Comparison of Print Consistency and Print Sharpness of Dry Toner Based Electrophotography and Liquid Electrophotography Digital Printing Engines

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Abstract

There is no denying that as the need for quick, inexpensive, and high-quality customised print output increases, the market shares of both digital technologies; ink jet and electro photographyare rising quickly. One of the so-called non-impact printing techniques is electro-photography, often known as digital printing. It is a master-less technology in which there is no information carrier acting as an intermediary. The ability to alter printing information after each cycle of the process and print changeable data of information is a major benefit of digital printing. Digital electro photography print engines based on dry toner and liquid toner are the two solutions that are now available for toner-based electro photography. These two print engines have different benefits, drawbacks, and applications since they are employed for different purposes. In this research, comparison of two very important print quality factors; print sharpness and print consistency of two widely used electrophotography print engines are studied and analyzed.

Keywords: Electrophotography, dry toner, digital printing, liquid toner, print sharpness, print consistency.

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Introduction

Electrophotography printing process is the extension of the xerography and is basically using photography by use of electric, not like the chemical process, being widely used by the lithography-offset printing technique (The Basics of Electrophotography, 1999). This particular printing technique was invented by Chester Carlson in the year, 1938, and he is popularly known as the father of modern digital printing. This printing process is also known as xerography, also, as Xerox Corporation was the one to introduce the concept of this particular printing**(**Mizes, et al.).

Electrophotography printing techniques works on six basic steps; staring with the charging of the photoconductor, more specifically the Organic Photoconductor (OPC), image formation of the OPC through exposure, latent image formation, image transfer from the photoconductor on to the printing substrate, fusing of the tonner on to the substrate surface, i.e., permanent fixing the tonners, cleaning of the photoconductor for removing any residual tonner particles and finally the photoconductor surface for a new image formation (Ientilucci, 1994).

Electrophotography printing technique falls under the non-impact printing process, or in a more simpler term, the masterless printing, where every printing cycle can be made different from each other, in terms of content. There is no permanent image carrier for effecting printing, as it happens in conventional printing processes. This

essentially makes it possible to print variable data printing (Sardjeva, et al., 2013).In electrophotography printing process, controlling final printing quality is very important. The final thickness of the printing ink layers plays a crucial role and it essentially depends upon the particle size of the tonners and the physical and chemical structure of the tonners in use. Care must be given to have a detailed analysis of the tonners to use for printing operation in a particular electro photography press (Kipphan, 2001).

Digital electrophotography presses based upon dry toners, popularly known as DEP (Dry Electrophotography), is very widely used in the printing industry, due its numerous merits. Since, its inception, it has created a unique place in the Graphic Arts industry and the overall growth and development is quite convincing (Sardjeva, 2014). Toners are basically fine dry powder, which melts on applications of heat, and contains, resin, colouring substances, wax and other additives to enhance the printability characteristics. There are mainly two types of dry tonners; mono component dry toner and dual component dry toner, and moreover they are selected carefully as per the requirement of the press (Medeiros).

On the other hand, Liquid Electrophotography, popularly known as, LEP, is a patented press of HP Indigo. This has gone one step ahead of the conventional printing techniques by eliminating the cumbersome process of plate preparation, mounting on the press and other related press activities. Possible reduction of makeready time/job changeover time, coupled with variable date printing and positive environmental aspects are some of the positive points of LEP (HP, 2020). The inks used in such presses are popularly known as, Electro Ink. The ink is supplied in the forms of paste and needs to be mixed with the imaging oils, during the printing cycle, internally in the printing machine. The very minute particle size of the toner is the hallmark of these types of ink and hence makes the LEP presses more effective in the print marketplace (Medeiros).

In the digital printing platform, it is very much necessary to maintain the colour consistency from the first printed sheet to the last printing sheet. While talking about the electrophotography, print consistency is considered to be easier to maintain in comparison to the other printing processes, especially the conventional printing techniques (Platinum Copier Solutions, 2019). Print sharpness is related to the fineness of the image quality, when it is being printed, so that the final printed output will have a better standout, when being viewed by the print end-users. Edges of the images generally plays a bigger role, while considering the image sharpness of the printed output (Katajamaki, 1998).

Review of literature

As per, AL-Rubaiey, et al., in the recent times, the segment of digital printing, both the electrophotography and the inkjet printing have increased, so as to take care of print on demand, variable date printing, low print run length and at the same time matching close to the print quality of various conventional printing systems. The digital printing base has made its presence felt almost all the areas of the printing arena; commercial printing, publications, packaging printing, etc.

As per, HP, the LEP presses, i.e., HP Indigo presses are designed to produce the final print products which are no longer less than the print quality obtained from the traditional printing process presses. This has made it possible to cater to the printing segment where print consistency plays a major role and print buyers and end-users are certainly accepting the LEP presses for printing of photobooks and high-end packaging printing along with commercial printing segment.

Further, HP, extended with, HP Indigo presses are manufactured with the facility of accurate positioning of the drops of Electro Ink, with utmost control, in comparison to the inkjet presses, where the ink droplets are forced onto the substrates through the air medium. This technology essentially results into accurate positioning and placement of ink on the printing media, like the convention

printing systems of gravure printing or offset printing presses.

Research Objective

In the recent times, digital printing is growing at a convincing rate and the traditional printing techniques are finding it hard to compete with the various digital printing techniques available in the market place. Day by day, print run length is diminishing and job verities are increasing without compromising the final print quality level. Cost of production is also one of the major issues when it comes to printing small quantity print batch size.

It is always highly demanded to produce consistent print output, without any colour and other related variations from first printed sheets to the last printed sheets. This certainly poses a bigger challenge for the printers to achieve print consistency. Dry toner-based electrophotography (DEP) and liquid toner-based electrophotography (LEP) are the most frequently used digital print engines besides inkjet presses, options available to the printers to take care of print on demand, customization, versioning and quick printing market segment.

Sharpness of the image always draws the attention of the printers and the print end-users when it comes to producing consistent print products throughout the whole print run. The main objective of this research work is to compare the print consistency and print sharpness of the two most widely used digital printing engines; dry toner and liquid toner electrophotography presses, so that one can decide suitably the particular print engine for specific print output.

Research Methodology

For print sharpness and print consistency, for which ten standard observers were identified and their visual observations are taken into account for the measurement of these print quality factors. The standard observers were identified and selected as per, “The Farnsworth-Munsell 100 hue test”. The standard viewing booth with D 50 illuminate was used for the viewing of the printed image with the help of a standard magnifying glass (10X) for the inspection of the image edge quality for assessing print consistency and print sharpness. One coloured dry toned based electrophotography press and one liquid electrophotography multi-colour press were used for printing of the developed test chart for assessing the print sharpness and print consistency.

High resolution pictures were incorporated in the test chart for assessing the print sharpness. 120 gsm gloss paper was used for printing purpose. The papers were tested in a certified laboratory as per the ISO 12647-1 standard. A total of 200 sheets in each print engine, were printed in the standard operating condition and the press room condition. After every 20 sheets the sheet was collected, a total of 10 printed sheets each from the two print engines were taken into data collection and analysis purpose.

For the print sharpness, edge quality of an image was measured by the standard observer. Ten standard observers were given printed samples to evaluate the print sharpness in the 1-5 scale reading, where “1” denoting the minimum sharpness and “5” as the maximum sharpness. It goes without saying that the ultimate viewing environment for the product is the ideal one for evaluating colour visually. Each observer received ten printed sheets to evaluate the print quality visually. The same procedure was followed for the two printing machines that were chosen for printing.

The same 10 standard observers who were previously chosen were given the ten printed sheets to evaluate for print consistency on a scale of 1 to 5, with "1" denoting the lowest print consistency and "5" denoting the highest print consistency. The observation was carried out with the help of light viewing booth at D-50 light source.

Data collection & Analysis

Out of the 200 printed sheets in dry toner-based electrophotography press, 10 sheets were collected and ten standard observers through visual observation under the D 50, light viewing booth, on a scale of 1-5, the data was collected for the print consistency. The master table was prepared from the collected data from the standard observers. Figure 1,

represents the data of standard observers, S1 representing the standard observer 1 and so on to S 10 as standard observer 10.

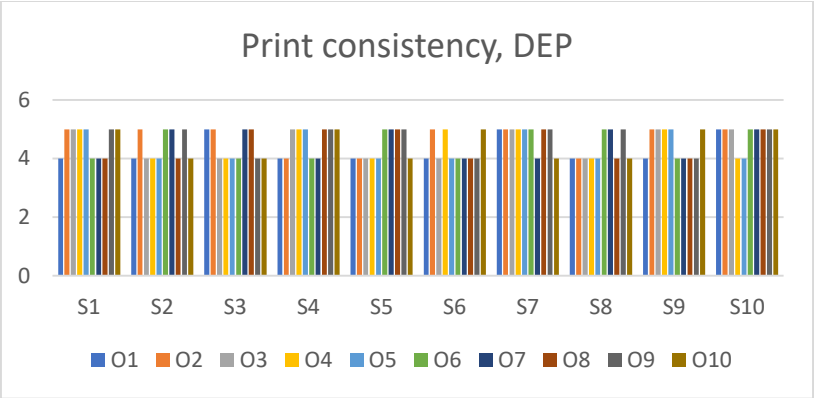

Fig.1 Print consistency, DEP

Out of the 200 printed sheets in liquid toner-based electrophotography press, 10 sheets were collected and ten standard observers through visual observation under the D 50, light viewing booth, on a scale of 1-5, the data was collected for the print consistency. The master table was prepared from the collected data from the standard observers. Figure 2, represents the data of standard observers, S1 representing the standard observer 1 and so on to S 10 as standard observer 10.

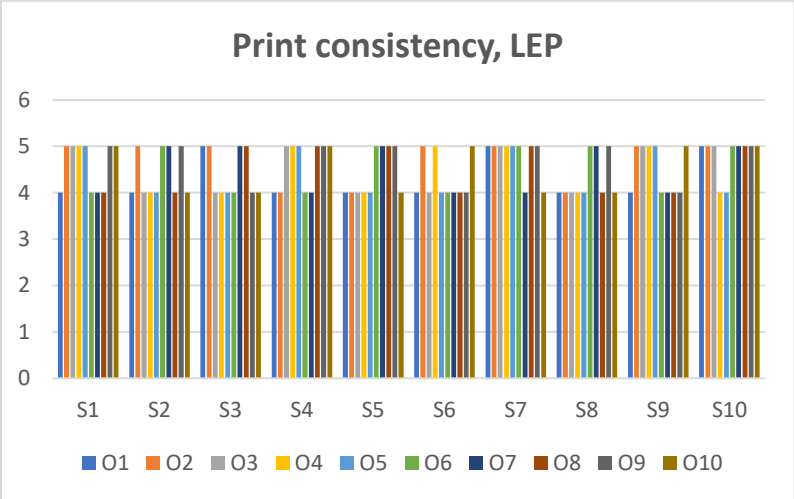

Fig.2 Print consistency, LEP

Out of the 200 printed sheets in dry toner-based electrophotography press, 10 sheets were collected and ten standard observers through visual observation under the D 50, light viewing booth, on a scale of 1-5, the data was collected for print sharpness. The master table was prepared from the collected data from the standard observers. Figure 3, represents the data of standard observers, S1 representing the standard observer 1 and so on to S 10 as standard observer 10.

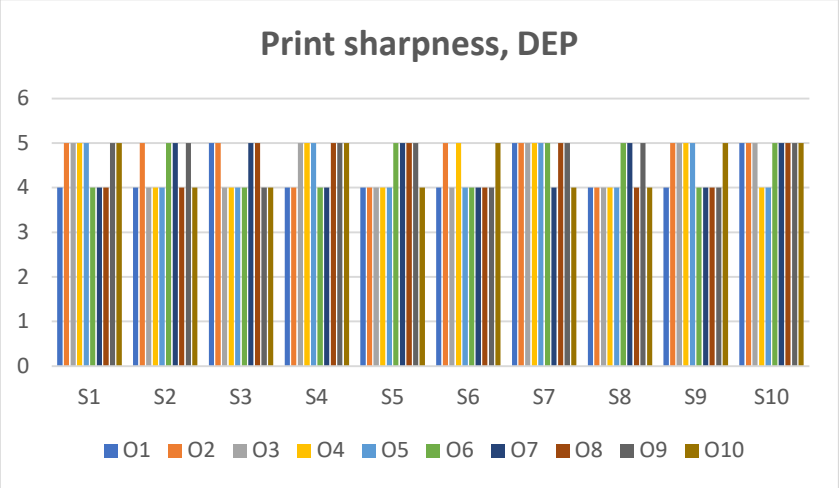

Fig.3 Print sharpness, DEP

Out of the 200 printed sheets in liquid toner-based electrophotography press, 10 sheets were collected and ten standard observers through visual observation under the D 50, light viewing booth, on a scale of 1-5, the data was collected for print sharpness. The master table was prepared from the collected data from the standard observers. Figure 4, represents the data of standard observers, S1 representing the standard observer 1 and so on to S 10 as standard observer 10.

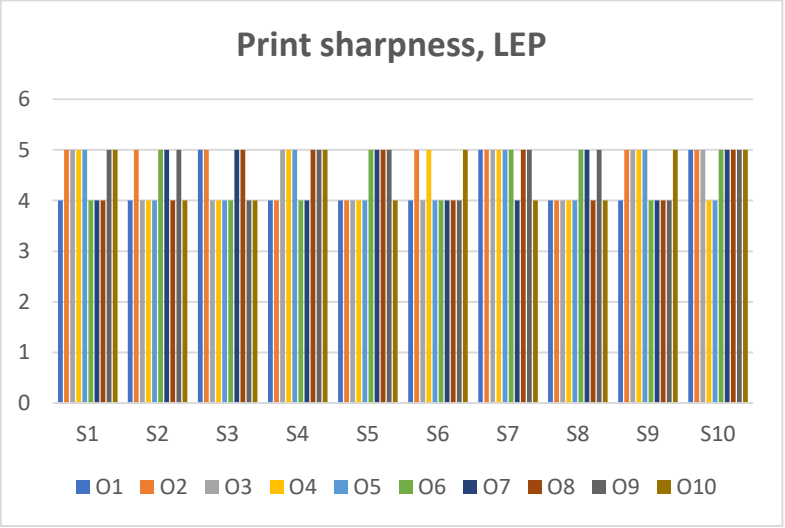

Fig. 4 Print sharpness, LEP

Result & Discussion

Print sharpness and print consistency are two highly important print quality factors, especially in digital printing platform to take care of final print quality. Digital printing is characterized by short run jobs coupled with mass customization and versioning. But at the same time, quality of the final print product is equally important, in order to sustain and grow in the market place. In recent time, technological developments in materials, process and technology have certainly made to possible to produce print products close to that of the traditional printing process, like offset printing and gravure printing process.

Print sharpness indicates how the graphics reproduction in each successive printed sheets are identical in all respects, like the sharpness of the dots, edges and the complete pixel. Print sharpness in both the dry toner based and liquid toner based digital electrophotography presses shows, very good results, as the value in most of the cases are above 4, which is certainly very impressive, as

far as the print sharpness is concerned. There is no much difference between the dry toner and liquid toner electrophotography presses, both of the print engines are very close, while considering print sharpness. The result shows, while printing gloss coated paper, in both the dry toner and electrophotography printing presses, print sharpness is of highest in nature.

Print consistency indicates how the colour reproduction in each successive printed sheets are identical in all respects. Coated papers are widely used in the digital printing industry for it's better printing surface and a wide range of coating on the paper surface to suit a wide range of end uses. Printing consistency in both the dry toner based and liquid toner based digital electrophotography presses shows, very good results, as the value in most of the cases are above 4, which is certainly very impressive, as far as the print consistency is concerned. There is no much difference between the dry toner and liquid toner electrophotography presses, both of the print engines are very close, while considering print consistency. The result shows, while printing gloss coated paper, in both the dry toner and electrophotography printing presses, print consistency is of highest in nature.

Conclusion

In the recent times, printing industry is facing new challenges from the respective digital media and it is the need of the hour to concentrate on innovative ways to counteract the possible threats, in order to survive, compete and grow in the marketplace. In the past, printing industry has successfully absorbed the shocks and will do same in the coming years, also. Digital printing techniques have edge over the traditional printing techniques in certain domain and print quality is a major issue, irrespective of conventional and digital printing platforms.

Print sharpness and print consistency are two very basic and yet highly effective print quality factors, which always draw attention of print producers and print buyers prospective, in order to attain highest level of printed output. Once these two print quality factors are taken care, the chances of rejection of the print job and reputation of the print providers in the market place certainly increases to many folds. In this research it is certainly concluded that, gloss coated papers are highly suitable for both the dry toner and liquid toner based digital electrophotography presses, when it comes to achieve highest level of print consistency and print sharpness.

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