking operations already use high-speed UV inkjet printing methods and are concerned about heat management to prevent damaging sensitive cable materials. These operations could easily upgrade to UV LED curing to more easily manage heat, lower operating costs and reduce downtime.

| Benefits of UV LED versus Traditional UV Curing | |
|---|---------------------------------------|
| Operating Life | Operating Life 10X Longer |
| Energy Use | About 1/3 Less Energy |
| Space Needed | Smaller Form Factor, Easy Integration |
| Environment | No Mercury or Ozone |
| Flexibility | Instant On/Off, Dimming |
| Production | Lower Costs, Higher Production Rates |

Embossing effects possible

With UV LED inkjet it is possible to print inks as thick as 100 to 150 microns to create an embossed effect onto the substrate. So industrial print operations using screen printing to print braille or decorating ceramics and glass can reap the benefits of UV LED inkjet as well. For example, pharmaceutical products are now required to have braille on them and some manufacturers are using UV LED inkjet printing to create the braille because it delivers more consistent print quality at higher production speeds than screen printing.

UV LED inkjet for industrial printing

UV LED inks are not ideal for every application, but are a perfect match for many industrial printing applications where their better adhesion makes them more permanent, an important functional requirement for most industrial printing applications. And even though brilliant whites are still a challenge with UV LED inks which tend to be slightly yellow, for most industrial print applications this is good enough.

For industrial print applications that require excellent scratch and scuff resistance, which can be challenging using UV LED inks, using a hybrid UV LED ink with some kind of secondary

cure mechanism can enable the use of UV LED curing for pinning enabling faster production speeds without losing print quality. Industrial printers should evaluate retrofitting their existing pad or screen printing line with digital inkjet printheads and UV LED curing units for an inexpensive and easy upgrade that delivers more flexibility, quicker turnaround time for lower volume print runs, and lower operating costs resulting in an impressive return on investment.

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