Efficient printing with ILP powered Digital Press

Abstract

Consecutive printing of different print jobs which require alternating substrate thickness on an In-Line-Primer (ILP) powered Digital Printing Press requires insertion of multiple non-productive (null) cycles. This is required to allow ILP to adjust its hardware (gravure rollers, gaps, etc.) such that priming of the substrate will be optimal prior to printing. The method proposed, allows printing of such jobs seamlessly, minimizing the number of non-productive cycles to a minimum of (1-2) vs. (>10) prior to the old method.

Introduction

The In-Line-Primer unit’s purpose is to prime the substrate before it reaches the digital printing engine and it might include several stages: (1) Dust removal; (2) Corona treatment; (3) Priming; (4) Drying. Typically, the system consists of several nips, few conveyors, rollers and vacuum belts. ILP systems support a variety of media thicknesses, commonly between 100 and 650 microns. Gaps and vacuum levels are adjusted according to substrate thickness - those adjustments may take up to ~3-4 seconds (depending on thickness change).

The digital printing process is controlled by the Engine Control Module (ECM), which receives the info about what to print next from the Digital-Front-End (DFE) sheet by sheet. This sheet by sheet principle provides the ability to print variable data, multi-substrate jobs, etc. In case of substrate thickness change between jobs, while ILP performs the aforementioned adjustments - the ECM will insert non-productive (null) cycles before actual printing starts. Those cycles are “wasteful” from the customer perspective and possess a negative effect on digital press consumable’s performance.

Typically, the number of such cycles is around 10-15 cycles and assuming each cycle commonly is 260ms - it sums up to 3-4 seconds of “wasted” time for each change. In digital printing, switching between various substrates during production is common and occurs often - since digital jobs are “short” as compared to offset or traditional printing. In order to allow efficient production, the digital printing press must support continuous printing of various jobs, with variable media. Specifically, multi-substrate jobs are single print jobs which include alternating substrates for each copy (book with cover as an example). Printing those on a digital printing press which is powered by ILP is almost impossible.

The described novel method minimizes the number of those cycles to 1-2, allowing efficient printing in general, and printing of multi-substrate jobs in particular.

Description
Authors utilize one-shot printing and heuristics regarding the time it takes the ILP to adjust to the thickness change, consequently reducing (significantly) the amount of null cycles inserted. One-shot printing is common in digital printing process and often requires an Intermediate Transfer Member such as a printing Blanket. In one shot digital printing all colors are printed on the Intermediate Transfer Member before the image is fully transferred to the printed media, opposed to a multi-shot printing where image is transferred to the media color-by-color.

The proposed method asserts to start printing N cycles before the substrate enters the printing engine for best timing (N is a selected parameter). When the substrate finishes priming and enters the digital printing engine, the printed image is transferred immediately. Prior to this proposed method, printing would start only after the substrate has finished priming. Fig-2 illustrates both methods.

![Diagram of print session showing old and new method]

Figure 2: Example of print session where sheet thickness changes between sheet #18 and sheet #19. As shown, the new method enables us to save significant time which was wasted previously.

Since time it takes ILP to re-adjust itself can be approximated (from testing labs and world-wide installed base actual data), authors propose to choose N according to thickness change ratio and number of colorants in the upcoming print job. For example, the digital printing press received thickness change between 200 and 300 microns - which takes approximately 6 cycles. Given the number of colorants in the next job is known (assume 4-colors), printing can be started after 2 non productive cycles (instead of 6). If the next job is a 6 colors job - printing might begin immediately and no time will be lost. Authors recommend to start printing after N-C cycles, where N is the approximate number of cycles it will take for ILP to adjust and C is the number of colors in the next job.
Printing immediately is not recommended since Ink present on the Intermediate Transfer Member (a printing Blanket for example) during print might become too dry and cause improper transfer or a severe jam event when actual transfer to substrate is performed.

In case of error, such as: (1) Jam between the feeding unit and the ILP; (2) ILP error which prevents adjustment; (3) other component error - transfer to Impression media which is located on the impression drum (to avoid ink drying) and terminate print.

The proposed method provides a significant time saving when printing variable media thickness continuously, and enables almost seamless printing of multi-substrate jobs on any ILP powered digital printing press.

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