New Technologies for Printed Material's Advanced Value in the Production Printing Market

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Abstract

RICOH Pro C901 was launched in the late last year. It was successor of Pro C900 which was launched in the late 2008 and has gotten favorable reviews.

Pro C901 has newly chosen RICOH original chemical toners called "PxP (polyester x polymerization)" and achieved near–offset, high image quality. Pro C901 is also focused on being used in production printing market. And we have given priority to making printed materials valuable.

In this report as the technologies for enhancing the printed materials, we will introduce the designing for stable image quality and the designing for UV varnish coating.

1. Introduction

In recent years, in the production printing market, as the print type is getting full of variety and the number of same image print is getting lessening, the demand for POD (Print on demand) is expanding so that you can print adequate number of prints whenever you need at lower cost. In the production printing market, it is expected that the image quality will be much more stable than the office-used printers because the printed materials itself becomes products.

Also, it is popular to coat the printed materials surface in order to put on gloss or to prevent from scratching or aging. We've been careful to match with UV varnish coating which is most popular surface coating since the beginning of designing Pro C901.

In this report, we'll introduce the technologies for stable image quality and UV varnish coatings we worked on for Pro C901.

2. Product outline

Fig.1 is the layout and the table.1 is the specification of RICOH Pro C901.

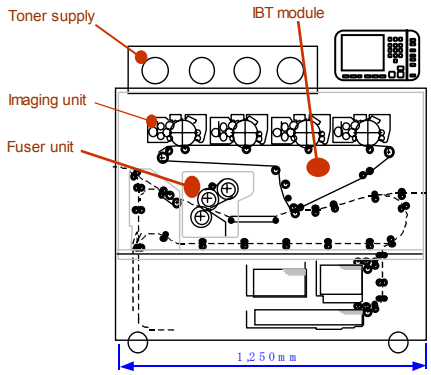

Fig.1 Engine Layout

Table.1 Specifications

Term	Specification
Configuration	Console
Printing Process	Laser Electrostatic Transfer System;4-drum Tandem Engine
Printing Speed per Min.	Full Color : 90ppm(A4_LEF),50ppm(A3)
	Black&White : 90ppm(A4_LEF),50ppm(A3)
First Print Speed	Full Color : Less than 13.5seconds
	Black&White : Less than 13.5seconds
Resolution	1,200dpi×1,200dpi
Tones Reproductivity	256tones
Zoom	25%～400%
Paper Sizes	Standard Tray : A5_SEF～12×18inch(305×457mm)
	LCT : A5_SEF～13×19.2inch(330.2×487.7mm)
Maximum Image Area	320×480mm
Paper Weights	Standard Tray : 60～220g/m^2
	LCT : 60～300g/m^2
Paper Capacity	Standard : 2,200sheets×1 + 550sheets×1
	Maximum : 12,100sheets (A3LCT×2 + Bypass tray)
Duplexing	Standard
Power Source	200V, 30A, 50/60Hz
Power Consumption	Less than 5,500W
Warm-Up Time	Less than 420seconds
Dimensions	1,250×1,100×1,450mm (Main unit), 3,083×1,100×1,450mm (+ A3LCT & Finisher)
Weight	630kg

3. Designing for Stable Image Quality

In the production printing market, there are so many kinds of patterns from low coverage image such as direct mail to high coverage image such as leaflets, posters, and graphic arts. Also the large print volume must be covered.

Pro C901's process control which is executed periodically is designed to achieve stable image quality against many factors including coverage and print volume.

3-1. Background potential correcting control

In the production printing market, it is very important to keep middle tone stable because a little difference in the middle tone could easily distinguish the color differences.

The electro photographic printers' developing γ vary depending on the environment such as temperature and humidity. In addition, extensively high or low image coverage or the characteristic change of developer or photoconductor through large print volume make developing γ range very wide in the case of production printing.

Fig.2 shows the image of BGP (background potential) control. The BGP correcting control makes the middle tone stable with changing the BGP depending on the depth of developing potential.

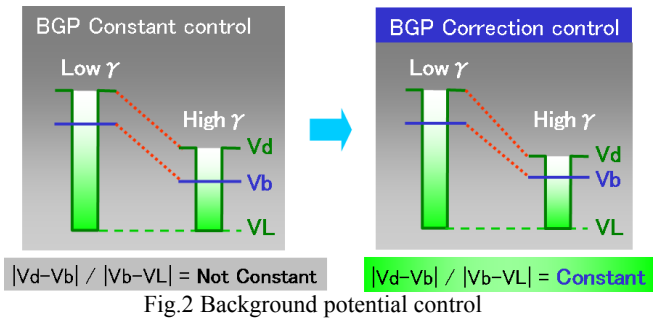

Fig.2 Background potential control

Fig.3 shows the relation between developing γ and middle tone density in the case of BGP correcting control and in the case of BGP constant control.

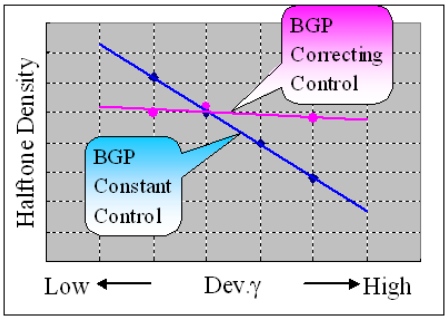

Fig.3 Halftone density

3-2. Toner density correcting control

The "process control" is executed periodically such as powered on or a certain amount of prints printed. That process control adjusts image quality by optimizing the process conditions. While it is printing the process conditions such as developing bias, laser power and so on remain unchanged and control toner density in order to keep the image density.

Fig.4 shows the toner density change depending on the printing situations. When the toner density gets too high, it could cause background dirt or developer roller's lock. When the toner density gets too low, it could cause carrier adhesion. The toner density must be kept in proper range to prevent from such problems. But the condition such as low humidity, low print duty and low coverage image makes Q/M and toner density high. And the condition such as high humidity, high print duty and high coverage image makes Q/M and toner density low.

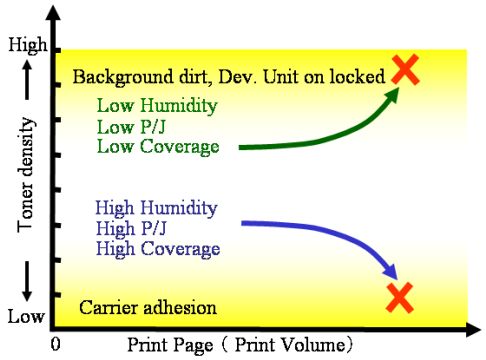

Fig.4 Toner density

Pro C901 calculate the DCL (Dev. Charge Level) through a process control executed periodically and make the toner density to the center in the usable range by setting proper developing γ. DCL means the toner electrostatic value standardized by toner density and is calculated by the equation (1). TC represent "toner density" and TCst represent the "normal toner density".

$$DCL = (Q/M) \times TC / TCst \quad (1)$$

Q/M is correlative with developing γ and is expressed like equation (2). The "a" and the "b" is constant and decided through experiments.

$$Dev.\gamma = -a \times (Q/M) + b \quad (2)$$

The equation (1) and (2) lead the equation (3). In brief DCL can be estimated through TC and Dev.γ

$$DCL = -TC \times (Dev.\gamma - b) \quad (3)$$

The Fig.5 shows the relation between toner density and Dev.γ. The relation between toner density and Dev.γ varies depending on DCL. But we can tell that relation once we estimate the DCL. That can make possible to move toner density to the center in the usable area by setting appropriate Dev.γ. That increases the margin of the worry that toner density goes too high or too low even when environment (temperature or humidity) changes or when there are variations in printing mode.

Even if the Dev.γ changes in wide range, the middle tone image quality is able to keep stable through the background potential correcting control. In this way we could achieve having high robustness against the many factors including coverage and print volume.

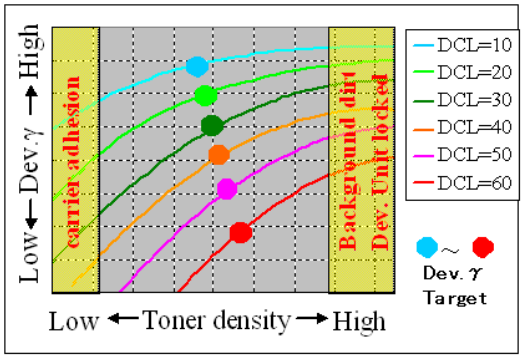

Fig.5 the relation between Toner dennsity and dev. γ

4. Designing for UV Varnish Coating

4-1. The demand for varnish coatings

Fig.6 shows the research of demand for surface coating of offset print and digital print. The demand for surface coating of digital print is lower than the one of the offset print. But it is expected that the print volume will shift from the offset to the digital print and that the demand for surface coating of digital print will expand.

There are some styles of surface coating such as laminate and clear toner but the demand for UV varnish coating is the most popular because of low environmental burden or comparatively low cost.

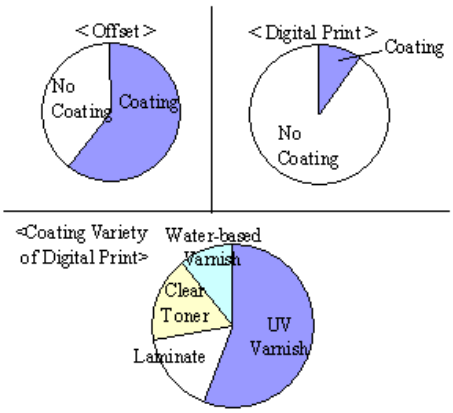

Fig.6 Surface coating in the present

4-2. The assignments of UV varnish coating

Pro C901 has changed toner from grinded wax-free to chemical wax-in and changed fusing system from silicone oil-used to oil-free in order to achieve higher image quality, higher reliability and less impact on environment.

On the other it was concerned that wax-in toner could be worse than wax-free toner regarding UV varnish coating and that it could cause repellent image shown as Fig.7.

So we decided that the items to be evaluated are wettability, adhesiveness, yellowing and gloss and started to work at evaluation from the very first stage of Pro C901 designing.

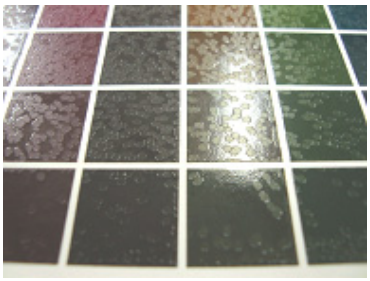

Fig.7 repellent image

4-3. The dealing method for the assignments

4-3-1. Wettability

The wax having strong polarity has good affinity because UV varnish has strong polarity. However toner waxes have generally low polarity and are chosen by several viewpoints such as fuser roller (belt) releasability, melting point and so on. Therefore there are limits to what toner wax prescription can do for the wettability.

Then we organized the relation between varnish prescription and repellent image and found out that the UV varnish containing surface active agent have good wettability with the printed materials.

Table.2 wettability test

item	varnish A	varnish B	varnish C	varnish D	varnish E
UV monomer	A,B	A,C,D	A,C,E	A,B	A,F
Photopolymerization Initiators	a	a	a,b	a,c,d	c,d
Solvent	Anon	Anon	-	Anon	-
Fluorescent brightening agent	-	-	contain	-	-
Surface active agent	-	contain	contain	-	contain
repellent	NG	OK	OK	NG	OK

4-3-2. Adhesiveness and yellowing

The UV varnish coating is often applied to the book cover and it is expected to protect the image from scratch or aging. Therefore the adhesion to the image is also important. If the adhesiveness is weak the UV varnish is easy to peel off as shown Fig.8.

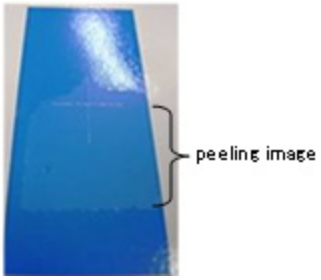

Fig.8 the peeling image

We found that the adhesiveness is controlled by integrating light power and that the bigger integrated light power gets the stronger the adhesiveness gets. On the other when the integrated light power is too strong the yellowing gets worse. Fig.9 shows the relation between the integrated light power and adhesiveness and yellowing. We could satisfy the adhesiveness and yellowing by optimizing the integrated light power.

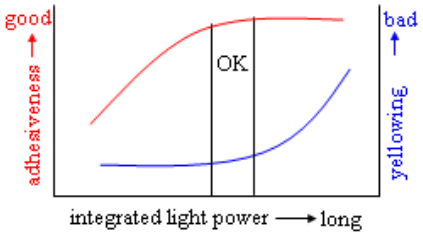

Fig.9 the relation between integrated light power and adhesiveness and yellowing

4-3-3. Gloss

We found that the gloss is controlled by the leveling time which is the time from UV varnish coating process to UV irradiation process and that the longer the leveling time is the glossier the surface gets because long leveling time makes the UV varnish surface smoother. We could get the appropriate gloss by optimizing the leveling time.

5. Conclusion

We introduced some technologies for printed material's advanced value in the production printing market.

We will develop our techniques that we have accumulated and keep producing fascinating products that can make more valuable printed materials.

References

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Author Biography

Tomohide Takenaka received his MD in micro mechanical science and technology from the University of Nagoya University (1999). He has worked in the Research and Technology Division at RICOH since 2009. His work has focused on the development of process of electro photographic printers.