AN EXACT SCIENCE

Mark Bale examines lab testing materials for new inkjet applications and explains how training services can help users to fast track their printing ambitions

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With inkjet printing making inroads into all sorts of industrial uses, the number of different materials being used has increased exponentially. This has allowed the flexibility of digital to be brought to applications previously covered by a multitude of analogue print methods.

In this article, we look at the increasing importance of laboratory pre-testing for investigating the viability of inkjet processes to address the needs of industrial manufacturing.

WHY INKJET?

This question comes up again and again when we consult for clients on the possibilities of using inkjet deposition in different industries. In applications involving versioning or personalisation of graphic decoration, it is often the ability to make short runs, or produce one-offs that is the driving factor. In markets where this is a benefit, inkjet was first implemented as complementary technology. A good example

"We have even helped on a project printing with DNA"

being the printing of variable data at high-speed using continuous inkjet (CIJ) onto newspapers or magazines. As was seen first in narrow web labels, the trend has been to replace the flexo and offset printers with technology that prints the entire graphic. This has evolved into ever-more-expensive printers for ceramic tiles, textiles, corrugated board, wallpaper, flooring etc.

In industrial printing, one of the biggest advantages of inkjet is the fact that it is non-contact. This means that it is possible to decorate irregular or fragile parts. The ceramic tile market benefitted in this respect and is often quoted as the biggest inkjet success story; with inkjet printers replacing screen and roller printing with an unprecedented adoption rate throughout the 2010s. Printed electronics is another area inkjet has benefitted, including printing of thin silicon wafers for solar cells.

Narrow-web label printing was one of the most active markets for industrial inkjet print, but soon eclipsed by ceramic tiles. More recently near-complete freedom in design flexibility is being made possible by '2.5D' of topography and functional 3D additive manufacturing.

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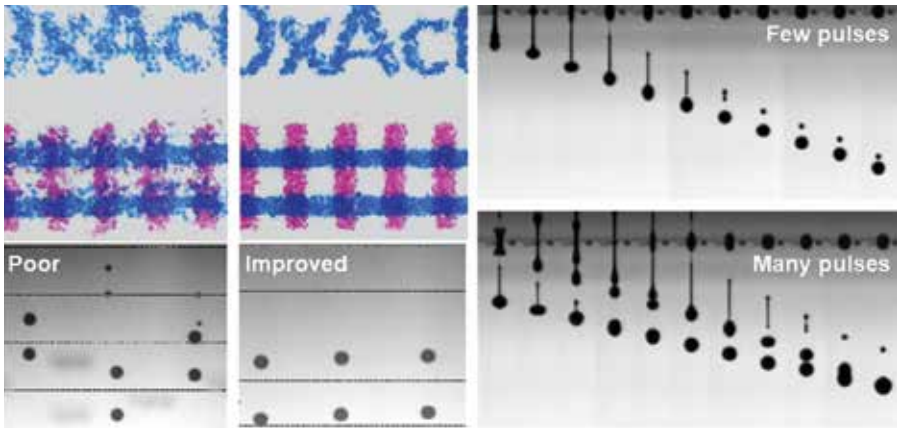
Scope for inkjet applications continues to increase with the evolution of printhead design

Dropwatchers in DoDxAct's UK lab and example images from looking at a Dimatix SG1024SA printhead



Inks can be tuned to improve jetting, and printhead waveform can be tuned to improve ink performance (left) and droplet size (right)

INKJET HEADS FOR SPECIALIST USE

One of the things that has enabled the ever-widening use of inkjet has been the evolution in printhead design that has made it possible to print on more challenging materials.

For ceramics, this was largely down to the ability to recirculate the ink to prevent the heavy inorganic pigments from settling out. After the early success of Xaar, almost all head manufacturers now offer printheads to the market to make this possible, including Fujifilm Dimatix, Kyocera, Seiko, ToshibaTec and Konica Minolta, with some of those now also available for water-based inks.

Over a similar period, there has been a steady growth in the use of inkjet in additive manufacturing (also known as 3D printing). This is a further industrial use that features a complex range of materials, from nanoparticles in solvents through to 100% light-reactive liquid resins. There are even 3D-printed pharmaceuticals that are approved for use[1].

IMPORTANCE OF TESTING

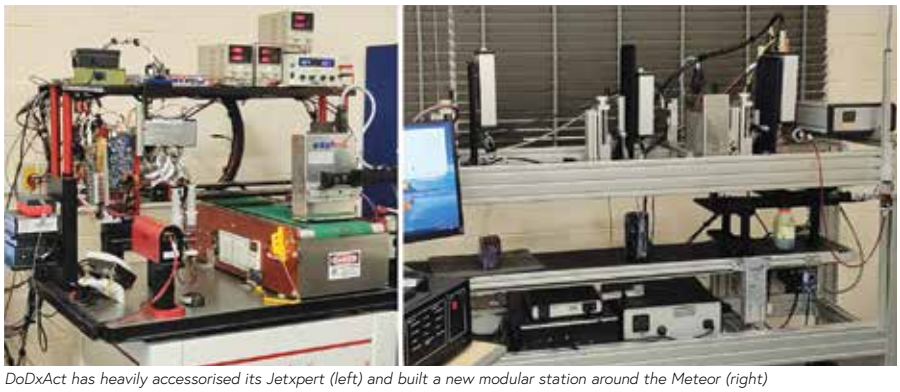
In our experience the consistent factor in getting applications into production is in understanding the interaction between the latest promising new material and the printhead, and then finding the best possible combination of available technology that achieves the all-important reliability for production. As we shall explore, this involves tuning of the fluid in combination with the design of the system, both in terms of head selection and ink delivery system, and the complex driving signals (waveform).

Because of the importance originally attached to making pretty droplets, ink labs specialising in inkjet have invested £ millions over many years into advanced optics for viewing the drops. Since the early 2000s, many hundreds of 'dropwatchers' have been sold around the world, and the author alone has had the pleasure of using six different types in his inkjet career. Meteor gave a nice introduction to theirs in a previous *Specialist Printing Worldwide* article[2].

"Ink labs specialising in inkjet have invested millions in advanced optics for viewing the drops"

The dropwatcher can be used in two main ways, depending on the expertise of the company that owns it. For many ink makers it was usual to tune the ink formulation by materials selection until a desirable image was obtained. This is still the case for some printheads, where the head waveform cannot be so easily modified. Alternatively, the head waveform can be tuned to maximise the performance of a given ink in a specific print, although this is not always allowable by the manufacturer.

In reality, most practical solutions for industrial inkjet deposition require a combination of approaches because a waveform alone cannot make an ink with the wrong physical properties suddenly become 'jettable'. However, as Xaar has shown in the last few years, some of the previously accepted 'norms' for inkjet printhead suitability can now be challenged, such as viscosity[3].



DoDxAct has heavily accessorised its Jetxpert (left) and built a new modular station around the Meteor (right)

NOT JUST JETTING

At DoDxAct [pronounced 'dee-oh-dee' exact] we help people who want to use inkjet by removing some of the learning challenges. As no process can be adequately demonstrated without the ability to print, both of our dropwatchers are also integrated into print platforms. The first of these is a commercial system, the Jetxpert Print Station, which we have heavily modified to meet the complex multi-project needs of our customers. The second, we built around the Meteor Dropwatcher and its modular approach to connectivity[4].

Using this equipment, we can expand from printhead testing into characterising substrate interactions or process integration (combinatorial experiments with other coating processes) and thus explore the end-use suitability. The diversity of graphic materials we have worked on ranges from UV inks for metal building cladding through to water-based inks for packaging. At the functional end we have tested binders and resins for 3D printing and ceramics fluids for electronic devices. We have even helped on a project printing with DNA.

In every project we have supported, whether it be a simple waveform tuning on CMYK, or a full ink formulation development project on a 3D binder, we have found that it is the combination of our chemistry understanding, practical equipment experiences and our process implementation know-how that has made DoDxAct's support so unique and helpful. All of this is underpinned by a knowledge of 'what to test and how' so that new applications can be brought to market much faster. ■

References

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