

Single-Pass Inkjet for High Quality Package Printing

Abstract

Digital printing for the packaging industry has traditionally meant single-color printing of barcodes, dates and serial numbers, and more recently, developments in electrophotography have led to good quality 4-7 color digital printing of labels.

But piezoelectric drop-on-demand inkjet technology is poised to have a significant impact on high-quality color printing of primary and secondary packaging.

The Package Printing Market

According to a study by research company Pira International Ltd, global consumption of packaging materials in 2005 was \$477bn, and is forecasted to grow to \$618bn by 2011. By this date, the breakdown of packaging materials is expected to be:

- Paper & board 38%
- Rigid plastics 21%
- Flexible packaging 13%
- Metal 16%
- Glass 6%
- Other 6%

The same source forecasts the value of printing for the packaging market as growing from \$215bn to \$291bn over the 2005-2011 period, and divides printing methods by 2001 as follows:

- Offset 34%
- Flexo 36%
- Gravure 15%
- Screen 4%
- Digital 7%
- Other 4%

It should be noted that in 2005 digital printing accounted for only 2.7% of package printing, and is forecast to grow by 23.2% per year over the forecast period – by far the highest rate of growth of any of the listed printing technologies.

Current digital printing is (a) almost entirely confined to label printing, and (b) almost entirely based upon electrophotography. As a 2007 Freedonia study of the world label market makes clear, packaging is the biggest single area of application for label printing, a market that is forecast to be \$100bn in 2011. Within the label printing field, pressure-sensitive labels are the most significant segment, forecast to grow to 55% of all label production by 2011.

Why digital?

Label printing is moving from analog to digital for the same reason that other areas of print (wide-format, commercial, and textile printing for example) are changing: better economics for short-runs, shorter cycle-times, reduced waste, and the possibility of printing variable data. With product varieties proliferating, and product life-cycles becoming ever shorter, the ability to print labels or packages on demand is becoming increasingly critical. Add to this the need to meet changing regulatory requirements for label text in a variety of languages, the need for product traceability (“ePedigree”), the need to improve supply chain efficiencies and to reduce waste by printing only what is needed, and the case for digital printing becomes compelling.

Inkjet v Toner-based Printers

The digital printing referenced in the above studies is mainly done by HP Indigo™ and Punch Graphics' Xeikon™ machines using, respectively liquid and powder toner to print onto roll label stock for primary label applications. According to consultants I.T. Strategies, over 700 such machines are in the field. The technology has allowed label converters to offer the benefits of digital printing, while maintaining print quality in four or more colors that is close to that obtainable with flexo. But the printers are relatively slow and, more importantly, limited in the format and type of substrate they can handle, and in the inks available.

Inkjet printing potentially overcomes some of these limitations: it is non-contact, and so can deal with some unevenness in the surface of the substrate; the substrate does not have to be in roll or cut-sheet form; it can be of any width; if any surface preparation is needed, it is likely to be similar to that already familiar to conventional printers (e.g. corona-treatment); and an inkjet unit can be integrated into a multi-unit web press. Examples of the last are the Nilpeter 'Caslon' machine, and Stork Prints' DSI inkjet module.

A more direct inkjet competitor to the toner-based printers is EFI Jetrion, with its Series 4000 color label printer. This narrow-web four-color UV machine is the current inkjet leader in terms of units installed, and the company claims a lower cost per label than is possible with the longer-established toner systems. EFI recently announced a collaboration with laser die-cutting manufacturer Spartanics to provide a digital converting solution. Other machine-builders, like Minneapolis-based Delta Industrial, have come at the problem the other way around – from the starting point of a custom converting machine manufacturer who has added color inkjet printing.

At Labelexpo this September, it is expected that at least one leading European vendor will show an integrated inkjet/converting solution.

DOD ('drop-on-demand') inkjet printing is not new, and has indeed been well-established in secondary packaging (outer case coding & marking) for many years. So it might reasonably be asked: why the sudden surge in interest in the technology for prime labels and direct-to-package printing? The answer lies in recent improvements in both the print quality and the reliability obtainable with piezo printheads. Most packaging materials require UV-curable or solvent-based inks, and until recently, the printheads capable of jetting such inks were developed for wide/grand-format application and had 40-80pl drop volumes. Newer greyscale printheads, capable of dynamically varying drop sizes in a typical range from 6-42pl have improved print quality without sacrificing productivity.

Of arguably greater importance is the improved reliability of single-pass inkjet printers provided by the recirculating ink supply system patented by Xaar under the name of 'through-flow'. The ink flow past each nozzle orifice reduces the likelihood of 'jet-outs' caused by gas bubbles or mechanical shock, and provides a self-recovery mechanism in case of such a failure. The result is a reduced need for maintenance of the print system. All the above-mentioned printers use this system.

Direct to Package Printing

Thus far we have mainly addressed digital label printing, in which toner-based systems have achieved the greatest initial penetration. Printing to flexible packaging roll-stock (PP, PE, BOPP, etc) is also open to competition between toner and inkjet systems. But we have seen that there are good reasons why inkjet is more likely to be the chosen digital technology for printing direct to product packaging, albeit at much lower speeds than package printers are used to. Dry-offset printing of cans and plastic containers is well-established, and very fast (2,000 cans/minute is not exceptional). But several companies are prototyping inkjet systems for short-run container decorating. One that has described its work publicly is Crown Holdings, whose beverage can business unit is using a custom-designed inkjet printer with Xaar printheads and custom inks supplied by EFI-Jettrion to print on sheet metal prior to forming of cans.

Other companies are looking at inkjet printing 'in the round' and even printing on irregular-shaped containers. In several applications, digital printing looks set complement – and potentially to supplant - screen- and pad-printing, as major companies like ITW Transtech start to offer single-pass inkjet printers that integrate into automated production lines.

Summary

The long-anticipated advent of high quality inkjet printing at a reliability level that is suitable for industrial production is now at hand. As with all disruptive technologies, it does not meet all user needs and, in particular, is significantly slower than conventional analog printing methods, if pre-press and make-ready are discounted, and only line-speed measured. But inkjet's flexibility in terms of ink and substrates, the environmental benefits of reduced waste, the ability to offer fast turn-around times, and the ability to print short runs economically will ensure that inkjet will play a major role in the development of package printing in the coming decade.

Author Biography

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