Scitex Digital Printing and Production Digital Technology

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Abstract

Scitex Digital Printing (SDP), Inc. manufactures high speed digital printers. Recent advancements in technology from SDP have defined a new category of print, Business Color™.

Markets and applications of Business Color include Direct Mail, Transactional Documents and Book Printing. Each of these applications have unique opportunities for Business Color printing including high variability of data, elimination of pre-print, and fast job changeover.

SDP products such as the Business Color Press with VersaMark® printheads are designed to provide low per page costs at high print volumes of 100% variable documents. SDP has developed modular Business Color printing systems to allow printing businesses to start with monochrome printing and transition their print offerings to include spot and process color. Product modularity also allows press capacity and versatility to increase with increased demand.

VersaMark printheads use continuous inkjet technology to print water based inks at 300 x 300 or 300 x 600 dpi. Printheads are 9" wide and can print up to 500 fpm. Paper treatment and coating technologies contribute to improving print quality; a variety of software technologies enable customers to produce documents with Business Color technology.

Introduction

With the increasing levels of marketing information brought about by computer networking technology in the 1990's, concepts such as one-to-one marketing and Customer Relationship Management (CRM) began to emerge. Data centers, direct mailers, and fulfillment houses looked for ways to personalize mass audience documents at production speeds.

The original imaging technologies meeting these applications were

- Electrophotography print on pre-printed forms
- Half page width (4.25 inches) inkjet imprinting on offset pre-printed forms with variable data
- Narrow format (2 inches or less) binary continuous inkjet or multi-deflection continuous inkjet printing addresses and marketing messages on finished mail pieces
- Thermal printing and DOD inkjet technologies printing addresses on finished mail pieces.

SDP was a dominant presence in the 1980's and 1990's for printing variable information with binary continuous inkjet technology. Initially printing narrow print at low resolution (120 dpi) SDP in 1992 SDP released a 4.25 inch, 240 dpi product to the marketplace. This technology was widely accepted in commercial printing markets for variable data imprinting applications due to its ability to print "laser quality" variable information at speeds of up to 1000 fpm.

Inkjet Hardware

SDP took the challenge in 1995 to demonstrate its 4.25 inch binary continuous inkjet printing technology in a digital press printing 100% variable full color documents. In order to apply the existing technology to the production applications, SDP took products designed to imprint variable information on pre-printed forms to the next level: printing full page color documents on blank paper. A technology demonstration was done at Drupa 1995. The demonstrated model printed at 200 feet per minute at a resolution of 240 x 240 dpi x 5 drops per spot and was called the Digital Color Press (DCP).

Image 1. The DCP at Drupa 1995

After the technology demonstration, SDP received strong interest for both variable and short run applications. Several technical challenges remained for SDP to create a commercially viable color product for production environments. These challenges were

- Increase print width and resolution
- Increase in speed
- Widen the color gamut
- Workflow and color management for documents

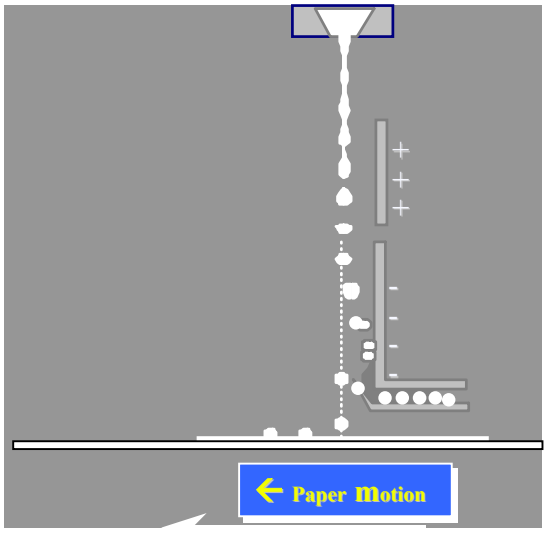

Image 2. Binary inkjet Technology

At Drupa 1995 full page variable data printing was achieved by utilizing two of these printheads to produce an 8.5 inch page wide image. The two head wide configuration produced a two column printed document. In order to produce a full page single column document, SDP later aimed to develop a full page width print head.

The technology demonstration equipment printed at 200 fpm printing. In order to create a commercially viable product, higher speeds were required to produce more documents and amortize hardware costs. Thus, a 9 inch print head was designed to print at 300 x 300 dpi x 2 drops per spot. The impact of this change was a printhead that printed at 500 fpm at a resolution and print quality acceptable to markets such as direct mail, book printing, and transactional documents.

The printheads use a 110 kHz resonator to generate 44 pL drops of ink. Each printhead can print a single color of ink, so a bank of 1, 2, or 4 printheads can be lined up in parallel to create monochrome, spot color, or process color capabilities.

SDP successfully developed these 9" wide printheads and branded them as VersaMark®. Shortly thereafter, the technology was integrated into paper handling equipment to create a complete roll to roll digital color press capable of printing process color documents at 500 fpm. This Business Color Press was launched at Drupa 2000.[1]

Image 3. The Business Color Press

With the 500 fpm capability in combination with the ability to print simplex or duplex, the Business Color Press can produce 8½ by 11 inch documents at rates over 2000 images or 1000 duplex documents per minute.

VersaMark printheads allowed for the creation of a digital color printing press capable of printing high speed variable documents affordably. This technology breakthrough brought several challenges to be overcome through various other technologies.

Data Handling and Color Software

Based on previous experience with handling variable data streams in imprinting applications, SDP had the data handling experience to deliver information via Raster Images Processors (RIPs) to their printheads at high speeds. Thus, the Business Color Press handles production job changes easily and without plate changes, etc. This ability positioned the Business Color technology in markets where makeready and set up costs are driving factors in production environments.

To enhance print quality with the high speed continuous inkjet technology, SDP developed a software package called the Business Color Toolkit. This software assists users with creation and modification of text, images, and logos so that printed documents can be generated with optimal print quality on a variety of papers.

The Business Color Toolkit has two major color management technologies: spot color matching and tone linearization. By printing test patterns on press, color measurements in L* a* b* space can be taken and the appropriate CMYK levels can be set for thousands of spot colors based on specific papers. This allows BCP users to print different spot colors from document to document at full speed.

For process color printing with multiple drops per spot, color ink loading on the paper can vary the density of the color from one type of paper to another. The Business Color Toolkit uses a technique called linearization to optimize ink load for a given paper. As the ink amount on paper increases, the color level increases, up to a certain point. Eventually, the paper becomes saturated with ink and additional printed ink does not add any perceived color. Linearization accommodates this by tapering off the printed ink level accordingly. Chart 1 shows a theoretical example of a change in perceived color density in a linear or non-linear ink / paper reaction.

Linearization is done through the Business Color Toolkit by printing test patterns on press and taking color measurements. With the collected data- about 30 color samples- a user can use linearization Look Up Tables (LUT's) to quickly define appropriate ink levels for a given paper to the data handling software.

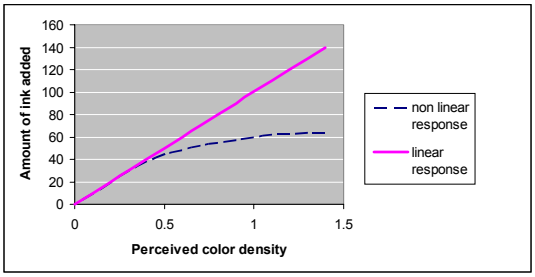

Chart 1. Theoretical non-linear response to ink loading

Color Gamut and Ink Technology

The challenge for SDP ink technology was to attempt to duplicate the SWOP color gamut with water based dye inks. In order to do this, SDP utilized typical cyan, magenta, yellow, and black inkjet dyes. However, surface tensions and shades of dye were altered in order to increase color gamut. The end result was that the Business Color CMYK ink set was able to print the SWOP gamut, however the gamut space does depend on paper type.

In order to maximize printhead runnability and reliability, dye based inks are used. The water based inks, having anionic dye colorants, have a lower level of waterfastness when printed on standard papers which typically have anionic fibers.

In order to create process color images at high speeds, ink formulations also require the appropriate balance of viscosity and surface tension to address issues such as color to color bleed and dry time. SDP modified its ink technology with surfactants in order to get a process color ink set with equal surface tensions that could print and dry at the necessary speeds.

The Role of Paper Technology

Paper technology enhances the print quality of SDP's inkjet technology with respect to optical density of print, paper cockle, waterfastness, and color gamut. In order to obtain high print quality with water based inkjet inks, the paper technology needs to accommodate water based dye inks.

Manufacture of inkjet papers requires technology changes so that water based inkjet inks, when printed, have higher print quality. Some of the factors in manufacturing an uncoated grade inkjet paper are

- Sizing to improve dimensional stability
- Cationic additives for waterfastness

In order to manufacture inkjet water fast papers at reasonable costs there are trade offs between functionality and cost. Typically cationic polymers can be introduced in paper treatments that allow significant increases in waterfastness with nominal increases in cost. These changes enable print quality for spot color or monochrome inkjet printing.

In order to offer the optimum color gamut to generate the highest quality process color images, paper coating technology is required. In addition to the typical ink jet receptive coatings include

- Pigment coatings on surface to increase brightness
- Anti-cockle additives

Use of these technologies produces measurable improvements in optical density, paper cockle, waterfastness, and color gamut.[2] The end result is that paper technology becomes a significant enabler for business color printing.

Given the markets targeted for Business Color, lightfastness is of moderate importance for color inks and higher importance for black inks. The requirement of black inks is typically "archival grade" printing- images that will last on documents for decades. Recent third party studies instituted by SDP have shown that the current black inks and paper technologies do produce archival grade documents.

In order for printed documents to meet certain customer requirements in the targeted markets, lightfastness is also required. Studies show that color inkjet dye based inks, have a lower level of lightfastness than pigmented alternatives.[3] Recent studies have shown that Scitex Digital Printing's black inks have the required light permanence when printed on coated or uncoated papers, while colored inks have lower levels of lightfastness on coated papers.[4]

Conclusion

Over the past 10 years Scitex Digital Printing has taken their inkjet printhead technology and combined it with ink, software, and paper technologies to create a commercially viable product for specific markets.

The final product is a digital printing press capable of producing color documents at higher rates of speed and at lower costs per document than other digital printing systems.

SDP positioned the final products in order to define the market space for Business Color technology.

Business Color printing markets such as direct mail, transactional documents, and book printing can benefit from the cost advantages at high volumes over existing technologies in their production environments.

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Biography

Eric K. Wilson received his Bachelor's degree in Chemistry from the University of Colorado, Boulder in 1993 and his MBA from Keller Graduate School of Management in 2002. Since 1995 he has worked in the inkjet printing industry, particularly in the ink and consumables areas. He has held various chemist, technical management, marketing research, marketing management, and product management positions. Currently he is the Product Manager for Inks and Substrates at Scitex Digital Printing in Dayton Ohio.