Development of Environment-friendly Process-less CTP Plate "PRO-T3 (Domestic Name : XZ-R)"

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Abstract

We developed a new environment-friendly, process-less CTP Plate "PRO-T3 (domestic name: XZ-R)", offering high press start-up stability. In the development of "PRO-T3", we established two technologies: Fine Particle Dispersion (FPD) and Rapid Stable Start-up (RSS). This article is a review of these two noteworthy new technologies, as applied to PRO-T3.

1. Introduction

The printing market's environment has drastically changed. Today, printing companies can hardly survive without increasing productivity, reducing delivery time, cutting cost and being environment-friendly. Computer to Plate (CTP) technology helps increase productivity, ensure stable quality, eliminate use of intermediate materials and reduce cost. Because of these advantages, CTP is now used for 70% of all the printing services in the world or 80% in Japan. CTP is virtually a de facto standard for printing.

Environmental awareness is increasing among users. The printing industry has established its voluntary standards as part of efforts for environmental conservation. One of the standards is the Green Printing Certification program by the Japan Federation of Printing Industries. The program is designed to encourage printing companies to produce eco-friendly printed products. The certification is granted to printing companies for their environmental efforts on the printing materials, materials used for printing process and printing process.

Similar efforts are made across the world. For instance, the concept of product carbon footprint, the total CO_2 equivalent greenhouse gas emissions from an entire manufacturing process from material procurement to disposal, is widely used.

FUJIFILM's Thermal CTP Plate obtained the Government's Carbon Footprint of Products (CFP) certification in accordance with the Product Category Rules (PCR) at the end of 2009. It is the first CFP certified product in the industry. The plate has been carrying the CFP label since (Fig. 1).

Fig. 1 Label for process-less CTP plate.

Eco-friendly design of a plate is certified with environment-friendly printing label (clione label) (E3PA). The highest grade is called Gold Plus. In the case of a printing plate, Gold Plus is awarded to a process-less CTP plate that uses no processing solutions (Fig. 2).

Fig. 2 Environment-friendly printing label.

2. Background of Development and Improvements Needed

In 2006, we launched PRO-T (ET-S in Japan), a Gold plus-certified process-less CTP plate for on-press development. In 2009, we launched PRO-T2 (ET-SH in Japan), PRO-T with enhanced on-press development capability. We have sold

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the plates to over 1,300 companies in the world and over 200 companies in Japan (as of December 2010) (Fig. 3).

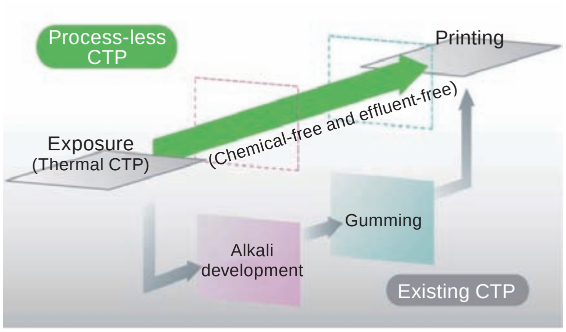


Fig. 3 Comparison between alkali-developable CTP plate and process-less CTP plate.

Process-less CTP has lower press start-up stability than alkali development CTP (Fujifilm: XP-F or LH-PJE). Users show an interest in process-less CTP for its short delivery time, low cost and space saving feature. But, some users decide not to introduce the new plate. In order to enhance the press start-up stability, which is synonymous with on-press development capability and ink receptivity, the plate must combine two conflicting sets of characteristics: (1) Plate durability and on-press development capability and (2) ink receptivity and on-press development capability.

We believe process-less CTP is the ultimate form of environment-friendly CTP. Seeking handiness for users, we have developed two technologies to achieve the conflicting characteristics above: Fine Particle Dispersion (FPD) for (1) and Rapid Stable Start-up (RSS) for (2). In 2011, we launched PRO-T3 (XZ-R in Japan) improved in press start-up stability. This report explains the technologies used for PRO-T3 (Fig. 4) [1].

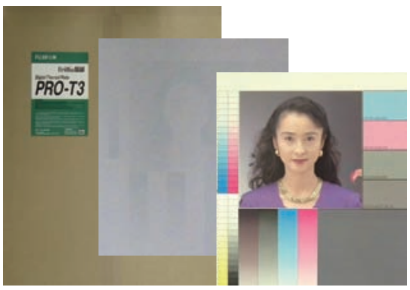


Fig. 4 Introduction of PRO-T3.

3. Process-less Plate technology

3.1 Our Process-less Design Policy

Fig. 5 shows the layer structure of our process-less CTP. Our process-less CTP is an on-press development system using a negative type radical polymerization. The on-press development system works this way. A laser-exposed plate is set on the press without being processed with a developer or any other chemicals, a fountain solution and ink are applied to the plate and the unexposed areas (non-image areas) are removed on the press to form an image.

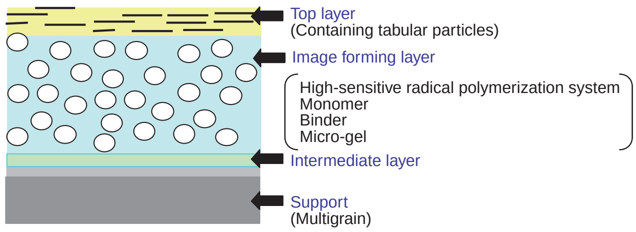


Fig. 5 Layer configuration of process-less CTP plate.

The on-press development mechanism we have employed consists of quick penetration of the fountain solution into the image forming layer (Step 1), formation of a water layer to reduce interface adhesion between the image forming layer and the substrate (Step 2) and peeling of the image forming layer by the adhesiveness of ink (Step 3) (Fig. 6).

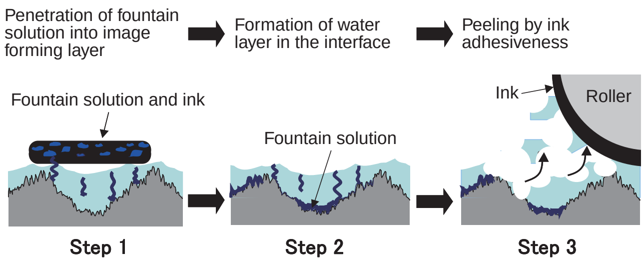
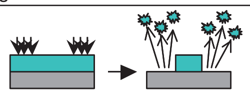
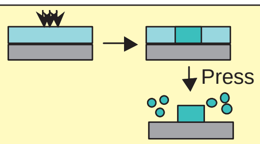
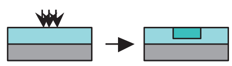


Fig. 6 Mechanism of on-press development.

Among all the process-less systems (Table 1), the advantages of the negative type on-press development system are that it has great resistance to stains as it can use an aluminum hydrophilic surface just as alkali development CTP does and that a reaction mechanism very effective for hardening an exposed layer can be applied to the system.

Table 1 Imaging technologies and the merits of each process-less CTP plate.

Image formation		Advantage	Disadvantage
Ablasion		Sensitive material design is easy when a high-powered laser is used	• Low sensitivity • Treatment of a scattering is required
On-press development		• Aluminum hydrophilic surface is available just as CTP for alkali development • A reaction mechanism very effective for hardening of an exposed layer can be applied	• Disposal of removed materials on the press is required • The removal speed of non-image areas can significantly affect the number of waste paper sheets
Polarity inversion		No need to treat removed materials	• Low sensitivity • It is hard to clearly separate hydrophilic areas from hydrophobic areas

We use a combination of the starter containing an infrared absorber (cyanine dye) and a photo-acid generator (iodonium salt), and the radical polymer containing monomer, binder and micro-gel to harden an exposed layer and have achieved high sensitivity.

The disadvantages of the system are that the removed materials on the press need to be detoxified and that the removal speed of non-image areas (hereinafter referred to as "on-press development capability") can affect the number of waste paper sheets.

About the treatment of removed materials, we have designed the sensitive material to let the removed materials dissolve and disperse in the ink not in the fountain solution. Using technology for removing hydrophobic areas of the image forming layer from the interface like peeling a skin and finely dispersing them, we have succeeded in detoxifying the removed materials on the press.

As deduced from Fig. 6, to improve the on-press development capability, we must speed up the penetration of a fountain solution by creating penetration paths, accelerate formation of a water layer by augmenting the interface hydrophilicity and increase the breakability of the image forming layer by the adhesiveness of ink.

When a large amount of hydrophilic ingredient is added to the image forming layer to speed up the penetration of a fountain solution, this will enhance the on-press development capability but decrease the ink receptivity as the image areas become hydrophilic. The image areas also become brittle due to penetration of the fountain solution and the plate durability will deteriorate.

For PRO-T3 (XZ-R in Japan) , we have developed two new technologies in addition to our existing process-less CTP technology. They are (1) FPD technology for combining plate durability and on-press development capability and (2) RSS technology for combining ink receptivity and on-press development capability. The following sections explain these two technologies.

3.2 Fine Particle Dispersion (FPD) Technology

Among the components of the image forming layer, we have focused our attention to micro-gel that largely contributes to improvement in plate durability. We have distributed unsaturated ethylene group unevenly on the particle surfaces and optimizing the hydrophilicity and hydrophobicity and developed a new type of micro-gel that disperses uniformly in the image forming layer.

The conflicting characteristics of plate durability and development capability are achieved by the high water penetration along the surfaces of uniformly dispersed micro-gel particles in the non-image areas and by the increased hardness by the reaction between the high-hardness micro-gel and the polymerized component in the image areas (Fig. 7).

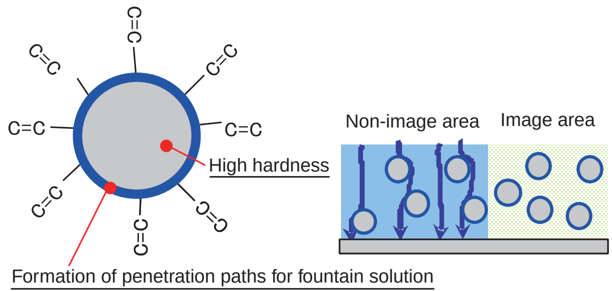


Fig. 7 Function of new micro-gel.

3.3 Rapid Stable Start-up (RSS) Technology

Our existing process-less CTP uses the ultrathin layer oxygen barrier technology (Fig. 8) including high-aspect-ratio tabular particles (filler) to achieve plate durability, on-press development capability and ink receptivity. This method, however, has a problem. While the coated topmost layer is drying to form the barrier, a certain percent of the topmost layer mixes with the image forming layer. The hydrophilic component of the topmost layer gives hydrophilicity to the image forming layer and that decreases the ink receptivity.

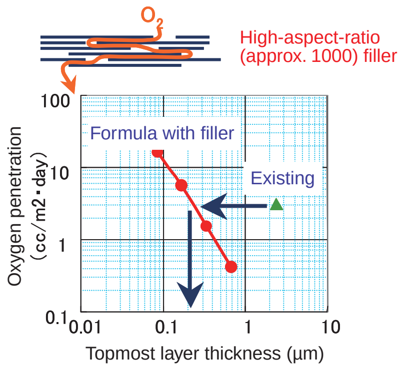


Fig. 8 Relationship between thickness of top layer and oxygen-barrier property.

To solve this problem, we have reviewed the polymer structure of the topmost layer focusing on the layer forming characteristics. We have also improved the coating method of a solution containing tabular particles. And, we have reduced mixing of the image forming layer and the topmost layer (Fig. 9). The image forming layer retains the hydrophobicity while the topmost layer surface is hydrophilic and helps penetration of a fountain solution. That the topmost layer above the image areas are removed effectively and the ink receptivity is drastically improved.

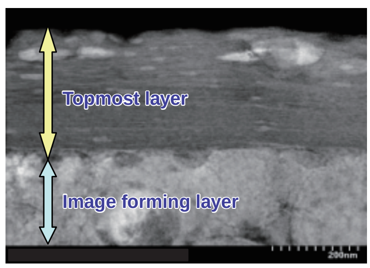


Fig. 9 Cross-section TEM picture between imaging layer and top layer.

To improve the on-press development capability, we have focused our attention to Step 2 (formation of a water layer to reduce interface adhesion between the image forming layer and the substrate) of the on-press development mechanism in Fig. 6. We have achieved the goal by reviewing the design of the interface (intermediate layer) between the image forming layer and the aluminum support.

For the intermediate layer of process-less CTP plates, we have used a support preserving (support adsorbing) polymer consisting of a functional group that accelerates a reaction with the polymerized component in the image forming layer (unsaturated ethylene linking group), a functional group that interacts with the support surface and a hydrophilic group (Fig. 10).

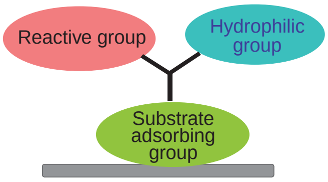


Fig. 10 Function of the polymer in the interlayer.

In this study, we have drastically improved the on-press development capability by employing a new hydrophilic group controlled in hydrophilicity, reactivity and interaction with the component of the image forming layer to help formation of a layer of fountain solution in the interface while maintaining the design policy of the polymer in intermediate layer.

Fig. 11 illustrates Fine Particle Dispersion (FPD) technology and Rapid Stable Start-up (RSS) technology.

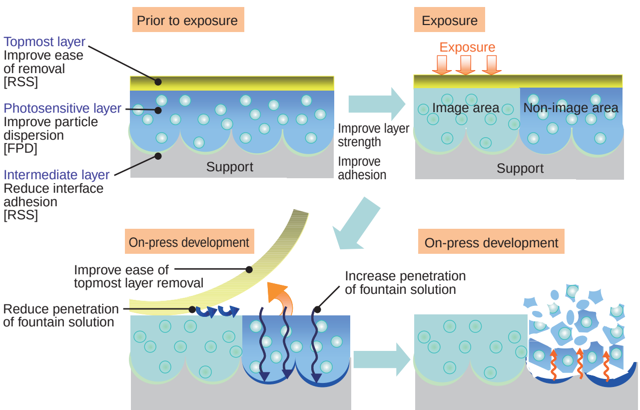


Fig. 11 Innovative technologies of PRO-T3.

4. Attainments of New Process-less CTP, PRO-T3 (XZ-R in Japan)

With the start-up stability dramatically enhanced, thanks to the two new technologies, the new process-less CTP will provide customers with greater satisfaction (Fig. 12, Table 2).

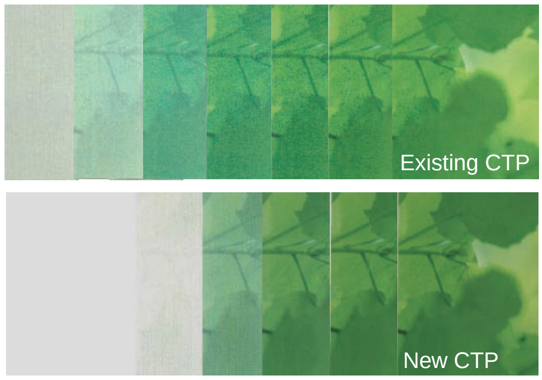


Fig. 12 Press start-up property of PRO-T3.

5. Conclusion

Process-less CTP brings various benefits to the users, such as eco-friendly printing, short delivery time, reduction in cost and space saving. It is significant that process-less CTP is enhanced in compatibility with existing presses, which many consider a problem that has kept it from being widely used for general commercial printing services. We believe PRO-T3 (XZ-R in Japan) will help process-less CTP to dramatically grow in the market and help the printing industry to boost efficiency.

Reference

1) Mori, Takanori; Kuramoto, Mamoru; Ishiguro, Yuriko; Ohashi, Hidekazu; Kawauchi, Ikuo. Development of environment-friendly fully process-less new thermal CTP plate. Proceedings of the 125th spring meeting of the Japanese Society of Printing Science and Technology. 15-19 (2011).

Table 2 Plate performance of PRO-T3.

		PRO-T3 New	PRO-T2 Existing	Alkali development CTP (XP-F)
Exposure sensitivity		120 mJ/cm^2	120 mJ/cm^2	120 mJ/cm^2
Plate durability		50,000 to 100,000 sheets	50,000 to 100,000 sheets	100,000 to 200,000 sheets
Start-up stability	Ink receptivity	○	△	◎
	On-press development capability	○	△	◎
Resistance to stains		○	○	○
Processing and effluents		◎	◎	△