

Large Format Ink-Jet Productivity: Challenges & Solutions

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Abstract

Large format digital printing has been available for several years in the graphic arts domain, yet digital printers continue to face limitations such as low throughput, low outdoor durability, limited media types and inferior image quality.

As a result, digital printing has competed only marginally with traditional methods such as silk-screen and offset printing. Digital printing methods have not gained a significant market share and are typically used only for very short runs.

With silk-screen large format print shops as its main market, Idanit has had to address critical technological challenges to compete successfully. This paper describes these challenges and their solutions, as implemented in Idanit's first product, the Idanit 162Ad printer.

Introduction

Idanit Technologies Ltd. is an Israel-based company that provides the graphic arts industry with innovative digital printing solutions. Established in 1994, the company developed a proprietary Turbojet Technology (worldwide patents pending) that uniquely enables high speed, large format, digital printing, on demand and at affordable costs.

The Idanit 162Ad, the first product based on this technology, is a roll-to-sheet printer. It has a print format of up to 249 x 157 cm (98" x 62"). The Idanit 162Ad prints 70 such sheets per hour at 200 dpi and 40 sheets per hour at 300 dpi. The 162Ad uses pigmented inks for outdoor durability.

Idanit encountered several technological challenges during the development of the 162Ad, designed to be a one-stop, self-contained printing press while retaining open system characteristics. It was designed to print superior quality images and to compete with silk-screen throughput. There was also a market need to ensure simple operation and automatic maintenance. Idanit's innovative solutions for these challenges are described below.

Principle of Operation

Media handling

The Idanit 162Ad is a roll-to-drum printer. Media is loaded from a roll, cut to the required print size, held on the drum

using a vacuum during plot time, and ejected to a conveyor that takes the media through the dryer.

All these operations are performed unattended for the required number of copies.

Idanit-162Ad Design Concept

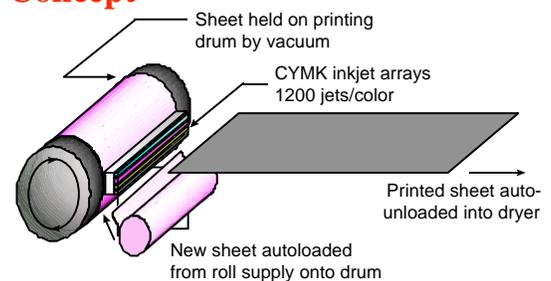


Figure 1

Printing

The printing bridge of the Idanit 162Ad contains 4800 nozzles, 1200 per color (CMYK), evenly deployed across the 1.6 meter bridge.

Printing is achieved as the drum rotates at high speed (the number of revolutions per minute varies according to the required resolution), while the bridge moves very slowly. In each revolution, 1200 lines of ink drops are plotted on the media for each color. During the revolutions, the gaps between the nozzles are filled to produce a continuous image.

One Stop Printing Press

Traditional silk-screen printing requires numerous stages before the squeegee may be run over the screen. Artwork for each color must be prepared, and then a silk-screen plate is prepared, usually by exposing the artwork against the screen. The image may then be printed, one color after the other. Drying is required between colors and at the end of the process. After printing, the screen must be thoroughly cleaned and kept in storage for reprint.

Digital printers avoid many of these steps, yet they are forced to add steps at several points enroute from the electronic data to the finished ready-to-ship prints. Some

roll-to-roll systems require external cutters. Some, especially electrostatic printers, require heat transfer to another media and then lamination to achieve outdoor durability.

Through a major R&D effort, Idanit has managed to achieve a complete one-stop solution for the print shop, as reflected in the following advanced features of the 162Ad:

- RIPS from all common input formats and tiling (with the optional 900st workstation);
- No need for loader: automatic roll loading;
- No need for cutter: the system outputs sheets;
- Ready-to-use output (with optional DR800 drying unit);
- No need for image transfer: prints directly on various media types;
- No need for lamination: pigmented ink with high abrasion resistance lasts up to 5 years.

An Open System

Silk-screen printing is a mature industry, with a variety of equipment manufacturers. It is common to find a production line that integrates equipment types (exposure system, printing press, dryer, etc.) of different vendors. Silk-screen is very tolerant to various types of media.

In the comparatively young digital world, some manufacturers close their systems, requiring proprietary RIP and tiling combinations. Some systems require a specific input format or media. Most systems require specific media types to achieve quality printing and outdoor durability.

Idanit can provide a complete solution to all these problems. However, the importance of free choice, both from the philosophical and commercial point of view, is also a key consideration. As a result, the decision was made to leave the Idanit system as open as possible, as reflected below:

- RIP: The customer may use the optional 900st workstation or input a pre-RIPped file in CT format;
- Input connectivity using removable media or fast Ethernet;
- Media: A variety of substrates are supported. Idanit does not sell or restrict the use of media, but rather supports calibration of customer supplied media;
- Dryer: The customer may use the optional DR800 or employ the Idanit dryer interface to connect other dryers.

Throughput

Throughput has been a weak point for digital printers. It has been a key barrier preventing digital printing from replacing traditional printing methods and gaining a significant market share.

The Idanit 162Ad is based on the company's Turbojet technology, which utilizes numerous nozzles at very high speeds to achieve the astonishing rate of more than 50 million drops per second. Combining this technology with fast, automated loading, sheeting and unloading, a 4 square meter (42 square feet) image may be printed in less than a minute, including loading and unloading.

At this throughput, the break-even point of the Idanit 162Ad against silk-screen printing is at 200-300 copies.

(This reflects cost only, without considering other benefits such as shorter production time, higher consistency, etc.)

Image Quality

Silk-screen printing is sometimes referred to as an art, because, to some extent, "black magic" is required to achieve the right colors and to ensure consistency for different tiles of a billboard. Registration between colors is also a challenge when working with fine resolutions.

Digital printing has solved these problems. Color matching correction requires just another RIP. Consistent colors are easily achieved. Yet there are new problems like banding, Moiré patterns and color gamut.

Printing at very high throughput using thousands of nozzles concurrently has made the challenge even greater. Idanit had to confront these complicated problems, such as wet-on-wet printing, alignment between nozzles and clogged or "weak" nozzles.

Screening

The Idanit 162Ad uses FM screening. The screening is based on prebuilt FM tables, and is performed by hardware while printing. The built-in random feature creates a smooth image without patterns. Calibration of the FM tables per media type enables consistent results over different media types and allows changing media without having to re-RIP.

Nozzle alignment and printing order

When using a multitude of nozzles (and jetpacks), alignment of the nozzles within a color and between colors becomes an issue. Idanit uses highly accurate machinery, including artificial vision systems, to achieve nozzle-to-nozzle tolerances of less than 15 microns across the printing bridge. The nozzle order for the four colors and the printing order are optimized to minimize wet-on-wet printing.

Printing calibration

It is impossible to achieve the same drop size and shape from 4800 nozzles. It would also require many hours per day to replace any jetpack that has 'weak' or clogged nozzles. Idanit has developed sophisticated calibration and compensation algorithms, based on printing and scanning several patterns. This enable the Idanit 162Ad to print with undiminished quality even when up to 2% of the nozzles are clogged.

Ink

Ink is an essential parameter in the quality equation, especially when a pigmented ink is used to achieve 5-year outdoor durability. Idanit has invested a great deal of effort to arrive at an ink with the following qualities:

- Conforms to the nozzles (consistent jetting without clogging);
- Processed colors enable wide color gamut;
- Excellent outdoor durability without laminating;
- Very good abrasion resistance.

Ease of Use

The silk-screen printing is a multi-stage task that requires complicated and time-consuming operations like screen manufacturing, color adjustment, screen cleaning, etc.

Digital printing has taken out most of the tedious work and turned printing into a highly automated “white collar” profession.

Idanit has introduced additional innovation to facilitate smooth, uninterrupted workflow. Several of the features that make this possible are listed below:

- Standard Windows user interface;
- WYSIWYG gray level control without reRIPping;
- Unattended printing, simply by loading a media roll and pressing a button;
- Automatic and computer-directed maintenance procedures