

A techie's dream destination

The broad inkjet church was out in force at TheJJC conference, with cutting edge technical developments to the fore. Heads, inks, presses, integrations, drying, control and software are combining to improve quality, reliability and productivity opening more applications, including labels and packaging. Report by *Sean Smyth*.

Organisers of TheJJC, ESMA was originally founded as the Association of European Manufacturers of Screen Printing Equipment back in 1990. It has developed to encompass new inkjet technology that is impacting their markets and launched a very successful new conference and exhibition, The Inkjet Engineering and Inkjet Chemistry conference in 2014.

TheJJC has grown significantly, attracting some 230 delegates to listen to 52 talks across two tracks, and providing a range of workshops in early October in Düsseldorf. There were also some 35 tabletop exhibitors showing off their capabilities and new innovations. This is primarily a technical and engineering conference aimed at equipment suppliers, with ink and control systems in evidence. The participants are bona fide authorities on their subjects, with patent holders and inventors much in evidence. A techie's dream destination, with innovation, education, knowledge sharing and networking firmly on the agenda.

Inkjet ahead

Before the event, there was a series of workshops about various facets of inkjet and I was invited to conduct one entitled 'Inkjet in Packaging'. This attracted some 30 participants, keen to better understand the opportunities and barriers of using inkjet in labels, cartons, flexibles, corrugated and in direct-to-shape for bottles, cans, tubes, tubs and caps.

As an exercise I passed around a pair of prints of identical subjects asking which was better. The results showed 23 votes for the inkjet

print (using the latest HP HDNA architecture) against just seven for the sheetfed litho sample. I did the same exercise at an event in Chicago in September where from about 70 voters, there was a majority of one favouring the inkjet sample. Now, I don't pretend this is a scientific measure, but I do think this is significant, because it demonstrates that inkjet print quality has improved greatly. It is certainly capable of delivering premium quality alongside litho and flexo in packaging and labels. Inkjet is well established in labels with systems delivering over 100 m/min at widths up to 400 or 500 mm, and packaging is seen as a great opportunity by many developers. In corrugated, a new range of single pass machines are creating huge interest for liner and post-print sheet printing with many machines coming to the market. The performance is improving in systems with the proposed Screen/BHS 2.8 m corrugated device, which has a top speed of 300 m/min, the most productive machine in the pipeline. This will no doubt be overtaken soon.

Covering the bases

The conference presentations covered all the applications of inkjet, commercial, publication and industrial as well as packaging. Speakers provided huge amount of detail about the intricacies of ink formulation – creating and stabilising pigment dispersions, new printhead designs, developing colour measuring and control, curing and drying and solving engineering issues involved in the supply.

As inkjet technology develops (and it will be 150 years since the first



Attendees at one of the conference tracks at TheJJC conference in Düsseldorf, October 2016

patents for the Kelvin Recording Syphon next year), it is being used in more applications, at higher speeds with new capabilities. If you wanted to know the relative merits of a shared wall piezo printhead (high nozzle density) or an isolated channel alternative (potentially three times faster firing rates) this was the place to come. And you would learn the optimal methods to manufacture them, and the waveform tuning to optimise image quality with the most appropriate ink and drying combination.

There were also some tasters of new technology that is in the pipeline. UV inkjet was at the helm, with LED curing systems poised to broaden the capabilities in labels and packaging, with new UV-C LED chips coming onto the market that will aid surface curing, particularly important in varnishing that is growing strongly in label and carton printing.

Curing and variable data

Lawrence Gamblin, president Collins Inkjet, talked about the developments his company, now owned by Japanese Chemical company Kao, have made in electron beam curing inks for the packaging and pharmaceutical sectors. He stressed the advantages of the technology in formulating inks for labels and flexible packaging, a guaranteed through cure that eliminates potential migration with no photoinitiator. This makes inks lower cost to make than UV, with greater stability and longer shelf life. He also mentioned tests carried out onto films with print speed of 40 m/sec achievable which is some 10 times faster than alternative inkjet systems under discussion.

EB curing is accomplished using a curtain of electrons bombarding the printed surface, usually under nitrogen. No pinning is required, and the curing occurs at low temperature with no need for cooling which will prove to be useful for thin heat sensitive films. Mr Gamblin reported interest from suppliers of sweet wrappers and wraparound labels.

Florian Fassler, head of digital applications at Wifag-Polytype, shared his company's experience in using variable data in packaging and labels. He explained about the different categories of variable data:

- coding and marking in technical date including competition and security applications;
- for short runs including the requirement to mix designs into the supply chain, and
- full variability including personalisation that will put significant loads onto the workflow and digital front ends.

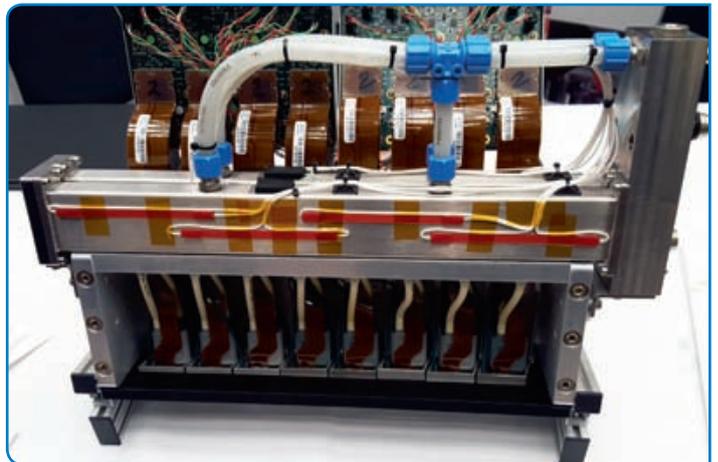
The use of variable graphics is not high in labels and packaging but it will grow, and it is important that companies understand the different loads this will place on pre-press (and administration) functions, and plan accordingly.

Inkjet expertise

Martin Bailey, CTO of Global Graphics, made an interesting presentation about the use of software that can be helpful in solving issues that crop up in developing turnkey and bespoke inkjet systems. Global Graphics produces RIPs and digital front ends, with much expertise in developing

workflow solutions, as well as bespoke solutions that enable systems to improve performance.

The company offers software and engineering services for labels and packaging presses, called Fundamentals. This helps inkjet press manufacturers and integrators reduce time to market and engineering costs. Fundamentals can also be applied to existing presses to overcome common quality issues, such as poor quality barcodes or small text, or defects caused by mottling and chaining, irrespective of other software choices that may have been made.



Inca Digital array of eight Fujifilm Dimatix Samba heads with electronics and ink delivery, which can be scaled to provide high performance

Industrial Inkjet Ltd (IIJ) is a leading integrator and problem solver. Paddy O'Hara, director of technology, talked about the company's experience in providing inline packaging inkjet systems. There are many enquiries for bespoke solutions and IIJ has considerable experience in marrying the heads, ink, electronics and software, pre-treatment, post treatment and verification, together these comprise the necessary enabling technologies for companies looking to add variable data capability at high production speeds. The challenge at high speed from a single pass system is to minimise time in flight and associated errors that can lead to artefacts and problems. The company supplies Konica Minolta printheads but is ink agnostic, highlighting the importance of thorough testing for a particular application. It uses a seven-stage ink testing process:

1. Checking compatibility with the head
2. Jetting reliability
3. Latency – the impact of not printing on a nozzle (may be issues with water based)
4. Reliability at high frequency
5. Stability in the printhead over a period
6. Print quality
7. Machine test

These tests are time consuming and expensive, but necessary to provide reliable, workable solutions. Mr O'Hara's message about the importance of proven experience in providing reliable, working solutions was echoed by many other contributors.

Streams of ink

Dan Denofsky, director, partner business development at Kodak, described the new UltraStream technology, with the company actively looking for partners to bring system to the market. He explained the advantages of continuous inkjet technology in terms of very high speeds delivering fast, uniform round drops that are satellite free. The water-based inks feature very small pigment particle size resulting in greater reflectance that gives very wide gamut and brightness. The inks continually wet the inkjet nozzle, meaning the formulators do not have to add humectants (wetting components) that keep the non-printing nozzles open that is needed in drop on demand technology. These are needed to boost nozzle performance, but do not help ink interactions at the substrate surface.

At drupa, Kodak showed a seven colour plus varnish system using Stream technology running at up to 200 m/min for flexible packaging



Seven colour Kodak Stream inkjet heads mounted onto a Uteco transport to deliver flexible packaging onto foils at speeds up to 200 m/min

on a Uteco press chassis. UltraStream takes the quality forward with smaller drops at the same speeds with the same inks, with a narrow web version for labels featuring XGV (extended gamut with varnish) on offer while Kodak is looking for more partner developers to produce new systems featuring the technology in packaging. The technology uses a clever phased charging mechanism to deflect the drops that do not print, eliminating the laminar airflow that blows away the non-printing drops in Stream technology that is used in the Bobst corrugated press. This makes the UltraStream heads smaller and simpler than the Stream heads, saving space and making them easier to integrate. Kodak said the heads will last for over 3 trillion drops (this works out to almost six years of continuous running), then they can be returned for refurbishment.

Ink drops

The drop on demand printhead suppliers were pushing advantages of their technology. Shane O'Neill, European sales manager, Fujifilm Dimatix, highlighted the higher speed, improved reliability and quality that is driving suppliers to use silicon MEMS (microelectromechanical

systems) technology to produce the nozzle and ink chamber system in a printhead. The consistency of manufacturing precision components is improved, to deliver smaller drops at high speed. Dimatix uses this to make the nozzle jetting chamber in the Samba heads, from a single monolithic construction that gives better accuracy and greater stability. The very fine micro engineering allows a smaller drop size of 2 pl, with a lower energy native pulse needed to create the drop, and there will be smaller nozzle error distributions.

Fujifilm employs a sophisticated sputtering process to add the piezoelectric material onto the wafers that means there is no wear on the piezo components that can cause heads to fail in operation. Dimatix said the heads have a life specification of 25 trillion actuations, almost eight years of continuous operation, this durability is key for further adoption in high performance applications.

One customer is Screen-owned Inca Digital, which is using the Samba heads in its development with BHS Corrugated Maschinen und Anlagenbau GmbH to print liner. The print engine will be 2.8 m wide, using aqueous inks with speeds up to 300 m/min, and is positioned before the corrugator and sheeter, to deliver printed sheets. It is the only reel to printed sheet system and BHS plans to sell the machine either as an option for new corrugators, or as an upgrade to existing installations. The single pass print bar will contain 68 individual 43 mm wide heads, and Inca is identifying other applications where wide arrays will be required. It showed the design with a test rig integrating eight of the heads, using the expertise in driving multiple heads they have gained in many high performance flatbed presses.

One of the applications is the very high quality, sheetfed inkjet space, where Heidelberg and Landa are both using Samba heads in their B1 presses. It is also used in the Fujifilm Jet Press 720S, a B2 machine using water-based ink that is finally gaining some traction well after the initial 2008 launch. There are now some 80 machines in the field, many producing high quality cartons.

New applications

Guy Newcombe, CEO of Archipelago, described the Powerdrop Print Engine that his company is developing at its Cambridge location. This is an interesting take on inkjet, with the aim of depositing large amounts of material quickly and accurately. In packaging this could be base white, adhesives, sealants and coatings, including new haptic materials that brands are exploring to add new functions to their packs.

The technology involves a pair of rotating cylinders (or drums), with a series of nozzles in the outer drum. This rotates at the same speed as the substrate passes underneath and a mechanism forces the material through the holes in a controlled manner into the substrate. The nozzles are much larger than in standard inkjet equipment where high quality and sharp text are needed, with a diameter of some 400 microns to allow very small drops in the microlitre scale to be deposited. The larger nozzles will

allow very high viscosity materials such as hot melt adhesives and colourants containing particulates with no nozzle clogging, enabling high opacity white and lustrous metallics. Throw distance depends on drop size, up to 15 mm as the large drops have sufficient inertia to land accurately meaning it can be used on irregular shapes.

The details are still sketchy, but the company claims it should be able to print up to a tonne of material per hour, moving inkjet into painting and adhesive applications. This is in the future; the initial iteration will be for a narrow web similar to a flexo application. The speed is up to 180 m/min, with flood coating the first system. Head addressing is under development to allow patterning and imaging in future plans.

Archipelago's goal is to help its customers to make improvements in quality and efficiency and to reduce waste, through a combination of precision measurement, precision engineering, and understanding of advanced materials. This should translate into accurate dosing of materials, reducing waste through over-dosage which will be a driver for customers to use the system. Compared to spray painting (spray guns put half the paint into the atmosphere, while glue needs solvent added to get through the gun), there will be major VOC reduction as the system allows high viscosity material to be printed, with pay-backs of around six months projected.

Mr Newcombe commented, 'Inkjet is really good at getting drops of fluid to where you want them, but if you put conventional paint or glue into a conventional inkjet head, it blocks it up, in seconds. So you need to use a completely different approach. We've combined our knowledge of materials together with our inkjet experience to create a totally new platform, which is our Powerdrop platform.'

'Many manufacturing operations need to dispense precise, microlitre, quantities of viscous liquids. Conventional metering systems can't deliver volumes that are sufficiently small. Inkjet systems cannot deliver viscous liquids.'

While not available today, this is another example of how inkjet(ish) technology is being adapted and adopted into new applications where there are problems. In packaging, white, adhesives, coatings and new tactile finishes can be digitised using the PowerDrop systems.

Monitoring systems

There are new quality systems for colour and increasingly to detect and eliminate defects at high speed.

German company Baumer has a system originally developed to monitor single pass industrial decoration printing and is looking to supply



Archipelago Powerdrop test rig showing nozzles in rotating drum dispenser

into other inkjet sectors. The modular ColourBrain system is being developed to check colour consistency and identify potential defects. It is working to understand which faults are noticeable by the eye, and so classify the errors and develop a database to determine the actions that need to be taken when a fault is detected.

The system was developed with a couple of universities, combining optical design and human perception. It uses cameras to measure fast moving multi-coloured textures and represent the resulting colour appearance as a mathematical model. In a process colour, application flashing LEDs are tuned to the colours in use (a red LED shows cyan in high contrast, blue and green show yellow and magenta respectively), so any defects in a channel are straightforward to detect.

The system is designed to find flaws without comparing the result to a master images, because fast, wide webs running at hundreds of metres per minute with variable content produce too high data loads that cannot be processed quickly enough to make immediate quality adjustments. The approach is not to use pixel-based monitoring, rather to adopt one based on colour and appearance modelling. Cameras with a resolution of 720 dpi, running at 50 m/min (designed to be upgraded to 150 m/min) will be installed early in 2017 on a 225 cm wide Hymmen single pass system.

Baumer has systems that can be used with packaging and code reading, and is looking at high speed single pass inkjet as a key potential market in future. These will be used to check colour throughout a run and to improve consistency between runs, even when versioning and personalisation is used.

Italian colour specialist Barbieri claims leadership in flatbed and wide-format inkjet printing, and is offering the qb-technology compact measuring systems for high performance inkjet which will be adopted in packaging applications where colour is critical. This is a range of spectrophotometers that will be mounted on press as part of closed loop control systems, intelligently controlling the output. The D50 illumination used is from LED technology, matching the M1 viewing condition in the ISO standard 13655-2009.

TheIJC conference provided a view into the incredible depth of technologies behind inkjet. Academics and development teams are working on precision engineering, material science and software to push inkjet forward. It is not surprising that quality, reliability and productivity have improved hugely, meaning that inkjet is increasingly competitive against flexo, litho and gravure alternative. There will be new capabilities, such as the Powerdrop, and these technologies will irreparably change the face of package printing – in the not too distant future. •