

Shallow Plate Reverse/Surface Printing with New FX Reducing VOC Emissions with Solvent-based Gravure

DAISAN FILMS CONVERTING CO., LTD. (DAISAN), a flexible packaging gravure printer and industrial material converter, installed its first THINK LABORATORY CO. LTD. "New-FX," a next-generation gravure cylinder plate making system. DAISAN began full operations using the new system in July, 2011. By fully taking advantage of the shallower cylinder, they are challenging some of the issues that come with solvent-based gravure printing, such as surface printing, reducing volatile organic compound (VOC) emissions, and reducing energy and material use during plating. There is much hope that this challenge will bring about a technological revolution in the gravure printing industry, which has seen little movement since the shift to water-based printing.

The End of the Boomerang

DAISAN's gravure plate making facility was previously composed of two THINK LABORATORY fully automated plating/etching "Boomerang" lines. They also used two THINK LABORATORY argon laser "Laser Stream" exposure devices and two DAINIPPON SCREEN MFG. CO., LTD. "Valcus" electronic engraving machines. Using the Boomerang, base materials of hollow aluminum cylinders were copper plated to the specified thickness. The Valcus' diamond stylus was used to engrave the surfaces of the

color printing cylinders with ink holding cells and the Laser Stream's laser was used to expose the dried photosensitive materials coated on the character printing cylinders. Following this process, the character cylinders were etched in the Boomerang to form the cells. Finally, the cylinders for both color printing and character printing were chrome plated in the Boomerang to improve the printing resistance of the cylinders. This process was used to form both gravure rolls for printing and coating.

The Boomerang and Laser Stream machines, however, were installed in 1994, and were approaching their renewal period. When DAISAN increased the size of its three-story steel frame main plant to a floor area of 5,874 m² in November of 2007, it began considering what to do about its plate making facilities. Because of high capital investment costs, however, this issue was put aside.

Mr. Takayoshi Matsui,

president of DAISAN, explained that when facilities become old, parts supply causes disruptions, so THINK LABORATORY president Tatsuo Shigeta approached them saying they should install new equipment soon. But because they had just expanded their plant in 2007, they were not able to make such a move until plate making settled down a little. Since their facilities were approaching their limit, however, they continually fretted over what to do about their next plate making equipment. On the other hand, at this time converters and gravure printing companies were faced with the elimination and consolidation of plate making equipment manufacturers around the world. Ohio vanished, Heidelberg bought out Hell, after which Hell was spun off, DAINIPPON SCREEN removed itself from the electronic engraving and plating line field, and Dae-twyler, Walther, Power, and Shepherd merged with Hell. The only independent plating equipment manufacturer left was THINK LABORATORY. DAISAN was worried about what was going to happen to the future of gravure cylinder making equipment manufacturers and converters. This was another reason they thought deeply about replacing their equipment.

DAISAN began discussing concretely what to do two years ago. They considered simply replacing their older

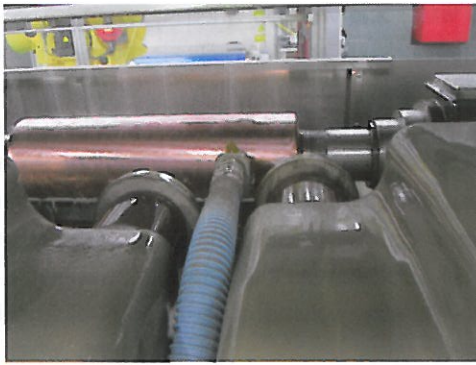


**DAISAN President
Takayoshi Matsui**

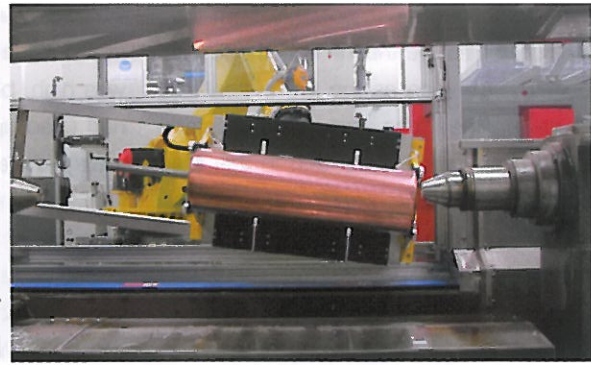


New FX Line

argon laser system with a new infrared semiconductor 208 multi-beam exposure device, using a system that could etch inside the laser exposure system instead of using a plating line. This meant giving up on the cylinder mounting crane that ran directly above the plating tank and installing an older generation "FX-80" New FX fully automated



Cylinder Being Polished After Copper Plating



After Polishing, the Robot Arm Takes the Cylinder for Drying

laser gravure plate making system plating line. Given space limitations, these ideas were rejected. Mr. Matsui asked Mr. Shigeta to draw an image of a line that included an etching system. Mr. Matsui felt at this time, however, that the THINK LABORATORY Boomerang, which used a stacker crane and an open plating tank, was at the end of its useful life. Since he felt that this system was no longer viable, he also approached ECOGRAPH AG, a swiss company.

Smaller Sealed Plating Tank

Mr. Matusi goes on to say that shortly thereafter Mr. Shiegta returned with the concept of the New FX. The new system used a European style sealed plating tank and an advanced robot arm that handled all of the processes, including plating, resist coating, drying, exposure, etching,

and polishing. At that time there was a large CG room in the plant into which the entire system would fit.

With the FX-80, the individual copper and chrome plating tanks are located in a line and cylinder transfer between the tanks is handled using a stacker crane attached to the ceiling. Because of this configuration, the installment area is long, totaling 35 meters. Even though the plate making line had grown old it was necessary to find an equivalent amount of space in the facility to install the equipment so that operations did not have to be suspended, space which did not exist. In contrast, the New FX has independent closed units for the different types of plating and uses two robot arms to transfer the cylinders, so all of the processes including degreasing, copper plating, polishing, ultra-sound cleaning, resist coating, laser exposure, developing, etching, resist removal, chrome plating, and sanding fit into a 10 meter by 16 meter space.

In actuality, the size of the machine was designed to fit nicely into DAISAN's CG room. Mr. Matsui found this solution enticing, especially because the robot

arm concept which Mr. Shiegta offered met with cost and space restrictions that suited the cylinder widths of 700-1,350 mm with which DAISAN worked at the time. In other words, it met with the basic conditions of placing all of the process up to etching in a single system and eliminating the stacker crane.

Moreover, as if to seal the deal, THINK LABORATORY installed the first New FX in operation on the second floor of its main plant in the Fall of 2010. Mr. Matsui says he had not wanted to buy the first New FX ever sold, but seeing it in action at the THINK LABORATORY plant convinced him to adopt the system. DAISAN also takes on outsourcing orders for plate making, and because different plating thicknesses are required and some systems cannot achieve full ballard plating, he also decided to install one ECOGRAPH cylinder plating line as well, the first such line in Japan.

Proving Reduced Solvent Use

New FX uses high-resolution laser technology to increase the resolution from 3,200 dpi to 6,400 dpi, but this also allows for a shallower cylinder. By skillfully matching inks or high-solid inks with the system, shallower plate depths reduce ink and solvent usage, which also ultimately reduces VOC emissions. Mr. Matsui says that this approach is prac-



New FX Control Clearly Displays Production Progress

tical. Converters use solvents from the time they dissolve the ink until the film is printed. As soon as the film is printed, however, they use expensive heated air to evaporate the solvent; in this era of needing to save energy and reduce costs, removing solvents with hot air is not viable. Thus reducing the use of hot air is a major issue.

Shallower plate depths had been verified since December 2009 on operational machines for surface printing only. While this verification naturally used the older argon laser plate making equipment, the tests used T&K TOKA's PIXESS ink, which is a dedicated advanced surface printing gravure ink that has good transferability and prints easily at slightly higher densities. Over 20 months they printed a total of 21 million meters. According to the results, when surface printing with

PIXESS there was some variation when the outside temperature and humidity was high, but compared to the ink they had used up until then, VOC emissions were reduced by 30% on average. This verification was not made through test printings or printings in a proofing machine, but is valuable because it is data from the actual printing volume of the actual machines.

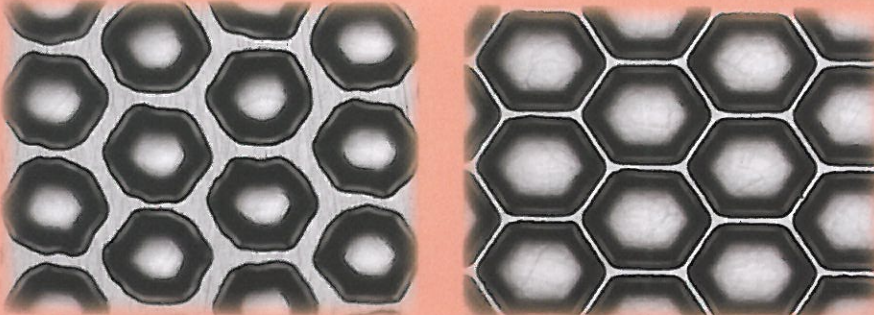
The printing used OPP film at a printing speed of 130-180 m/min. Previously, speeds ranged between 100-150 m/min; shallower cylinders allow for faster drying times and because solvent usage was reduced they were able to increase the speed. Cylinder depths were 30 μm at first, but have been made progressively shallower to 22 μm and 18 μm . Their next goal is 15 μm .

DAISAN uses surface printing for

about 20% of its food packaging, meaning reverse printing accounts for a far larger share of work. As they were able to successfully surface print in December 2009, they attempted shallow cylinder printing using high-solid inks for reverse printing, too. At that time, however, the conditions with extrusion laminating resin temperatures were insufficient, which resulted in delamination. As a result they stopped reverse printing in this way.

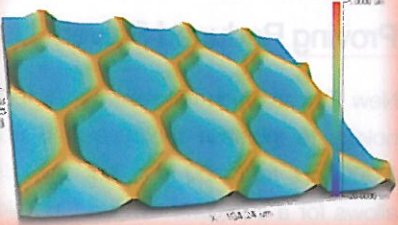
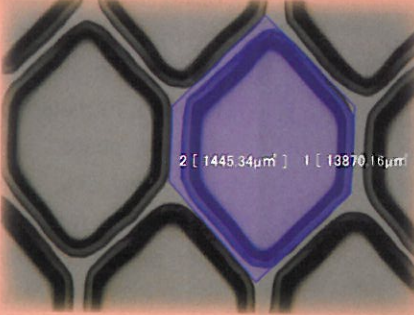
With the installation of the New FX as an impetus, they began shallow cylinder printing using SAKATA INX CORPORATION's improved "Belle Color" reverse printing specific gravure ink. Previously, cylinder depths had been 28 μm , but are now shallower at 15-20 μm .

The announcement of DAISAN's performance has also spread through ink



Increased Resolution of New FX Laser

The left photo is the limit to the dot shape at 3,200 dpi; at 6,400 dpi G-ratio is also possible as well as is stable plate making with 4 μm cell walls. These cylinders should improve flexible packaging printing and are suitable for roll-to-roll processing of functional materials.

Maximum Dot % at 6,400 dpi

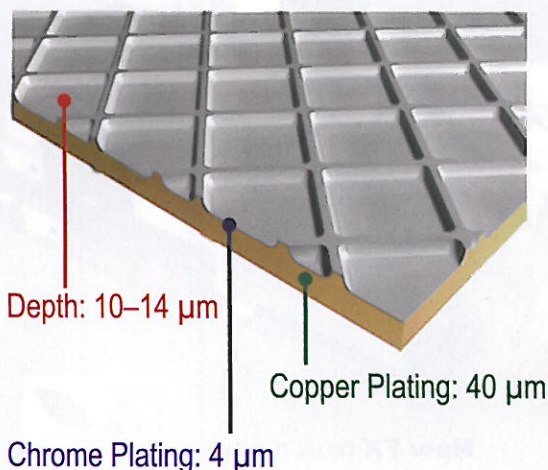
The largest dot % with gravure printing is 80%, but at 6,400 dpi the maximum dot % is 90%, even at 200 lines per inch. As a result, densities of 2.10 with a depth of 11 μm are possible, which expands the density ratio at low depths and is suitable for both light and shadow printing while reducing ink and solvent usage.



The Robot Arm Is Placing a Cylinder in the Ultrasound Cleaning Unit. The DAISAN Line Has Two Such Units

manufacturers to cylinder customers. In this way, they are not only successful in terms of cylinder making, but also in reducing solvent use through shallower plates and are able to offer reduced VOC emissions while meeting the requests for plate making. Because DAISAN is a converter with its own printing department, they are able to clearly show how their cylinders perform. If a dedicated cylinder manufacturer tried to explain the performance of their cylinders, they would be less convincing. As a company that has installed a New FX, however, DAISAN can provide advice at their customers' printing facilities and Mr. Matsui goes on to say that printers are waiting eagerly for the cylinders. The prices of cylinders made using the New FX are the same as those for standard solvent-based cylinders.

Last year, 2011, is the simultaneous kick-off year for DAISAN surface and reverse shallow plate printing. Mr. Matsui says that although capital investments in the hundreds of millions of yen were required for plate making facility renewal, they installed equipment that forms stable cells, so they intend to fully take on shallow cylinder printing and will continue to analyze the data to see how far they can prevent wasted resources.



The FX-eco Plate Made by New FX

Unneeded Materials

Mr. Matsui explains that through this technological revolution in shallow cylinders, the flexible packaging gravure printing industry has come to see just how much unneeded material has been applied to cylinders.

For example, if a system can truly form cell depths of 10 or so micrometers, there is no need for copper plating of 80 μm or 100 μm . Because DAISAN installed a New Fx, they have reduced copper plating thicknesses from 80 μm to 40 μm for flexible packaging printing for food (but not for industrial items). Chrome plating has also been reduced from 6 μm to 4 μm . Through this reduction, the time needed for copper plating has been cut in half, and that for chrome plating by two-thirds. As a result, they can now plate 150 cylinders a day, or 3,000 a month operating 20 days a month. In addition, because printing lots in the flexible packaging gravure printing industry are becoming smaller and smaller, there is no need for chrome plating of 10 μm when lots of 2,000 meters or a few hundred meters are common.

Naturally, one premise is that the cylinder base materials must be high-quality, so base processing is a key point.

DAISAN plans on doing this base work in-house as well.

Although plating uses a massive amount of electricity, by reducing plating thicknesses they are able to save electricity as well. Moreover, since plating is uniform, this reduces the burden on polishing, in turn reducing the frequency with which they purchase consumables. DAISAN

is also now able to recover the copper dust produced during polishing, reducing wastewater treatment as well. Mr. Matsui explains that since they are trying to make plate making itself environmentally friendly, they intend to attach an electric meter to the New FX distribution board to collect data on power consumption. If DAISAN installs the ECOGRAPH plating line, they intend to attach a meter to it and compare the results.

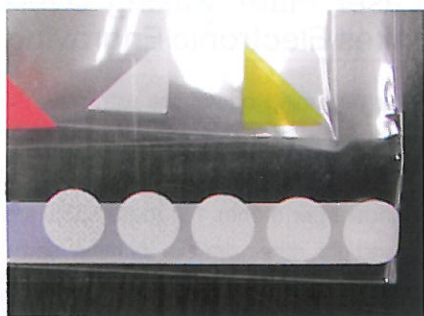
Laser Plate Making Overtakes Electronic Engraving

After beginning operations with New FX a change in DAISAN's plate making took place. DAISAN produces 700-1,000 cylinders per month. Of these, 20% are bound for other gravure printing companies. Color printing cylinders account for 60% of production. In the past they would have produced all of these plates using electronic engraving, but today they produce 80% of these cylinders using a laser. Mr. Matsui explains that until now there was variation in the color expression with laser-made cylinders, so they could not make this shift with the argon laser. Today, however, almost all colors are accurate. Customers who are very concerned with colors pose problems when colors are not sharp during replating or plate modification, so DAISAN still uses electronic engraving, but Mr. Matsui has ordered a switch to laser engraving as soon as possible.

By operating New FX at full capacity, it is possible to plate 70 cylinders in eight hours, or 1,400 cylinders over 20 days of operation. DAISAN also maintains 9,000 cylinders. In the past, they held 12,000 cylinders, but with the introduction of this system, they disposed of all of their cylinders below 900 mm. Except for special cylinders, they have consolidated their cylinders into three sizes: 1,100, 1,200, and 1,300 mm.

Dot Code on all Types of Film

By locating 25-dot patterns in a 2 mm square, it is theoretically possible to form 300 trillion patterns of invisible "Grid Output" dot codes. These can be produced using New FX or the previous generation of FX systems, but DIASAN can print 4-5 patterns of different dot sizes on all of their printed film because they have confirmed the conditions under which the dot codes can be clearly read even



The Five Circles at the Bottom of the Image Are Dot Codes

if the type of substrate changes and regardless of whether the film is surface or reverse printed. They already have one specific order for such dot codes.

An Unusual Use for New FX

Finally, Mr. Matsui presented some future options for New FX that go beyond gravure printing. For example, he proposed making rollers for adhesive

coating used in dry laminating shallower and in contrast to shallow plates, by plating cylinders with 100 µm of copper he proposes using New FX as a way to form honeycomb cells to expand their business into thick-film coating.

DAISAN FILMS CONVERTING CO., LTD.
www.daisan.com



The Robot Arm Is Setting a Cylinder in the Etching Tank

THINK THINK LABORATORY

Gravure Cylinder Making System

New FX Debuts in 2011

patent pending

Space Savings

1/2

50% reduction in area compared to FX-80
 Robot handling replaces stacker crane

Power Savings

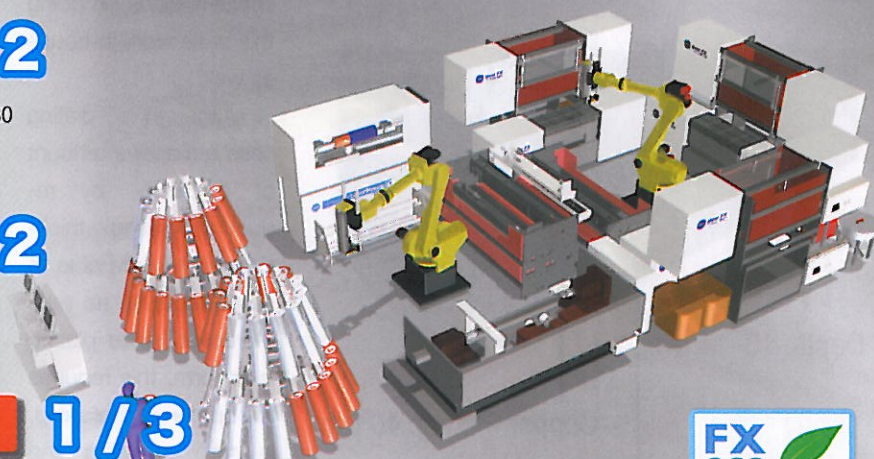
1/2

50% reduction in power consumption

Water Treatment Savings

1/3

66% reduction in water treatment costs



New FX basic model



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