Analysis of high speed inkjet presses

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Abstract

Developments over recent years have seen a significant increase in the number of print engine solutions available in the field of production (high volume) inkjet. The technologies are having a significant impact on the shape of the printing industry. There is great interest in the possibility of opening up new markets with these devices and shifting production from other printing methods, be they offset, toner based digital, or flexography. The use of inkjet devices offers the opportunity to provide personalized, variable, or short / medium run length products in a cost effective manner to the customer that toner based digital solutions did not provide. It also allows the possibility of adding new products due to the ability to produce printed material in a variable format. In referring historically to the changes in technology [1], those that have a lasting

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impact are those that can improve productivity while producing either a similar quality to the process they are replacing or a commercially acceptable quality for the product category, a function many of today's inkjet engines are capable of.

This paper investigates in detail these different market segments that are serviced by inkjet devices from newspapers, books, and transactional documents to commercial printing applications and the different requirements for these marketplaces. Each of the print engines were assessed for their applicability to the different market places. Some of the characteristics evaluated include production image resolution, the introduction of artefacts into the images introduced by either the software or hardware configuration, and performance.

Introduction

Inkjet is having a profound impact on the printing industry. With the introduction of single pass machines, they have shifted the economic conditions and printing methods used for producing products. This is going to evolve as new applications, technological advancements and devices are introduced. Certain markets provide great opportunities for inkjet technologies: these include amongst others books, catalogues, newsletters, magazines, newspapers, packaging, transactional (including trans-promotional), and direct mail pieces. These different market segments will be described in this paper, along with some of the major solutions that are available from the different manufacturers.

The inkjet industry is seeing a large amount of research and development from numerous companies, highlighted by the number of patents that are being submitted. There were over 4,000 patents registered worldwide in 2009, while in 2010 there were 3,569 patent applications published relating to ink jet technology, equivalent to 297 per month [2], Figure 1.

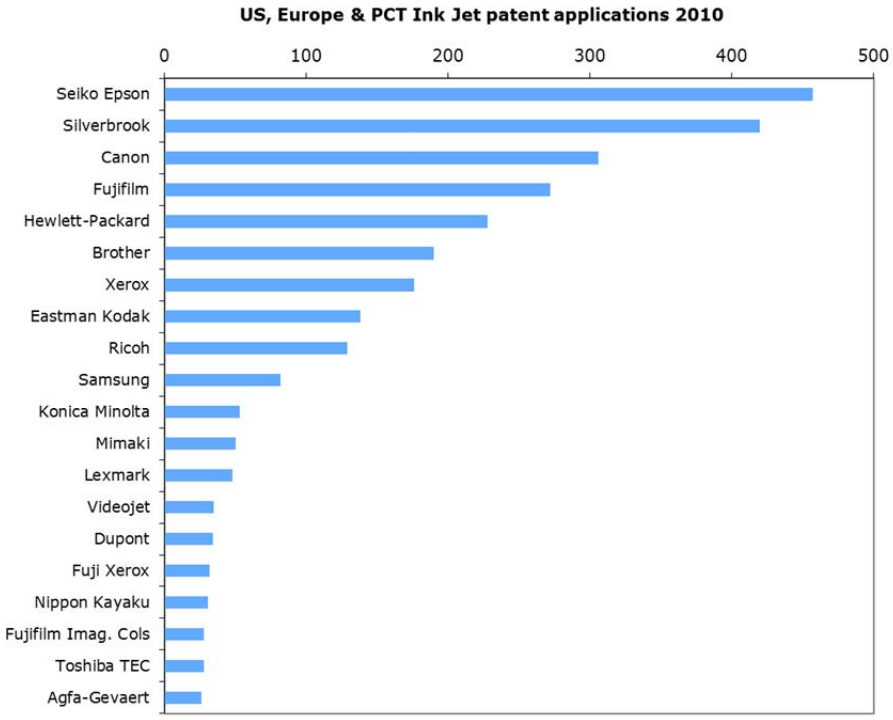


Figure 1: Patents submitted in 2009

Approximately 78% of the patents submitted were for hardware, approximately 19% for ink technologies, and approximately 3% for substrate developments. Inkjet head technologies have improved to the

point where they can now image with either dye or pigment based inks through the same head technology. Additional nanotechnology improvements in the heads have facilitated more reliable and consistent heads.. They are not susceptible to blockages, allowing the development of single pass inkjet machines. These machines are becoming increasingly prevalent in the marketplace today for both production and in the future with wide format devices.

Market segments and devices

It has been stated that there have been many developments in the inkjet market for proofing, wide format, and high speed production. This paper focuses on high speed production devices available in the market for purchase and their targeted markets. There are print devices available from many different manufacturers, and these are targeted at different markets and verticals. The common solutions available from the main vendors are listed below.

With respect to press speed discussed with regard to the device, this is the maximum rated speed of the device. There is also normally a quoted quality for the device, but as the press speed increases the print quality (or DPI) will often reduce. After evaluating the speed information, there are a number of questions that should be asked with respect to machine utilization (which is the more important factor) and how this is calculated to provide true comparison between the different devices. In addition, it is important to analyse what has been included into the estimate of available time? Questions asked should include if maintenance is

included in the calculation (what type), what quality was achieved, and the type of jobs. The base line for this calculation has been shown to vary significantly between vendors. Finally, the final speed of production can be significantly affected by the performance of the software and hardware providing the printed data.

- **AGFA :Dotrix.** This is a piezoelectric drop-on-demand print solution with variable dot size utilizing UV-curable inks that can be used in many packaging applications. It is capable of printing on a wide range of substrate calipers, ranging from board to flexible packaging substrates. The press speed is at the lower end of the devices evaluated, with a rated speed up to 105 ft. /min. It does use pre-treatment of the substrate using an anilox roll.

- **FUJIFILM Digital Inkjet J Press 720.** This print engine uses piezoelectric print-head technology developed by FUJIFILM Dimatix. The device is targeted to the commercial print market and is one of the few high speed digital print engines that is printing on sheeted material. It uses a pre-coat process to allow it to print on conventional offset substrates and has a rated speed of 2,700 4-up sheets per hour.

- **HP T300/T200 web press**. These inkjet presses are unique in utilizing thermal drop generation with multiple jets in line to further improve quality and minimize the impact of the jet blockages. It makes uses of a scalable architecture to allow for increase in the web width and processing speed, with the rated speed at the time of

writing being up to 400 ft. /min. Immediately prior to the printing of the CMYK inks there is a bonding agent applied to the web through a series of inkjet heads. The market focuses of these presses are book publishing, direct mail, transactional printing, and newspapers.

- **InfoPrint 5000**. The inkjet press utilizes piezoelectric drop-on-demand used extensively in direct mail, transactional, and by service bureaus. The InfoPrint 5000 prints from roll material and can print additional inks, such as MICR. This is a high throughput machine, with the speed at the time of writing being up to 420 ft. /min. This press has a large install base in the transactional market as it transitions from monochrome on pre-printed shells to full four color process printing.

- **Kodak Prosper Series.** The stream inkjet head technology produces a continual inkjet stream making this device unique from the rest of the solutions from the other vendors. Kodak has produced a standalone print engine and these heads can be mounted on web presses and in-line finishing equipment. The droplet sizes are changed by altering the heat in the jet annulus where the droplets emerge from. This changes the surface tension of the ink and this will produces the different sized droplets as it directly affects the split characteristics of the jet of ink. The small droplets formed are deflected by an air curtain and the ink from these unwanted droplets is recycled back into the main ink reservoir for the press. At the time of writing, this can operate up to speeds of 650 ft. /min with a target market of color books, direct mail, catalogs, magazines, and inserts.

- **Kodak Versamark Series**. These print engines are used for many high-volume variable solutions, such as transactional, direct mail, and data center printers. They are roll fed and based on piezoelectric drop-on-demand inkjet heads available in a choice of either pigment or dye based solutions.

- **Océ JetStream Series**. These print engines utilize piezoelectric drop-on-demand heads using water-based inks, and they are used in transactional and direct mail solutions. They are used extensively when printing MICR inks. These presses have a large install base in the transactional market and check business as this the market transitions from monochrome on pre-printed shells to full four color printing. At the time of writing they can operate up to speeds of 656 ft. /min.

- **RISO ComColor series**. These print engines are developed to print on cut sheets, with applications in medium-volume production. They are used in transactional, direct mail, booklets, manuals, marketing collateral, general office communications, and where the ink coverage is low. At the time of writing they can operate up to speeds of 146 ppm letter. They are targeted towards institutions and commercial printers with optimal run length between 20k - 500k impressions per month.

- **Screen Truepress Jet520.** This print engine is piezoelectric drop-on-demand solution and uses water-based inks with modular designs

for magazines, newspapers, books, and transactional products. At the time of writing they can operate up to speeds of 420 ft. /min.

- **TKS JetLeader**. This is piezoelectric drop-on-demand print engine using water based inks focusing specifically on newspaper applications. At the time of writing they can operate up to speeds of 492 ft. /min.

- **Xerox Production Inkjet System**. This uses piezoelectric heads to create the printed image using resin based inks. At the time of writing the press is new and limited information is available about its performance can print characteristics.

For updated information on the device capabilities, please refer to www.printing.org/inkjetproducts.

As seen in the earlier discussion, there are many different market sections for which there are opportunities using inkjet technologies. These include transactional, trans-promotional, books, direct mail, packaging (flexible and carton), point of purchase, brochures, newsletters, catalogues, and newspapers. These will be discussed in the following sections.

The transactional printing market is undergoing a change with a reduction in the total number pages produced. This is mainly in the printing of pre-printed offset shells that the variable data is added to using a monochromatic (black only) printing engine or with black only

statements. The total number of pages that are produced using four color variable are expected to increase over the coming years. Variable printing allows the inclusion of trans-promotional content in these transactional documents.

Trans-promotional is the inclusion of secondary advertising for products or services in combination with the transactional document, either from the company providing the information or from advertising. The detailed knowledge about the customer allows for a targeted message or advertising to be carried out, thereby increasing the effectiveness of that messaging. The move to full variable allows for a more targeted communication only the information that is specific to the customer being delivered and not a large quantity of pre-printed forms that may not be relevant.

As book run lengths are getting much shorter and less stock is being carried by the retailers of such product, high speed inkjet is suited to book production. High speed inkjet devices are particularly suited to text books, manuals, and specialist titles. This allows for “Just In Time” (JIT) delivery of materials with efficient and responsive manufacturing operations. In addition, the use of digital, and in particular inkjet, has opened up possibility of publishing to a much greater audience with many new publications and authors.

Several of the print engines target the packaging market. Packaging is one of the few growth areas within the printing industry because it will not be replaced by a PDF or other electronic media as our purchased

products will always need packaging. The production inkjet solutions can now print on both flexible materials and board, covering many packaging applications. The use of digital allows for the personalization and appropriate regionalization of certain products where appropriate to different areas such as schools, universities, or sports teams. The print engines can also be used for the production of point-of-purchase materials.

Newspapers are another market that several high speed inkjet manufacturers have targeted. The circulation of offset and flexographic printed newspapers is decreasing with the competition from other media and delivery mechanisms for news. The use of variable allows for short run publications and the regionalization of the content and advertising. With the large number of people living away from their home it allows for production of national newspapers in different countries in a cost effective and fast manner. The variable nature allows the advertisers to target the messaging to either specific locations or demographics when this information is known.

High speed production inkjet is a growth area in printing and we will see many new applications of this technology in the coming years.

Evaluation methodology

The printed samples used in the evaluation were obtained from production runs or sample demonstrations from different press manufacturers. Multiple image areas were selected and viewed under a

microscope. Photo-micrographs were taken of the different areas as seen in Figure 2. The different characters within the images were then analysed for their visual characteristic structure..

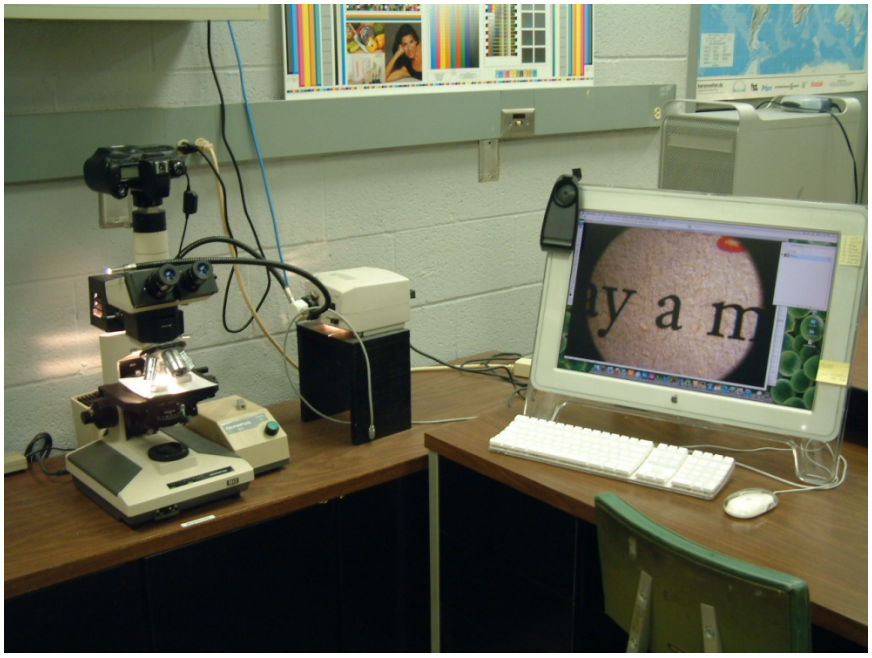


Figure 2: Image capture from the printed material

Results and Discussion

The different printed samples' photo-micrographs were evaluated and compared to typical lithographic print. Images used in this paper were selected to represent typical print applications for the typefaces used. Analysis was not dependent on the font type, so differences in the font can be observed in the images used in the paper. There are differences between the substrates and each substrate is optimized for the printing

type or engine. The same fonts were not used in the printed material analysed.

A comparison for an “a” font character between lithographic and digitally printed font is shown in Figure 3. The lithographic “a” print has good definition to the edge and a sharp transition between image and non-image area. The digitally printed “a” has raggedness from the digitization of the font and from the placement of the individual ink droplets forming the character.

	
Lithographic	Digital

Figure 3: Example of lithographic printed font

Figure 4 has the “a” character printed on the five digital print engines along with lithographic print. There are clear differences between the lithographic and the digitally printed characters, as there are between the five digital print engines. In all cases the image produced from the

lithographic process shows the best edge detail (no pixilation of the image) and good definition of the printed character between image and non-image area.

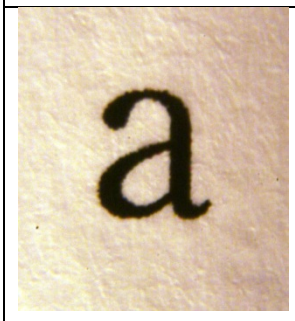
		
Kodak	HP	TKS
		
FUJI	Lithographic	InfoPrint

Figure 4: Digitally printed “a” fonts

There are differences in the digital prints from the edge detail and the impact of the substrates used in production. The Kodak prints show the largest amount of pixilation with the individual ink droplet being evident in all of the images examined. There is a good contrast between the ink image and non-image areas – the ink is clearly above the surface of the

paper. The HP prints show reasonable edge definition; however, it is apparent there is some influence with the underlying paper structure. It should be noted there is a bonding agent applied immediately before the CMYK inks to all of the HP prints evaluated. The TKS prints were all made on newsprint substrate, the lowest paper grade within the evaluations and showed a small influence of the underlying paper structure. The pixilation was apparent but at a similar level to the HP and InfoPrint examples. The images from the InfoPrint print engine show more through of the underlying paper structure than the majority of the other prints analysed. Finally, when considering the FUJI prints they showed the least amount of pixilation and a very clear definition. It should be noted that the prints produced from this device used the highest quality paper and the print engine is significantly slower than the others in the study.

A printed “E” character from the five digital print engines as well as lithographic print is shown in Figure 5. There is a direct correlation with the characteristics and trends from the other text discussed earlier. Clear differences between the lithographic print and digitally printed characters are shown; moreover, there are differences between the five digital print engines. The trends seen with the earlier characters with respect to image quality, influence of the underlying substrate, and the pixilation of the prints are apparent with these images.

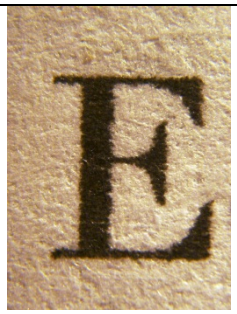
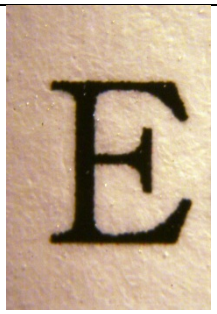
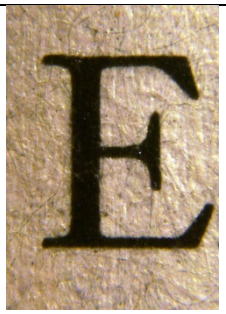
		
Kodak	HP	TKS
		
FUJI	Lithographic	InfoPrint

Figure 5: Digitally printed “E” fonts

Conclusions

High speed inkjet production technologies will have significant impact on the future of the printing and communications industry. These devices can print on a wide range of different materials and technologies of the devices are being developed at a rapid rate. The devices print using predominantly piezoelectric heads, though devices are available using thermal and continuous jet heads. Different coatings are applied offline

prior to printing or inline to help with print quality. In many cases, the speed of the device is related to the quality of the print produced.

There are many target marketplaces inkjet can be directed towards including direct mail, book, catalogue, point of purchase, transactional, transpromotional, newspaper, labels, cartons, packaging, and flexible packaging. The growth in these areas is related to the existing marketplace and data available to drive business growth.

The analysis of the different print engines shows that there are significant quality differentiators between the engines when evaluating the fine print details. However, when evaluating all of the prints for many of the applications, the quality produced was “fit for purpose” and would be acceptable to many consumers. The challenges with the devices are related to high end publications, high color applications, and the impact of the substrate on the quality of the final product.

References

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