A Screen Printers' Guide to Digital Flatbed Printing

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Introduction

Sometimes it seems that there is a new digital version of everything - cameras, music, and film. We adopt new technology with enthusiasm. The digital takeover that we all see in our home and in the high street has also been taking place behind the doors of print firms around the world. Digital printers use a data file, unlike other print disciplines that use fixed photographic plates or screens to define the image.

Digital printing is a broad term. At the small-scale end is office printing – the friendly inkjet printer by your desk (or at home). At the other extreme are digital offset machines, from Indigo for example, and five metre wide superwide vinyl roll-to-roll printers such as the Vutek range. In between is the main bulk of commercial wide-format printing using, in the main, inkjet technology.

The majority of wide-format printers today use water-based dye or pigment inks, mainly through thermal print heads. Examples are those made by HP, Roland and Encad. The print from this group of machines is not really an outdoor product. It relies on a special water-receptive coating on the small range of media that it supports. The solvent printers all use piezo-electric technology print heads, providing a much more robust and long-lasting head. Solvent printing, however, is used for a limited range of substrates, typically flexible vinyl-based, either self-adhesive or banner grade.

But the big area, and the one of great interest to screen printers is flatbed digital printing, using UV cured inks, printing onto rigid substrates. In this segment are machines supplied by a number of manufacturers including Inca, Zund, Vutek and Scitex.

Flatbed digital printers are used in short runs to produce the kind of direct-to-substrate jobs that screen print has done historically, such as point of sale, graphics and signage. A flatbed printer holds a rigid substrate and can print something roughly as big as the bed itself. The bed has to be able to support substrates that are thick and heavy. Its X- and Y-axis control must be precise, and operate at high speed to take advantage of new fast-drying inks. And it has to lay down ink precisely and consistently.

Flatbed digital printers are becoming popular because they solve a problem

Unlike screen printing, digital flatbed printing has little in the way of pre-press processes, so it gets to work more quickly. After printing there is no cleaning out to do, so the machine can move on to the next job as soon as the next substrate is loaded. Digital flatbed printing thus offers ease and speed of setting up, as well as good quality printing. It also gives print buyers an opportunity to cut down on waste.

Once running, screen printing is fast. While the set up costs are high, the marginal costs of keeping a press running are low, so many buyers are tempted to order too much "just in case", and store the surplus. Stocks of finished print can end up being held indefinitely in-store, in warehouses, or on call-off with the printer. The amount of waste is staggering.

Factfile 1: It is estimated that up to 50% of print production is unused. How does it happen? Imagine a buyer needs 3,000 pieces. But it costs little more to have 4,000, so the firm opts for the higher volume. It can take up to 6 – 8 weeks to get the piece designed, approved and signed off, and by then a senior person decides they might as well have 7,000 as it costs so little extra. Finally it gets printed. The piece is out-of-date the minute it is printed. But it won't get re-printed with so many copies in stock.

By contrast, the digital discipline works "just in time". It is easy to print quickly a few hundred off. The buyer can change the text or graphics electronically, and send the data to the printer who can print and deliver fast. It offers the flexibility to print in different languages, make special offers, and so on. A buyer may order a dozen different versions throughout the year. The total volume printed might be greater than a large screen print order, but many more pieces will be used, rather than sitting gathering dust, with all the storage costs that generates.

UV curing inks

Almost all digital flatbed machines available now use UV curing ink. Solvent-based inks provide good adhesion to a specific range of substrates and they are durable and colourfast. But they have a strong odour and are classified as harmful. Digital solvent inks can contain 70% or more volatile material. Volatile organic compounds (VOCs) are environmentally undesirable and are, in fact, controlled by regulations. Firms can only emit a limited quantity of these before they are obliged to burn or re-cycle them. By contrast, the formulation of UV ink is relatively benign.

Factfile 2: If a flatbed digital solvent print machine uses 2 tonnes of ink in a year, 70% of which is solvent, that means 1400 kg of solvent per machine emerges. If the firm runs five machines, a total of *seven tonnes of solvent* comes out of the process in a year.

UV curing ink is formulated to dry when ultra-violet radiation is aimed at it. It is a phase-change process. The UV radiation causes the monomers in the ink to polymerise, trapping the colour pigment. Screen printing has moved rapidly over to UV curing inks, partly for environmental reasons, but also because of the considerable reduction in wastage and better colour consistency.

Most digital flatbed machine makers started off using solvent based inks, but have now switched from solvent to UV inks. Sericol, a leading ink manufacturer, having already developed UV inks for the screen industry, recognised that digital markets would also need UV inks for what is essentially the same application, and so specified UV from scratch.

Factfile 3: ***"UV curing"*** means that UV radiation dries the ink. Some water-based ink products offer a "UV resistant" ink set: ink that will not fade quickly in daylight – an entirely different meaning.

UV ink dries near instantly at any speed: it is liquid until the UV radiation hits it, causing it to dry immediately. This allows digital flatbed inkjet machines to operate at high speed.

In a UV inkjet process print nozzles do not get blocked because there is no evaporation or natural drying of the ink on or around the print head. This helps to prolong the durability of print heads and to maintain the "up-time" of the machine.

The pigment particles in UV inkjet inks are around 1,000 times smaller in volume than in its screen equivalent. Moreover, the dots produced using UV inks suffer from far less dot gain than solvent, resulting in finer, sharper images.

From product-led to application-driven

There are many hundreds of digital flatbed printers in use around the world, and the numbers grow daily. Among the main suppliers are Durst, Scitex, Vutek, Zund and the market leading Eagle and Columbia machines from Inca.

Originally when the technology became available, machine manufacturers adapted existing wide-format solvent or water-based machines and went off in search of an application. This product-led method largely failed. The successful approach by others in this field was to plan machines "holistically" with application, ink, substrate and machine working together. Sericol, with its application expertise, helped to develop with Inca the specification for their Eagle and Columbia machines. The main application requirements are a blend of cure rate, adhesion, light-fastness, durability and mechanical properties. This application-driven approach has been considerably more successful in meeting the needs of the market.

Factfile 4: Digital flatbed printers will print on wide variety of substrates:

Foam centred board, foam PVC, polycarbonate, polystyrene, rigid PVC, self-adhesive PVC, ABS, acrylic, coated metals, corrugated, display board, fluted polypropylene, and even wood.

If you are buying a machine, get your prospective supplier to let you test all the possible substrates you might want to print on. Then check the quality with your buyers.

There are two main types of machine in the market. One type, in which Zund is the market leader, is a highly flexible machine, often used for investigating new markets, looking for new applications and novel ideas. These are typically slower printers bought by purchasers that do not have big volume commitments for their machine.

The other type consists of machines designed for production. They are bought to run full-time, offering high throughput, high quality and profitable output with, importantly, high "up-time". The Eagle and Columbia models from Inca offer the highest production speeds on the market by some margin.

Digital developments to expect

Despite huge advances in digital flatbed printing, there are still significant developments needed to compete alongside screen printing in the low volume end of the market. Screen printing has an important home-field advantage, which digital machines cannot yet match – spot colour. A digital machine would have to be able to deliver up to 6 colours per print, both transparent and opaque, from a palette of more than 500 colours. In addition screen printing can deliver specialist inks, such as fluorescent and metallic colours, which cannot be jetted today due to the physical properties of the pigment particles used.

At the moment digital inkjet printing uses universal ink. That is, ink formulated to work in any application asked of the printer. Changing ink on a digital machine is a cumbersome and wasteful process: ink feed systems are long and they have filters that need to be changed as well. Ink lost in removing the old product is not large in volume, but since ink performance is typically 100m^2 per kilogram, even a small wastage can mean a good deal of potential print lost.

There is a work-around: some digital flatbed machines have been designed with registration pins and a screen vacuum bed. This means that the substrate is always perfectly aligned. The digital printer will happily lay down the main design, and the substrate can then be passed through a screen press to add spot colours. Or, in fact, they will also print graphics onto a screen-printed substrate. And in the case of the Inca's Eagle and Columbia machines, the registration pins retract to allow true edge-to-edge printing, without having to trim the substrate after printing.

Some surfaces are difficult to print on, both for screen and digital processes. To overcome this currently, you can put a pre-coating on it, flame treat it, and corona treat it. But it is likely in the future that substrate- or application-specific inks will be developed for the digital market, as they have been for screen printing.

There is a constraint on getting new digital inks to market quickly: gaining approval from print head makers is a necessarily thorough process. Manufacturers have to be certain that the ink will work with their head satisfactorily, and not cause maintenance or warranty problems. So usually inks are optimised for each print head type.

Finally, screen inks cope better than digital with tough post-press conditions such as moulding, high flexibility and high temperatures. In future, therefore, expect to see digital machines designed to handle tougher application specifications, offering more durability and adhesion. As production speeds increase, it will help digital machines to contribute fully as part of a multi-press process.

The natural evolution of digital flatbed printing will be to develop single pass machines. Currently all wide-format machines have a small number of print heads, due to their cost. By reciprocation processes, they plot an XY movement to build the image. A single pass machine would be quicker with less mechanical movement.

As digital productivity climbs, the economic run length compared to 4-colour screen printing gets larger. For example, right now the cost of printing on a Columbia beats 4-colour screen up to around 150 prints. But just a small percentage gain in productivity will push that figure much higher. In a few years, its makers expect it to match the cost of 4-colour at up to 250 prints.

The digital flatbed printing market is here and expanding. It offers a new opportunity in short run printing, which many purely screen firms were not able to address profitably. There are good and bad machines, as in all areas of industry, and UV curing inks are clearly a differentiating factor. The machine designs that are sharply focussed on the application and the needs of customers will come to the fore.

After all, customers do not walk in and ask for a kilogram of screen print, they ask for a specific printed product. Firms have to be able to produce good quality, good value work for customers in the way that suits the customer's needs. In more and more cases, the best answer is digital flatbed printing.

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