

# Analogue to Digital – The Evolution of Ink Systems for Ink Jet

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## Abstract

As Digital Production Printing becomes more established and increases its influence in areas beyond display graphics, there will be an increasing need for additional ink technologies. Whilst the primary requirement of any ink system is that it operates reliably in the ink jet printing device, this alone is not enough for the successful implementation of the digital production system - the ink must also meet the multifarious requirements of the markets in which the digital print process is being used. Various print sectors will be reviewed, their requirements analyzed and the issues involved in developing ink systems considered. The sectors considered will include; - display graphics, publishing and perhaps the most challenging of all – packaging. Additionally, the emergence of hybrid digital presses will be considered, where there will be an even greater need to match the digital ink performance and appearance to that of its analogue printed counterpart.

## Introduction

The first requirement of any ink jet ink is that it performs reliably in the relevant printing equipment. The reliability of all types of ink jet has dramatically improved over recent years due to advances in ink formulation and equipment integration. As ink jet moves into digital production printing in varying market areas, there will be a need to produce systems that can deliver jet inks which meet the already established end user requirements. These requirements will have been established with the conventional (screen, flexo, gravure, offset) ink technologies. Although, ink jet can be viewed as an enabling technology i.e. print on demand, low/no origination costs, potential for short run, reduced print inventory etc, there can in most fields of printing only be so much acceptance of compromise with the performance of the finished printed item. Additionally, and somewhat paradoxically, although ink jet printing in many ways offers much greater flexibility, in terms of print run length, it can be much more restrictive in terms of ink selection, since currently changing inks on digital equipment is not desirable or cost effective.

Three areas will be examined to illustrate the compromises required and how ink jet technology can best tackle the difficulties.

## Screen Printing

Screen printing is a highly versatile process used to print a very extensive range of items and substrates – from plastic bottles to point of purchase display graphics to circuit boards to rub-off lottery tickets. When the variety of applications is considered it is not surprising that the variety of inks employed is huge. Even within one sector, such as display graphics, the number of inks used will be large, with different products being employed for different substrates. The same ink would not be used for a vinyl banner that is used on a fluted polyolefin point-of-purchase board for instance. The constraints of the current digital equipment means that ink changeover is precluded and so inks have been developed that must perform as a compromise solution for many substrates.

Ink jet printers producing output which would have traditionally been screen printed, have been successfully used for some time – e.g. for posters, POP boards etc. These were initially either water based (“studio” type wide format printers) or solvent based systems printing vinyl or acrylic based inks for indoor and outdoor display. The advent of ink jet printers capable of printing UV-Curing ink has greatly enhanced the portfolio of display materials that can be printed, in particular in the rigid display area.

Adhesion is one key performance parameter, which will only be optimal if inks of the correct basic chemistry and balance of flexibility are used on differing substrates. In current UV-curing ink jet equipment, inks with flexibility properties balanced for use on both rigid and flexible materials are being employed. Whilst these may be a suitable compromise, they are being accepted as exactly that – a compromise. It is likely that future ink jet systems will require the ability to load different ink types for different substrates. These ink types would have to be fully compatible and “top-loadable” assuming that the same set of print heads are used in the equipment.

## Publishing

Digital production of publications such as books and newspapers already occurs but to a very limited extent. The extent of penetration of ink jet into these markets will be determined by three major factors: speed, print quality and cost. Ink systems will have to be developed which offer fast drying and adequate print quality on the substrates of choice. The paper stock can be specially selected to better accommodate the jet ink, but use of

special papers or coatings will inevitably increase the cost of the final output and this will diminish the overall attractiveness of the “digital printing solution”. Low cost in-line substrate treatment to enhance print quality on conventional media has been demonstrated by Aprion and this sort of approach may be of great value.

Ink jet inks are very different in their physical properties to the lithographic or letterpress inks commonly used to print newspapers and books and the volume of ink printed down by the ink jet process is also larger. It is thus not surprising that the inks will interact with the substrate very differently. The high viscosity of the lithographic inks means that the ink will not strike through the substrate and will have high optical density. Achieving equivalent performance on the same substrates with ink jet inks is a great challenge and different formulating approaches will be used in the ink jet inks compared to the conventional products.

### Packaging Printing

Packaging printing is one of the most varied and challenging areas that ink jet is currently venturing into. The range of substrates is large and the number of post-print operations and requirements of the finished article also extensive.

In flexible packaging for example the finished print may require wet filling, heat sealing, deep freeze resistance, low migration levels of ink components to avoid taint and odor issues, mar and scuff resistance, over-lacquerability, product resistance etc etc.

In some cases it will be possible to print with ink of similar technology type to the conventional ink. For instance it may be possible to print with a solvent based ink onto flexible packaging mirroring the conventional flexo or gravure inks that would have been used. Even in these cases though, it must be realized that there are issues to be addressed. In the ink jet ink (printed via Piezo DOD) the solvent blend will generally have to be slower drying than for instance a flexo ink. This in turn will mean that drying of the ink jet print will be more difficult and retained solvent may be an issue. Additionally, obtaining the correct wetting and print quality on typical substrates used in the various markets will be a development challenge. The low viscosity of the jet ink will mean that wetting characteristics are considerably different to the conventional flexo or gravure liquid inks.

UV-Curing ink jet is again a highly attractive option for digital presses due to the reliability of the inks in the Piezo DOD printheads. Dotrix have demonstrated the SPICE™ print engine and the.factory™ for single pass web printing with capability for packaging applications<sup>1</sup>. In many packaging applications though, where food is involved (even if the packaging is secondary) odor and migratables will be a key factor. With the low viscosity (and hence high monomer content) and the high photoinitiator levels of ink jet inks, it is generally more difficult to attain low odor and low extractable/migratables prints. With newly developed

photoinitiator chemistry and the possible use of nitrogen inerting, acceptable print systems will be achievable.

### Hybrid Digital Presses

In certain areas digital printing of complete items is not currently practical due to speed, resolution and cost issues. In such cases “hybrid” presses are an attractive route forward in the short to medium term. In such presses part (or the majority) of the print is printed by conventional means and then a digital print unit will add a variable part of the print. Such an approach has been shown by Chromas (Argio digital press) and by Mark Andy<sup>2</sup> (integrating a Dotrix SPICE™ unit) – both resulting in hybrid ink-jet/flexo presses for label printing. In a related way, at DRUPA 2000, Heidelberg Druckmaschinen AG, showed an ink jet unit for “imprinting” onto preprinted offset prints.<sup>3</sup>

In all these hybrid applications there are two key aspects that need to be addressed – the ability of the ink jet system to overprint pre-printed material and for the print appearance of the ink jet and conventional print to be similar, in order to avoid a mismatched appearance. Given the different nature of the inks used in the conventional process it is not surprising that getting matched appearances may not be possible. However, there is clearly much that can be achieved from ink formulation development.

### Conclusion

The different physical nature of jet inks compared to their “conventional” counterparts and the difference in the method of application (non contact versus contact), inevitably means ink jet print will not exactly match conventional print. Continued ink development and system integration, together with some acceptance of compromise in print quality/performance will though ensure the successful penetration of ink jet into traditional print markets.

### References

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### Biography

**Nigel Caiger** received his degree from Oxford University in 1985. He joined SunJet (formerly Coates Electrographics) in 1989 and is now Technical Manager – Ink Jet Products, overseeing activities of a development team working on various inkjet technologies including UV-curing, phase change, water and solvent based inks. He has several patents in the field of jet inks.