Sample Issue

Partial Articles Only

FOCUS ON

Replacing Plating With Metallic Decorative Film for Smart Entry Vehicles

Speeding Up Job Change-over and Enabling Variable Offset Flexible Packaging

Increasing Opportunities for Employment Diversity at Japan's Converters

Achieving the World's Highest Variable Printing Inspection Speeds

Reducing Down-time With a New Butt Splicer and Stabilizing Coating Drying

Balancing Roller Temperatures Without Using Water or Oil

FEATURE

Economic and Population Indicators Make Vietnam the Next Big Market for Packaging
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Faced with a dropping birthrate and aging population, small and medium sized companies in Japan often struggled with labor shortages. Meanwhile, the younger generation in Japan is not simply willing to work for a good salary, and in many cases places importance on working conditions that meet their lifestyles, which has further exacerbated these labor shortages. In response, one flexible packaging converter in Japan advertised for two female high school graduates, a previously untapped human resource for the industry, to operate its new solventless laminator. Although the solventless lamination machine is located in a clean room, the image of converting and printing plants as dirty, dangerous, and difficult to work remains and means that women tend to avoid this type of work. Yet the two women applied in part because they were more interested in physical labor than office work, and are now able to replace the heavy roles and handle the substrate splicing work in an effortless manner. In fact, the two young operators have already reached a level where they investigate ways to handle the work with less loss on their own.

Today’s converting equipment and machinery industry assumes that automation will be a key advantage for the future given that companies are shifting from their reliance on machines that require so-called craftsmen to handle the work based on experience and intuition to machines that enable any operator to produce the same results. As manufacturing increasingly shifts to incorporate IoT and AI for these purposes, the industry also expects to see a greater number of young women, like those in the previous example, begin to participate.

On a different note, we visited Propak Asia in Bangkok this past June. Within Southeast Asia, Thailand’s flexible food packaging industry has seen the greatest amount of growth, with estimates indicating that there are some 1,000 converters in the country. With so many competitors and with some of these converters starting to do business in developed countries, these companies have had to change direction and focus on quality. As such, many companies with the available capital have installed high-quality Japanese machines and equipment. On the other hand, Japanese companies cannot sit idly by waiting for these markets to expand, particularly since Chinese machinery companies have developed equipment for these markets that delivers fairly high quality at a lower cost, as low as US$350,000 for an 8-color printing machine in one case. In other words, the challenge for Japanese companies is how to compete in these low-cost fields. For those companies that have continuously focused on increasing performance and quality, however, it can be difficult to limit functionality and simplify the equipment.

Given the need to build machines that suit both domestic and international markets, the movements of equipment and materials producers in Japan will be an area to watch.
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Replacing Plastic Plating
With Metallic Decorative Film on
Smart Entry Vehicle Door Handles

KOHKI CO., LTD.
www.kohki-ss.jp

Given the huge number of parts required for automobile assembly, the base of the automotive industry spreads widely across many fields. Film converters have built strong ties with automobile parts suppliers through their work with automotive interiors, sheets, and harness tapes, but they have yet to make inroads into exterior parts where films are rarely used. Despite the recent push to replace painting and plating with film decoration, it is not easy to deploy new technologies in the automotive industry because of its strict quality standards and cost management structure. One rare example of success in this sector that provides a hint of the potential for film decoration in vehicle exteriors was the use of TOM to apply a metallic appearance to the door handles of a global model sold by Honda Motor Co., Ltd. Nowhere near the scale of the large-scale parts manufacturers, it was a small 60 employee company called KOHKI CO., LTD. located in Ibaraki, Japan, that undertook this challenge. Under the leadership of Yuichi Oga, technical director at KOHKI, a team composed of members from Fu-se Vacuum Forming Ltd., TEIJIN LIMITED, and OIKE & Co., Ltd. succeeded in the endeavor.

75% Drop in Revenues
After the Global Financial Crisis

Founded in 1984, KOHKI primarily provides automotive part injection molding services, but also supplies a wide range of injection molded parts for office automation equipment. Although KOHKI expanded steadily at its outset, increasing competition from a growing number of competitors led it to venture out from molding to molded part assembly in the 1990s. In this way, handling all steps from molding to assembly in an integrated manner enabled KOHKI to respond to the expectations of their customers. In 2001, KOHKI also acquired satellite plant certification from Honda Lock Mfg. Co., Ltd., an automotive parts manufacturer within the Honda Motor group. Revenues peaked in 2007, at which time the company had grown to employ 50 individuals.

In September 2008, the global financial crisis triggered by the failure of Lehman Brothers washed over the Japanese industrial world. The resulting strength of the yen following the collapse of the dollar drove large-scale automotive parts manufacturers to establish new plants outside of Japan and increase overseas production. As a result, KOHKI saw a drastic fall in orders from Japan, causing revenues to plummet by 75%.

“At the time we did not have painting or decoration lines,” says Mr. Oga, “so work that required painting was taken by other companies and orders from Japan fell. Customers felt more secure placing orders with companies that could handle all steps from molding to finishing. Moreover, molding and assembly are labor-intensive, so the limited nature of our services meant that we always lost out in terms of cost competition. Without providing some additional value, we saw no other way to survive, and eventually realized that decoration technology was necessary.”

Yuichi Oga
Technology Director
Miyakoshi Printing Machinery Co., Ltd. (Miyakoshi), the manufacturer of the MHL Series of LED-UV flexible packaging offset rotary presses, recently succeeded in developing a new intermittent LED-UV offset rotary press with improved applicability to high-mix, low volume printing jobs. One of the drawbacks found with the MHL Series is that the printing cylinder sleeve, the blanket cylinder sleeve, and the impression cylinder need to be replaced for each new job, which increases the total time required for change-over work when the ratio of high-mix, low-volume jobs is high. In response, Miyakoshi applied their proprietary intermittent web handling system to overcome this challenge. The machine, called the VAR18B, was developed at their Miyakoshi Precision Machinery Kunimi plant, located in Akita Prefecture. Prior to delivering the first unit to Shikoku Kakoh Co., Ltd., a blown film producer and manufacturer of food, medical, and industrial packaging materials, Miyakoshi unveiled the VAR18B to 100 representatives from domestic printing companies and the media during an open-house held in February.

Towards Realizing Intermittent Offset Flexible Packaging Printing

Miyakoshi first announced their MHL Series of sleeve-type LED-UV flexible packaging offset printing presses during JGAS 2013. Since then, they have delivered units to three companies in Japan and one unit overseas. Although, offset rotary flexible packaging printing is an initiative that is almost non-existent anywhere in the world, and only Miyakoshi and a few other companies have applied the technology successfully, it offers several advantages.

For example, UV-sensitive offset inks cure when exposed to LED-UV, so adhere to film substrates without being heated. This in turn ensures high printing precision because there is no...
Changes in the Workplace Environment Lead to Greater Opportunities for Diversity at Japan's Converters

Nearly all industries in Japan are now faced with the need to deal with progressively severe labor shortages. Increasing wages rarely attracts job applicants, however, and there are aspects of the way in which young people work today that cannot be fully measured using the standards of the past. The converting industry, which handles a broad range of manufacturing, is no exception. Despite this situation, at least one company has succeeded in attracting applicants by changing the way they defined their job search and making changes to their workplace environment. As part of this move, TOTAI Co., Ltd., a Japanese converter with a long-standing history in the industry, began making reforms at its Fujikawa plant last year, including the installation of a solventless laminator. In fact, the machine is now operated by a recent pair of high school graduates who are only 19 and 20 years old, and both of whom are women, something rarely seen in Japan's converting industry.

Installing Their First Solventless Laminator

As part of their efforts to improve efficiency, TOTAI developed a plan to install a laminator in an unused space within their plant. After having both the sales and plant management departments make a detailed study, TOTAI's plant management department ultimately took the lead and installed an Italian-built Nordmeccanica Super Simplex solventless laminator. Nordmeccanica's Super Simplex solventless laminator is a popular model, of which more than 1,000 units have been built and delivered around the world.

The major factor in choosing to install this solventless laminator, however, was the installation footprint. As can be seen in the photo, the available installation space has a low ceiling that would make it difficult to install a dry laminator, which requires a long drying unit. Moreover, the installation area is located in a clean room that assumes the use of solvent-free adhesives, which means there are no deodorizing units or exhaust systems in place that could be used for dry lamination. In fact, the room is completely devoid of any odor.

Despite converting plants being considered tough, dirty, and dangerous places to work, the installation space is actually very clean. Although risks still remain in any manufacturing environment, most dangers that are involved in operating the new machine or carrying out the work have been sufficiently dealt with by thorough safety checks and safe operations. In terms of tough, however, there is no question that mounting and removing the heavy substrate rolls is difficult work for
Crossover is fully automated and can be setup in a few simple steps, so even the two new operators can set and start inspection easily.

**Careful Adhesive Selection**

The key to successful solventless laminators is selecting the proper adhesive. In this light, Nordmeccanica builds and sells Labo Combi adhesive testing machines, which adhesives producers around the world use to develop adhesives for solventless laminators. "We tested adhesives made by many of the adhesives producers and compared their performance and price before selecting one. And we ultimately spent six months selecting the adhesives," says Mr. Sakakura. The time the company spent on selecting their adhesives shows just how important the adhesive is for solventless laminators.

**Expanding the Business for Solventless Products**

By adding solventless lamination to its dry lamination capabilities, TOTAL is now able to deliver worry-free products that do not contain organic solvents for certain products and applications. "Although it is true that there are some products that are difficult to laminate using solventless lamination because of their structure, in other cases we can make products of the same level of quality as dry lamination with solventless lamination. So we feel the next step is figuring out how to use these two options effectively going forward. In either case, the key is finding a solventless lamination adhesive with good performance. We have only been operating the machine now for about six months, so we still need to make improvements as we observe the performance results throughout the different seasons. The operational rate is also only about 50% at the moment, but we expect the two new operators to maintain their motivation as they grow through their experiences under the severe plant conditions and in the industry. We also hope that this connects to the next step," says Mr. Serizawa.

Given that Japan as a whole is faced with labor shortages and is struggling to pass on converting technologies, many companies now feel they must automate their converting equipment. As technology advances towards greater automation, more and more companies in the converting industry are also becoming more open to employing women than in the past. This is particularly important in that women—who often come into contact with food packaging in supermarkets, for example—may become interested in involving themselves in printing and design. As such, the issue of greater diversity in Japan's converting industry will be a topic of interest going forward.

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**Contact Type Desk-top Film-Sheet Thickness Measuring System**

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<th>TOF-5R</th>
<th>TOF-6R</th>
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</thead>
<tbody>
<tr>
<td>Measurement length</td>
<td>10-10,000 mm</td>
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<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>AC 100-240V ± 10% 50/60 Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature/Humidity</td>
<td>10-40 °C / 35-80 % (no condensation)</td>
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<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>0.5 µm</td>
<td>1.0 µm</td>
<td>0.1 µm</td>
</tr>
<tr>
<td>Accuracy (20°C)</td>
<td>±(0.8±0.1) µm</td>
<td>±0.2 µm</td>
<td></td>
</tr>
<tr>
<td>Measuring force</td>
<td>0.5 ± 0.1 N</td>
<td>0.8 N or less</td>
<td>0.3 ± 0.01 N</td>
</tr>
<tr>
<td>Measurement pitch</td>
<td>1 mm</td>
<td>1 mm</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>Measurement range</td>
<td>0.03-3 mm</td>
<td>0.02-2 mm</td>
<td>0-100 µm</td>
</tr>
</tbody>
</table>

* Export permission is necessary. (Japanese Govt.)

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**YAMABUN**

Precise Thickness Measurement and Control

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**Exhibit**

9th Film Tech JAPAN
Date: December 5-7, 2018  Venue: Makuhari Messe
Trinity digi Achieves the World's Highest Variable Printing Data Inspection Speed

Digital printing’s ability to print variable data in a continuous manner is no longer a surprise, but this capability necessarily requires an approach to defect inspection that differs from that of other printing methods. Foreseeing the greater use of digital printing in the future, DAC ENGINEERING CO., LTD. began working on this challenge three years ago and unveiled its new solution as the Trinity digi full-color digital variable printing inspection system at the 2018 Converting Technology Exhibition. In addition to its high resolution inspection capability, the system is notable for achieving the highest inspection speed (80 m/min.) for variable printing in the world, even when every printed image varies.

Conventional printing inspection methods that inspect non-variable printing results use a single image as a standard against which all subsequently printed images are compared. In contrast, digital variable printing inspection systems must be able to inspect each image individually when the printing data changes, so using a single standard image is not an option.

Although variable printing inspection systems have been available for some time, Trinity digi is the first to inspect each variable data full color image at high resolution (300 dpi: 0.084 mm inspection resolution in the X-axis and Y-axis) and at high speed (80 m/min). When used on high speed printing machines, however, Trinity digi can be set to inspect images at a resolution of 150 dpi in the Y-axis to achieve an inspection speed of 170 m/min. Trinity digi converts the variable printing data in a similar manner to the RIP systems used in digital front-ends and compares the individual printed image data captured with a camera to this converted data. Trinity digi is faster at converting the data than digital printing machine RIP systems, however, so this work does not place any additional burden on the operator.

Moreover, Trinity digi can be used with short-run continuous printing, in which case the digital data only needs to be processed when the printing data is changed. After this, the images taken of the printed data can be inspected by comparing these images to each other in order to detect tiny changes in density.

To capture the images, Trinity digi uses a Coco! Sensor camera unit, which is composed of an integrated CCD camera and LED light source that reduces the installation footprint. Trinity digi is also available in three inspection widths (300, 600, 900 mm) and can be equipped on all variable inspection systems.

Some of the sectors in which DAC ENGINEERING is looking to apply Trinity digi include inspecting marketing label and bag printing, as well as flexible packaging printing. They also offer the system with an option that can simultaneously read and inspect bar codes, QR codes, variable text, and OCR text.
The high-end model controller
Pursued usability function

**Outline**
- PEM-3000 is a controller which carries out meandering control of a web in combination with the sensor and a driving device of G series.
- The touch panel of the color liquid crystal was carried and universal operability is realized.
- The interface with external equipment, such as an external I/O terminal for controlling LPC from the outside and an analog output terminal for monitoring the state of a web, is equipped standardly.

**Features**
- The touch panel of a color liquid crystal can be operated intuitively.
- For external control, the input terminal for changing operational mode and the output terminal of alarm are equipped standardly.
- The analog output for monitoring the state of the web which the sensor detected is equipped standardly.
- The connection with a sensor or a driving device serves as a connector type, and can wire easily.
- A sensor is connectable to four channels. While using it as an object for meandering control, it can be used as an object for the monitor of a web.
Even before changing its name from Inoue Kinzoku Kogyo Co., Ltd. to Techno Smart Corp. in 2012, Techno Smart was one of Japan’s leading coater manufacturers. Over the last year or two, however, the company has seen its international revenues and orders far exceed those from Japan. Despite being faced with the need to spend more resources in response to this international demand, the company continues to drive forward with new technical developments, several of which it displayed at new functional material 2018, held this past February at Tokyo Big Sight. Two of their more recent results on display were a butt splicer unit designed to significantly shorten down-time and a substrate run-out stabilization system designed to stabilize drying in simultaneous double-sided coating lines. We spoke to Haruhiro Iida, managing director of Techno Smart, about where the company stands today, its research and development focus, and its future direction.

Demand for Japanese-built Machines Drives International Business

Techno Smart’s business is currently grounded in two main sectors, namely flat panel display (FPD) optical film coating lines and lithium-ion battery (LIB) electrode coating lines. On the other hand, Techno Smart has also seen strong demand for the film lines used to produce the special films found in ceramic capacitors, semiconductors, and other electronic devices. Despite the dominance of Japan in these sectors, Techno Smart has actually seen rapid growth over the past year or two in the ratio of its international revenues. According to Mr. Iida, who also serves as the general manager of the sales department and managing director of the Tokyo Branch, Techno Smart’s revenues and orders from companies outside of Japan, particularly elsewhere in Asia, have now reached 80%, up from only 30–40% three years ago. In particular, a large part of their international business stems from China.

“Growth in the Chinese FPD and LIB industries has been the driver of this shift,” says Mr. Iida. “Whereas the FPD sector is not as strong in Japan as it was in the past, China still has plenty of room for growth, which is driving orders for optical film and other types of coating lines. China has also been accelerating capital investments in production capacity and higher production speeds for automotive LIB, which is also driving the demand for longer drying equipment. One thing that can be said for Chinese companies in general, is that they are increasingly demanding high-performance equipment. Companies that used Chinese-built coating equipment in the past are now aiming to set themselves apart by producing higher quality products, and are therefore switching to Japanese-built equipment. Japanese companies are also making capital investments, so business from both countries has been healthy.”

Mr. Iida goes on to say that the interest of Chinese companies in Techno Smart equipment is in part due to their fairly good reputation going back many years. “Some 10 years ago when the Chinese market was not yet attracting the interest it receives today, one well-known large-scale company in China installed some of our coating equipment. Some of the coating engineers at this company later started their own businesses or transferred to other companies, which helped spread the awareness of our equipment’s performance and reliability. Along with this, we have continued to focus on marketing activities and the foundation built by our well-received technical capabilities seems to have finally produce results. In other words, although the share of international revenue is higher than we ever expected, this is not simply the result of serendipity. Our thorough support services have also been well-re-
Correct for meandering, based on pattern criteria!

**Uses pattern matching**
The system takes basic positions from within the entire image (such as the line, edge, pattern and text) and stores them in memory, detects web meandering and sends out correction signals.

**Uses ZNCC (Zero-mean Normalized Cross-Correlation)**
Stable detection is assured, even if there are variations in external light and print density.

**Easy Search function**
Simply specify the reference position from within the entire image and press the Search button to record the reference position in memory and start the detection.

**NI SERIES**
Nireco Intelligent Camera NIC100
Nireco Intelligent Panel NIP100
The Latest in TOSHIBA MACHINE GROUP Extrusion Technology

Toshiba Machine Group Solution Fair 2018

Over the three days from May 17th to May 19th, 2018, TOSHIBA MACHINE GROUP held its annual Toshiba Machine Group Solution Fair to unveil the results of its developments over the past year to customers in the growth fields of optical films, nano-technology, IT, energy, and automobiles, among others. Held at TOSHIBA MACHINE’s Numazu Headquarters and Plant and Gotemba Plant in Shizuoka, Japan, the event, now in its 16th year, focused on the Group’s developments under the theme of “The Challenge to ‘Promising Future’,” and sub-themes covering “Initiatives for Evolving Next-generation Automobiles and Cutting-edge Technology Industries.” Along with 122 supporting companies, five more than the previous year, TOSHIBA MACHINE CO., LTD., TOSHIBA MACHINE ENGINEERING CO., LTD., TOEI ELECTRIC CO., LTD., FUJI SEIKI MACHINE WORKS, LTD., and SHIBAURA SEMTEK CO., LTD. exhibited the Group’s strengths as a general machine manufacturing group that supports a broad swath of the manufacturing industry (automobiles, electronics, optics, nanotechnology, and other fields) as it stands today. Although the exhibits at the event were categorized under the four key words of “energy/environment,” “improved labor productivity,” “IoT/ICT,” and “Responding to New Materials,” the area of greatest interest to the converting industry was the Group’s developments into extrusion technology, particularly sheet forming, nanoparticle dispersing and compounding, separator films, film stretching, double-sided micro imprinting, and on-demand decoration.
Converting Machine Guide

Product List

Latest Information

Find the latest in converting related equipment:
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• Contact information for manufacturers and dealers
• Search by product type
• Search by company
• Listings in English and Japanese

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News & Report

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Thin, Light-weight, Flexible Millimeter Wave Absorbing Sheets Help Reduce Vehicle Collision Avoidance System Malfunction

Kansai Paint Co., Ltd.
www.kansai.co.jp

Millimeter wave radars have come into use as one means of detecting obstacles in vehicle collision avoidance systems. These radars, however, can cause the system to malfunction as a result of millimeter waves that reflect off of unrelated objects. In cooperation with Wave+X Incorporated, a manufacturer of road signs, Kansai Paint Co., Ltd. developed a new sheet that absorbs extraneous electromagnetic waves in the millimeter wave band. In this way, the sheet is expected to be applied to the top of walls along highways, signboards, tunnel ceilings, and the tops of tunnel walls to absorb millimeter waves that are emitted by collision avoidance systems that would otherwise scatter off of these objects and cause the system to malfunction. At only 0.4 mm thick, the sheets are thin, lightweight, and flexible enough to conform to curved surfaces.

They also consist of a surface protection film that provides the sheet with a design quality that allows for more than 20 different color variations. We spoke to Toshiaki Nagano, director of the Industrial Paint Division and person in charge of developing the sheet, about its background and features.

Collision Avoidance Control Sensor Technology

Vehicle related technology development has recently entered a stage of significant innovation. Going beyond collision avoidance systems that simply apply the vehicle’s breaks when an obstacle is detected, research and development is also making progress into realizing fully automated vehicles that can

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<td>•High-precision visual detection</td>
<td>•Low-effectiveness at night and in bad weather</td>
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<td>•Inexpensive</td>
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<td>Infrared (LiDAR)</td>
<td>•Enables 3D Mapping</td>
<td>•Difficulty detecting faraway objects</td>
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<td></td>
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<td>•Low-effectiveness in bad weather</td>
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<td></td>
<td></td>
<td>•Expensive</td>
</tr>
<tr>
<td>Millimeter Wave Radar</td>
<td>•Detects faraway objects</td>
<td>•Problems detecting moving people</td>
</tr>
<tr>
<td></td>
<td>•Functions at night and in bad weather</td>
<td></td>
</tr>
</tbody>
</table>

Advantages and Drawbacks of Sensor Technology Used in Collision Avoidance Systems and Self-driving Vehicles

July / August 2018
Induction Heated Jacket Rolls Enable Balanced Temperature Adjustment Without Using Water or Oil and Enable Rapid Cooling

Yoshihide Kitano
TOKUDEN CO., LTD.

1. Air-Cooled Jacket Roll Ideal for Balanced Temperature Adjustment During Heating and Cooling

Following the stretching step, the oriented film manufacturing process includes an annealing/heat-setting process, during which the roll temperature is set slightly lower than the film temperature in many cases so that the rolls will also cool the film. As such, these rolls require the ability to provide balanced temperature adjustment during heating and cooling. Until recently, hot-water rolls were generally used in low temperature processes and oil-heated rolls were used in high temperature processes. Although our Induction Heated Jacket Rolls have been adopted in many cases in the preheating step prior to film stretching and in the stretching process itself, their lack of a cooling function prevented their use in the annealing/heat-setting process.

Towards the end of 2016, however, we developed the Air-Cooled Induction Heated Jacket Roll (Air-Cooled Jacket Roll), which, as the name implies, is a high-precision heated roll equipped with an air-cooling mechanism. Likewise, it is ideal...
Economic development changes eating habits, which in turn change the demand for the functionality and format of packaging materials utilized in processed food distribution. Although Japan and other developed nations have already passed through the initial stages of this transition, Southeast Asia is currently undergoing the early stages of this change in earnest. In particular, the outlook for high economic growth rates in Vietnam, even among the rest of Southeast Asia, is attracting strong interest from the converting industry around the world. As such, we visited ProPak Vietnam 2018, an international processing and packaging exhibition held at the Saigon Exhibition & Convention Center in Ho Chi Minh City between March 20 and 22, to take a look at the changes in the Vietnamese society and packaging industry.

Record of 496 Exhibitors

The combined exhibition space covered by ProPak Vietnam, now in its 13th year, and the concurrently held 7th Plastics &
HK-1350SP

Definitive Polishing Machine
Based on
Years of Research and Technical Devotion

HRC Single-head Mirror Finish Polishing Machine

HK-1350SP

Installation Footprint: 3,500(L) × 1,500(D) × 2,100(H)

Features

- Unlike the pressure calibration systems found in conventional polishing machines, our sturdy frame and whetstone head utilize a unique HRC pressure calibration mechanism that enables both heavy grinding and an ultra-mirror surface finish polishing.
- The whetstone can be replaced for a cylinder mirror finish polish, regardless of the type of material.
- We can also produce polishing machines for shaft cylinders.

Option: digital cylinder diameter meter (φ100–300 mm) is also available

Gravure Cylinder Polishing Machine Specifications.

<table>
<thead>
<tr>
<th>Specification</th>
<th>HK(SP Model)</th>
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<tbody>
<tr>
<td>Distance Between Centers</td>
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</tr>
<tr>
<td>Machine Length</td>
<td>1,500</td>
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<tr>
<td>Polishing Wheel Shuttle Distance</td>
<td>2,000</td>
</tr>
<tr>
<td>Max. Polishing Wheel Diameter</td>
<td>300</td>
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<tr>
<td>Main Shaft Rotation Speed</td>
<td>30~500</td>
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<td>Polishing Wheel Revolution</td>
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<td>Polishing Wheel Pressure</td>
<td>10~70</td>
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<td>Polishing Wheel Shuttle Speed</td>
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<tr>
<td>Tail Stock Taper</td>
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<tr>
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<tr>
<td>Max. Cylinder Load</td>
<td>250</td>
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<tr>
<td>Total Machine Weight</td>
<td>4,500</td>
</tr>
</tbody>
</table>

Gravure Cylinder Specifications.

HORICHI KOUSAKUSYO CO., LTD.
201-8 Kitano, Wakayama-shi, Wakayama 649-6331 Japan
Tel: +81-73-461-8082  Fax: +81-73-461-8083
http://hrc.bsj.jp/

Tokyo Printing & Equipment Trading Co., Ltd.
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http://www.tpe-t.co.jp/
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Kemayoran, Indonesia

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Messe Düsseldorf Asia
As one of the world’s leading suppliers of equipment and services to packaging and label manufacturers in the folding cartons, corrugated board, and flexible materials industries, BOBST held its COMPETENCE 18 Open House from June 5th to June 8th, 2018, at the Bobst Mex Competence Center in Switzerland. Attended by 600 visitors, including many of the leading packaging and label manufacturers and converters in the industry, the event aimed to show the “Solutions for the challenge of tomorrow,” addressing key trends facing packaging converters, such as the need for shorter runs, greater versatility, e-commerce, and constant innovation.

“We develop our solutions with our customers in mind and all the direct feedback we receive at events like this helps us to improve even further,” said Philippe Milliet, Head of Business Unit Sheet-fed. “Many attendees were surprised by the pure breadth of what BOBST offers. BOBST is an expert in substrate processing, converting and printing, and it was very rewarding being able to demonstrate several of the company’s most innovative solutions first-hand, and to talk with visitors about the very tangible difference we can make to their businesses, now and in the future.”

The event offered live demonstrations of selected key BOBST machines, and provided information about some of the developments in BOBST Services. Highlights included live demonstrations of the EXPERTFOLD 165 folder-gluer together with the SPEEDPACK automated packer. With its ability to bundle a large range of box formats and types, from solid board up to double wall corrugated board boxes, SPEEDPACK delivers defect-free and smooth high-speed packing.

The event also offered live demonstrations of MASTERCUT 106 PER and MASTERCUT 145 PER, two highly automated and high-productivity die-cutter models. These high-speed machines deliver fast, uninterrupted production with high productivity for size IIIb and size VI, respectively, and deliver a high quality finished product. The MATIC system equipped on the MASTERCUT 106 PER attracted a significant amount of attention because of its high degree of automated operations as a die-cutter.

In addition, attendees had the chance to see EXPERTFOIL 142 in action, the only genuine size VI hot-foil-stamper in the world, and the only stamper with 600 tons of embossing pressure. This machine enables up to six blanks in format VI instead of only two in format IIIb, meaning margins can be increased on a wide range of jobs.
Technology Developed to Automate Manual Eyeglass Lens Coloring Offers the Potential for New Expressiveness

NIDEK CO., LTD.
www.nidek.co.jp

Eyeglasses are no longer simply used to correct visual acuity, but the variation of products has been expanded into the realms of fashion and functionality, including UV and blue light blocking. Despite this development, many of the production processes still rely in large part on the hands-on work of skilled craftspeople. In fact, one of the more skill-reliant aspects is the lens coloring process, in which individual lenses are tinted individually at a time by an expert. In response, NIDEK CO., LTD. developed a new tinting method called Transfer Tinting technology, which enables a shift away from the conventional tinting process. This technology first prints a transfer paper with a special ink, then places this transfer paper on the lens surface, and sublimates the ink in a vacuum. Finally, the ink is absorbed into the lens in an oven. More recently this technology received the 43rd Inventions Grand Prize from the Japan Society for the Advancement of Inventions.

Photo 1 Head Office and Hiroishi Plant (top) and Osawa Plant (bottom)

Photo 2 Head Office Showroom Displays the Company’s Past Products and Technologies, Including Many of the Familiar Devices Seen at Eyeglass Stores and Ophthalmologists

From Ophthalmic Instruments to Optical Coating of Spectacle Lenses and Optical Products

Under the concept “invisible to visible,” NIDEK was founded...
Having made pro-active capital investments in die-mold based manufacturing equipment, the Japanese die-mold manufacturer NAGAMINE MANUFACTURING Co., Ltd. has expanded its ability to respond to a broader set of customer needs. One particular need that has emerged in recent years among their customers is the ability to miniaturize and refine products and components. During neo functional material 2018, NAGAMINE MANUFACTURING displayed several of their latest die-molds and unique structures made using these as a way of promoting their ability to support the efforts of their customers in meeting these demands. Along with delivering equipment, they also provide prototype die-mold making and molding services.

Microscopic Honeycomb Structures

One featured item on display at their booth was a ceramic (99.9% Al₂O₃) honeycomb structure optical filter with a cell density of 13,000 cells per square inch. In fact, this is the first optical filter in the world to be made with a die-mold at this cell density. The 9 mm diameter display sample consisted of a 0.22 mm interval grid (0.17 squares and 0.05 mm wide walls). According to the representative, the die-mold used to produce the optical filter is based on the know-how that the company has accumulated throughout their history in die-mold making, including the careful selection of tools, materials, and processing conditions.

Miniature Nozzles

They also displayed examples of miniature conveyor suction nozzles used to mount miniaturized components on circuit boards for example, in the production of the IC chips used in sensors, for which demand has been growing along with the increased functionality of automobiles, including more advanced sensor-based vehicle driving systems. In some cases, these nozzles can be made of a conductive ceramic material that serves as a static electricity countermeasure, for example the samples on display were made of conductive zirconium. The shape of the nozzles can also be designed to suit different needs.
mounting unit configurations. Similarly, dispenser nozzles can be made with a minimum orifice diameter of 5 μm (at a precision of +/-1 μm). In the medical field, these nozzles are also used to dispense droplets containing cells, for example.

**Porous Metals**

In addition to die-molded items, NAGAMINE MANUFACTURING also exhibited samples of different types of porous metals with different thicknesses, pore diameters, pore ratios, and base metals. These items were made using an annealing furnace as a way to uncover demand for smaller lots. According to the representative, the high thermal conductivity of porous copper enables the metal to be made into heat sinks with a high heat radiation effect. Meanwhile, porous titanium can be used for regenerative medicine because it can be embedded in the body. Moreover, these porous metals can also be used to make porous electrode materials (gas diffusion layer) for vehicular fuel-cells.
Using Zinc Oxide Nanowires to Identify Cancer From microRNA Found in 1 mL of Urine

Department of Biomolecular Engineering, Graduate School of Engineering Nagoya University School of Engineering www.apchem.nagoya-u.ac.jp/III-2/baba-ken/UTDMCLPC-home.html

With one in every two people in Japan expected to suffer from cancer, this has become the leading cause of death in Japan today. In fact, 370,000 people died of cancer in 2015 alone. In this light, the Ministry of Health, Labour and Welfare stated the importance of cancer screening that leads to early detection and treatment in its “Basic Plan to Promote Cancer Control Programs (3rd term)” (March 2018) and has been aiming to increase the rate of screening. Unfortunately, cancer screening places a heavy burden on the patient, while working age people often do not have the time for screening and sometimes overlook the opportunity for screening. In response to this situation, Nagoya University has been researching ways to enable simpler cancer screening procedures. Associate Professor Takao Yasui and his research group at the Nagoya University Graduate School of Engineering recently succeeded in identifying unique microRNA (miRNA) markers found in cancer patients from 1 mL of urine using a zinc oxide nanowire device. More specifically, the device extracts more than 1,000 species of miRNA from the extracellular vesicles (EV) contained within urine, which can then be used to identify the presence and degree of specific miRNA markers in patients with urinary system cancer, as well as those with lung, pancreatic, and liver cancer. By employing this technology, Dr. Yasui and his team have enabled the potential for early detection of cancer via a painless, burden-free urine test.

miRNA as a Cancer marker — Medicine has advanced to a point where we can now save the lives of those with cancer if it can only be discovered early, but it is important to provide the appropriate treatment as soon as possible. You have discovered a unique trend in the miRNA found in the urine of cancer patients, thereby indicating the possibility of more easily diagnosing cancer using a non-invasive urine test. This approach will potentially increase the number of cancer screenings and decrease the number of cancer deaths. Can you tell us about the background leading

Profile: Associate Professor Takao Yasui, Ph.D. (Engineering)

Born 1984, Dr. Yasui graduated from the Nagoya University School of Engineering with a degree in Chemical and Biological Engineering in 2007. In 2009 he completed his master’s at the Nagoya University Graduate School of Engineering with a degree in Chemical and Biological Engineering, and in November 2011 he completed his PhD in the same program. From January 1, 2012, he served as assistant professor in the same program. He has held his current position since February 2018. His field of specialty is nano-bioscience and nano-materials engineering.
think someone’s lungs are in trouble, for example. Therefore, our goal is for this nanowire screening approach to be introduced in addition to the existing CT and PET (positron emission tomography) testing methods that are currently used for cancer screening, and thus hope it will serve as another judgment criteria for doctors.

―It is surprising that these results can be obtained from just 1 mL of urine.

Dr. Yasui: In terms of volume, 1 mL is actually a lot. Although the amount that can be consistently injected from a syringe is 1 mL, we can actually extract miRNA from as little as 0.2 mL.

We also assume that this method will be applied in practice using the urine left over from standard urine testing. In general, medical institutions take a minimum of 7 mL of urine as samples for these tests, of which about 5 mL is actually used. So we set our test to use a small volume of 1 mL so that it is less than this left over amount and in hopes that doctors will more regular use the remaining 2 mL for urine-based cancer screening. If the urine is to be disposed of anyway, we feel that everyone will be more likely to take advantage of it.

―Recently, Hitachi, Ltd. also put out a release regarding a urine test based cancer screening method.

Dr. Yasui: Hitachi is looking at metabolite in the urine, which is an approach that differs from ours. But we feel that more options for analysis will only help to improve the accuracy of diagnosis. So this is a positive development. Both of our technologies will coexist. We feel that science today has entered a period where we need to combine various technologies to produce a single answer. Compared to the happiness of humans, competition is a trivial matter.

―What is your future vision for urine-based medical diagnosis in general?

Dr. Yasui: Today’s treatment methods diagnosis disease based on the data of many strangers, but our technology will allow doctors to estimate a patient’s condition based on the change in the individual’s own urine. In the future, I think that urine will be collected continuously at medical institutions and during health check-ups from the time an individual is born and stored as a database, which will then be used to diagnosis and treat diseases based on trends seen in the individual from the urine collected throughout their history.

It is the job of doctors to save lives, but it is our job as engineers to change the future through technology. Likewise, it is also our responsibility to listen to the needs of doctors and contribute to the world through engineering.
Despite its excellent heat-resistance, light-resistance, and transparency, glass presents challenges in terms of its high production temperature, which results in a high environmental impact and the need for high-temperature production facilities. As such, a glass that can be worked with at low temperature, like plastic, would offer significant advantages. Under this concept, Dr. Hirokazu Masai, Senior Research at the Department of Materials and Chemistry, National Institute of Advanced Industrial Science and Technology (AIST), cooperated with ISHIZUKA GLASS CO., LTD. to develop a low-melting point glass made from raw materials that can be melted and fused into glass at a temperature of around 500°C. In contrast to original silica glass, which is made by fusing a mixture of raw materials at temperatures exceeding 1,800°C, Dr. Masai and his team set out to modify the phosphates and metal compounds used in phosphate glass to enable a lower melting temperature material. The resulting glass is colorless, transparent, and has the same heat-resistance and light-resistance inherent to glass, but has a better moisture-resistance than phosphate glass. Now that LED are brighter and use shorter wavelengths than in the past, LED devices have come to require a greater durability, a fact that led Dr. Masai to begin working to apply the new glass to LED lenses and other optical components. The ultimate goal of his research, however, is to mold glass using injection molding, whereby he expects this type of simple plastic molding method will expand the application of glass.

Profile: Dr. Hirokazu Masai, Senior Researcher

Dr. Masai holds his Ph. D. in Engineering from Kyoto University in 2005 (Department of Molecular Engineering).

April 2005–March 2006: Project Researcher at Nagaoka University of Technology
April–November 2006: Project Researcher at Tohoku University
December 2006–March 2010: Assistant professor at Tohoku University
April 2010–March 2017: Assistant professor at Institute for Chemical Research, Kyoto University
April 2017–present: Current position

Silica Glass Fuses at 1,800°C

—You have successfully devised a revolutionary glass making method that can make glass at 500°C, but can you tell us about the lead up and social background behind your work?

Dr. Masai: During my time at Kyoto University, my research involved making thin inorganic fluorescent films on glass substrates. I started working with ISHIZUKA GLASS when they showed interest in my research. Although glass has several
originally developed several years ago using clay instead of polymers and a binder by the National Institute of Advanced Industrial Science and Technology (AIST), Claist is a material that can be formed into a flexible film with unique properties. More recently, however, AIST has been working to create new applications that utilize Claist’s characteristic high gas and water vapor barriers. Specifically, the AIST Consortium Clayteam, launched in 2010 and consisting of 87 members from public research institutes, local governments, and private companies, has been focused on designing applied products that correspond to the various needs of private enterprises. We spoke to Takeo Ebina, Prime Senior Researcher at the AIST Research Institute for Chemical Process Technology, chairman of Clayteam, and inventor of Claist, about Claist and some of the most recent Claist product developments.

—Please tell us a little about Claist.

Dr. Ebina: Claist film is primarily composed of a type of clay called smectite, which can be either natural or synthetic. Smectite itself consists of 30–70% of a mineral called bentonite, which, unlike the clay used in standard pottery, has a denatured structure resulting from the effects of underground hot water. So the Northeastern part of Japan, in particular, is a good source of natural smectite because of its many hot spring.

The silicate structure of smectite clay crystals is formed of 1 nm thick, plate-like nano-particles connected in long horizontal chains. This network of silicon and oxygen is also able to capture other elements, such as magnesium and aluminum. When sodium ions become trapped between the crystals, these ions will become hydrated and cause the clay to swell, giving smectite a gel-like property.

—There are many applications for Claist, but tell us about its use as a filler.

Dr. Ebina: By using the raw material used to make Claist film as a filler (additive), we can utilize this gel property and apply the filler as a viscosity control agent in cosmetics or as a dispersant in agricultural fertilizers. For example, with fertilizer sprays made by mixing inorganic fertilizer and water, the fertilizer sinks to the bottom because these sprays tend to contain a high concentration of inorganic material. Because smectite creates a three-dimensional network in which the individual crystals
IGAS 2018
INTERNATIONAL GRAPHIC ARTS SHOW
7.26[THU.]-31[TUE.], 2018 | TOKYO BIG SIGHT [東京ビッグサイト]
Opening Hours: 10:00 a.m. to 5:00 p.m. (11:00 a.m. to 5:00 p.m. for the first day on July 26 [Thu.])

For Pre-registration:

Organizer
Japan Printing Machinery Association (JPMA), Japan Association of Pre-Press & Digital Printing Systems Suppliers
Entries With the Highest Level of Functionality, Design, and Marketability in the Event’s History Receive Awards at JPC

2018 Japan Packaging Competition Awards Ceremony

Given the inseparable nature of products and packaging, the number of new packages nearly rivals the number of new products every year. As one of the most important competitions in Japan that aims to stimulate the advancement of new packaging formats, the 57th Japan Packaging Competition (2018JPC), organized by the Japan Federation of Printing Industries (JFPI), held a ceremony to award the best of these new formats this past April in Tokyo. Of the 163 entries, a total of 41 received awards, including two for the grand prize (Minister of Economy, Trade and Industry Award).

First held in 1962, JPC is an event that aims to stimulate the development of superior product packaging through competition. In addition to ease of use and other basic packaging aspects, JPC comprehensively ranks packages from a multitude of angles, including safety and health, environmental consciousness, and sales and marketing capability. Awards are presented to the winners based on these criteria as a means of contributing to the development of packaging related industries and society as a whole.

During the awards ceremony and speaking as the organizer representative, Masayoshi Yamada, chairman of JFPI, states, “we have seen fewer product entries in recent years than in the past because of the severe economic situation, but the 163 entries this year exceeded the 150 entries from the previous years. More importantly, however, the quality of all entries reached a higher standard. Packaging not only represents the quality of the product contained therein, it also serves to ensure the ease of use by everyone through universal design and can function as a POP display in stores. Packaging must also be recyclable. So it is no exaggeration to say that packaging has an impact on product sales. JPC comprehensively judges packaging from these perspectives. And through the JPC we hope to continue to contribute to the development of the industry.”

As an invited speaker, Yasuo Yano, deputy director of the Media and Content Industry Division, Commerce and Information Policy Bureau, METI, added, “the progression of Japan’s aging society has continued to change how we live our lives. Packaging is essential to our daily life, so easier to use packages that are closely tied to the lifestyles of the elderly will likely come into demand. Having continued for more than a half-century, JPC holds significant value and I hope to see it continue into the future.”

Under the concept of challenging the low profitability of the snack packaging market and targeting the king of all snacks—potato chips—with a metallic stand-up pouch, KOIKE-YA Inc. won the first of two Minister of Economy, Trade and Industry Awards, the top price in the JPC, for its KOIKEYA PRIDE POTATO package. The second winner was Kao Corporation, which received the award for its Smart Holder & RakuRaku eco Pack, a special holder with a replaceable label and an ease to use refill pouch. In this case, the refill pouch can be set directly into the special holder, which allows the holder to be made with less plastic because the back can be removed and allows all of the contents to be squeezed out more easily.

Meanwhile, the METI Director-general Manufacturing In-
Data for 2017 Show Stability in Japan’s Packaging Industry

The Japan Packaging Institute recently released a sampling of statistics that show the changes in Japan’s packaging industry from 2013 to 2017. These data include the value and volume of packaging/containers, and the value and volume of packaging related equipment shipped during this period. These statistics were compiled by the Japan Packaging Institute as a means of helping those in packaging related industries better understand the state and future trends of the domestic packaging industry.

Packaging Industry Shipped Value (billion of yen) 2013–2017

<table>
<thead>
<tr>
<th>Year /Material</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging/Container Total</td>
<td>5534.41</td>
<td>5705.14</td>
<td>5781.40</td>
<td>5672.66</td>
<td>5652.77</td>
</tr>
<tr>
<td>Change from prior year (%)</td>
<td>100.7</td>
<td>103.1</td>
<td>101.3</td>
<td>98.1</td>
<td>99.6</td>
</tr>
<tr>
<td>Packaging Equipment Total</td>
<td>440.65</td>
<td>451.28</td>
<td>461.30</td>
<td>480.43</td>
<td>496.74</td>
</tr>
<tr>
<td>Change from prior year (%)</td>
<td>102.2</td>
<td>102.4</td>
<td>102.2</td>
<td>104.1</td>
<td>103.4</td>
</tr>
<tr>
<td>Total</td>
<td>5975.06</td>
<td>6156.42</td>
<td>6242.70</td>
<td>6153.09</td>
<td>6149.51</td>
</tr>
<tr>
<td>Change from prior year (%)</td>
<td>100.8</td>
<td>103.0</td>
<td>101.4</td>
<td>98.6</td>
<td>99.9</td>
</tr>
</tbody>
</table>

Packaging Equipment Production Volume (billion of yen) and Number of Units Produced 2013–2017

<table>
<thead>
<tr>
<th>Year /Equipment</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>Value</td>
<td>Units</td>
<td>Value</td>
<td>Units</td>
<td>Value</td>
</tr>
<tr>
<td>1. Packaging/Packing Machinery Total</td>
<td>353824</td>
<td>393.70</td>
<td>323005</td>
<td>400.74</td>
<td>337206</td>
</tr>
<tr>
<td>Change from prior year (%)</td>
<td>99.2</td>
<td>102.0</td>
<td>91.3</td>
<td>101.8</td>
<td>104.4</td>
</tr>
<tr>
<td>Individual Packaging/ Inner Packaging Machinery Subtotal</td>
<td>265236</td>
<td>330.63</td>
<td>247195</td>
<td>338.33</td>
<td>261963</td>
</tr>
<tr>
<td>Change from prior year (%)</td>
<td>95.7</td>
<td>101.5</td>
<td>93.2</td>
<td>102.3</td>
<td>106.0</td>
</tr>
<tr>
<td>Outer Packaging/Packing Machinery Subtotal</td>
<td>88588</td>
<td>63.07</td>
<td>75810</td>
<td>62.41</td>
<td>75243</td>
</tr>
<tr>
<td>Change from prior year (%)</td>
<td>111.4</td>
<td>104.5</td>
<td>85.6</td>
<td>99.0</td>
<td>99.3</td>
</tr>
<tr>
<td>2. Bag Making Machinery Total</td>
<td>1104</td>
<td>26.19</td>
<td>987</td>
<td>24.19</td>
<td>1022</td>
</tr>
<tr>
<td>Change from prior year (%)</td>
<td>102.5</td>
<td>105.3</td>
<td>89.4</td>
<td>92.4</td>
<td>103.5</td>
</tr>
<tr>
<td>3. Paper Converting Machinery Total</td>
<td>316</td>
<td>20.76</td>
<td>365</td>
<td>26.35</td>
<td>422</td>
</tr>
<tr>
<td>Change from prior year (%)</td>
<td>103.3</td>
<td>103.5</td>
<td>115.5</td>
<td>126.9</td>
<td>115.6</td>
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<tr>
<td>Packaging Machinery Total</td>
<td>355244</td>
<td>440.65</td>
<td>324357</td>
<td>451.28</td>
<td>338650</td>
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<tr>
<td>Change from prior year (%)</td>
<td>99.2</td>
<td>102.2</td>
<td>91.3</td>
<td>102.4</td>
<td>104.4</td>
</tr>
</tbody>
</table>

1 The fiscal year for “Packaging/Packing Machinery” and “Bag Making Machinery” runs from April to March of the following year.
2 The units and values for “Packaging/Packing Machinery” and Bag Making Machinery” in 2016 are planned amounts (actual results are estimated to fall below the planned amounts).
Session 2
Pressure Sensitive Adhesive Tape Science and Industry
PSA Tape Adhesion Mechanism
(2) Interfacial Bond Strength

Yoshiaki Urahama
Guest Professor
University of Hyogo

4. Degree of Interfacial Bond Strength

4.1 Influence of the Interface and Bulk on Adhesion Energy

4.1.1 Phenomenology

The first question we must ask ourselves regards the difference in the degree to which the interface and bulk contribute to adhesion in PSAs as compared to adhesives.

When designing products that utilize the adhesiveness of adhesives and PSA, it is important to evaluate and control both the adhesive bulk and surface (the interface with the adherend). The former is responsible for the fluidity, retention, and stress relaxation of the adhesive, so bulk design focuses on the rheological properties, which are relatively easy to evaluate and control. Meanwhile, the latter is responsible for the wetting property and interfacial bonding with the adherend, so surface design focuses on either the interfacial adhesion energy or the work of adhesion. However, a simple, universal evaluation method has yet to be discovered.

More recently, Minamizaki et al. have conducted some highly interesting research into this topic. Using the density functional theory, a type of molecular orbital theory, they calculated the interfacial adhesion energy between the adhesive and the adherend. The following is a fairly long excerpt from their published report.

The research used a butyl acrylate polymer (BA) as the model adhesive. Adhesive strength, used here to indicate adhesion performance, is typically measured as the resistance to peeling at the adhesive interface. In many cases, the peel strength can be expressed as the resistance per unit length (width) as peeling progresses, but when failure is considered to progress in a linear (width) mode, the energy per unit area is used as the value for peel strength. Many organic adhesives are elastic, as typified by PSA, so we only need to observe the energy required to break the interface with the adherend and the dissipated energy required to deform the bulk layer of the adhesive during peeling. An example of the degree to which the interface and the bulk contribute to the measured adhesive energy is shown by Equation (1) below:

\[ G = Wa f(v) \]  

(1)

Here, \( G \) is the actual measured value and is called adhesion energy or strain energy release rate; \( Wa \) is the part contributed by the interface and is called the thermodynamic work of adhesion. Meanwhile, \( f \) is the function that expresses the part contributed by the bulk and is called the dissipation function. Here, \( v \) is the peel speed. Based on the dissipation function mode, in this equation the value when peel speed is zero is either \( Wa \) or \( G_0 \).

The thermodynamic work of adhesion, in other words the index for the interface contribution, is typically calculated using the following Dupre Equation (2) based on the measured contact angle data, or the expanded Fowkes formula (3) taking into consideration the dispersive component \( (d) \) and polar component \( (p) \) as the surface free energy:

\[ Wa = Y_S + Y_L - Y_{SL} \]  

(2)

\[ Y_{SL} = Y_S + Y_L - 2 \sqrt{Y_S^d \cdot Y_L^d} - 2 \sqrt{Y_S^p \cdot Y_L^p} \]  

(3)

Depending on the type of liquid used in the measurement,
1. Reliability Analysis Technology

1.1 Introduction

Although coating films have emerged as essential industrial goods, they contain different types of defects that can negatively affect their properties. The main factors of deterioration include heat, static electricity, stress, and ultraviolet light, among others. As with other industrial goods, developing reliability models and deterioration models is therefore important for coating films. In this case, deterioration models are generally based on activation energy. Similarly, the field of accelerated testing has recently been expanded to coating films, while technologies have been established to predict the life-expectancy of coating films. Except with integrated circuits and a few other special cases, however, it is rare to conduct accelerated testing for all units in the case of food and electronics.

In this chapter, we will introduce several aspects related to product reliability, including deterioration models, activation energy, accelerated testing, and life-expectancy prediction.

1.2 Films and Film Failure Modes

Figure 5.1 shows an example of a coating film failure (deterioration) model. In this case, the cross-section of the film deposited onto the substrate contains defects caused by factors including moisture penetration at the interface and a charge at the film surface. New fractures and corrosion will begin where these defects occur. The mismatch between coating film stress and substrate stress is another factor of deterioration. Therefore, failure analysis must differentiate between types of deterioration in which the causal factors are found within the coating film and found at the interface. Figure 5.2 shows a photograph of a deteriorated coating film. In this photograph, we can see that many tiny cracks have formed in the surface of the coating film and that moisture penetration has caused swelling. In this way, there are several modes of coating film deterioration, which can be expressed using activation energy as a function of time.

1.3 Activation Energy and Failure/Deterioration

The major factors that cause substances to deteriorate are generally reactive phenomena caused by heat and sparks, for example. Activation energy determines how deterioration progresses, and can thus be considered the threshold at which these reactions begin. We will provide an overview of activation energy based on Arrhenius empirical chemical kinetics. Chem-
polarizability $\alpha$ is considered to be constant. In other words, based on this equation we see that the change in the refractive index directly reflects the change in the molecular number density. Therefore, the decrease in the refractive index of the polymer film in Figure 5.12 indicates that the penetration of the alkali solution and consequential swelling reduces the molecular number density. In this way, by measuring the refractive index we can analyze the cohesion property of the material with a high degree of sensitivity in a non-contact manner. The refractive index can be easily measured using an ellipsometer, an Abbe refractometer, or light interferometry, for example. Moreover, this approach can be used to measure specimens in various states, including thin films, bulk, and solutions.

1.9 Closing
In this chapter, we focused on the failure model, occurrence probability, activation energy, and life-expectancy prediction as a way of introducing coating film reliability analysis technology. Ensuring the safety and reliability of technologies has become an issue of top priority. Similarly, the term reliability has even come into common use and has attracted strong interest from society as a whole. More recently, the fields of safety and reliability have been positioned as their own academic frameworks, and it has become important to nurture engineers from this perspective.

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1. Introduction

Polymers have recently come into use as a means of light-weighting industrial products, including organic-inorganic composite devices and composite components. The greater amount of polymer usage in these composites over the past few years has driven the technological advancement in every product area. The flexibility in polymer design has also contributed greatly to this progress. In particular, complex electronic and electrical components have increasingly led to the need for polymers with a variety of properties, which has also led to complex material design methods. As such, since the 1980s design has gone beyond controlling the primary configuration using synthesis technology, the standard approach at that time, and now utilizes compounding technology that provides functionality by blending different types of materials. This approach needs multiple technologies, including dispersion and manufacturing technologies, to design polymer products in which the higher-order structure is strictly controlled. At the same time, this approach requires technologies that can quantitatively analyze the structure in order to deliver stable quality.

Some of the polymer material analysis methods conventionally used in this case are the functional group and molecular level chemical analysis methods, such as nuclear magnetic resonance and infrared spectroscopy. More recently, however, analysis methods based on high spatial resolution morphological observation, such as transmission electron microscopes (TEM) and scanning probe microscopes (SPM), and physical analysis methods that use X-ray scattering have become essential. Moreover, in-situ analysis using high-intensity synchrotron radiation to reproduce the manufacturing conditions and usage conditions in the user process has already been adopted as an analysis method for many polymer products.

The development of these types of organic material analysis technologies has enabled high design precision, so some products that were considered to be difficult to design with conventional methods can be provided with stable quality. In addition to the bulk properties, advancements in material surface analysis technologies and organic sputtering technologies have been notable. Hereby, monitoring the segregation of components in the depth direction, not simply the top surface, and improving the properties by controlling these have been challenged.

Pressure sensitive adhesive (PSA) films must now be able to adhere to adherends with various compositions and surfaces under various circumstances, taking control of the component dispersion state, which is an important design parameter. Similarly, the release films used to protect the surface of PSA films demand vastly different properties depending on the type of PSA and the processing conditions. Likewise, understanding and controlling the structure of these has become important for delivering stable quality.

In this session, the surface of a thin release agent layer on a release film will be analyzed and its morphology will be observed using an SPM. Moreover, several image analysis methods will be applied and evaluated to consider the mechanisms of release force issues with release films.

2. Release Films

Release films are typically used to protect the surface of PSA and adhesive films that are directly incorporated into products. In this case, the adhesive force of the PSA and adhe-
16. Optimizing the Screen Mesh and Screen Mask

Screen printing uses a screen mask that is made by forming a pattern on a screen mesh, so the ink deposition method is far different from that of other printing methods.

Unlike other printing methods (offset, flexo, gravure) that deposit the ink coated over the imaged area of the printing plate surface onto the substrate, screen printing passes the ink through the openings in an elastic screen mesh before depositing the ink onto the substrate, after which peel-off lifting raises the screen mask off the substrate.

Given this principle of ink passage and peel-off lifting, the print quality is greatly affected by the screen mesh's wire diameter, mesh count, open area rate, thickness, and strength. The thickness, flatness, and resolution of the photosensitive emulsion that forms the patterned openings, as well as the wetting property of the ink on the emulsion, also affect print quality. As such, it is extremely important for printing engineers to determine the screen mesh and screen mask specifications, and accurately recognize the quality.

In general, print quality is determined by the plate and ink. This is also true for screen printing, so we must accurately understand those elements that are important to the screen mask, including the screen mesh, emulsion specifications, and quality. In other words, the appropriate screen mask specifications and quality are important preconditions for high-quality screen printing.

The screen mesh plays the following roles in screen printing.

① Provides the screen mask with the elasticity required for good peel-off lifting (repulsion granting)
② Enables high-definition patterning of the photosensitive emulsion (pattern forming)
③ Secures a uniform thickness as a spacer for ink film thickness control (ink film thickness control)
④ Suppresses the deposition of ink and paste to ensure printing resolution (ink deposition inhibition)

(1) Repulsion Granting
Realizing good peel-off lifting is a precondition for high-quality screen printing. Likewise, the mesh strength and tension required for this purpose are important factors that significantly affect the uniformity and stability of print quality. In short, the screen mesh should be stretched over the screen frame at

About the Author
After working for the mask maker Tokyo Process Service Co., Ltd. from 1990 and the printing machine manufacturer Mirco-tec Co., Ltd. from 1994, Mr. Sano established SP-Solutions Co., Ltd. in October 2000 as a screen printing technology consulting company. Over the following 17 years, he has provided 20 companies with technological support for high-quality screen printing in the fields of plasma display panels, ceramic components, printed circuit boards, flexible devices, graphics, and decorative printing. Today, based on his “Paste Process Theory,” Mr. Sano is collaborating with mesh producers and printing equipment manufacturers to promote the standardization and improve the image and position of screen printing.
8. Developmental Status of Fundamental Technologies Aimed at Promoting the Commercialization of Revolutionary Batteries

NEDO’s project for developing the fundamental technologies to promote the commercialization of revolutionary batteries (RISING2), a policy implemented in FY2017, is aimed at overcoming the following challenges.24

Despite the fact that LIB cells used in consumer electronics had achieved energy densities of 200–250 Wh/kg as of 2015, there are still several technical challenges that must be overcome by the LIB cells used in automobiles. For example, the battery performance required by the main power source in automobiles is far greater than that for standard consumer electronics, and there is a high demand for performance in terms of output and durability, both of which are in a trade-off relationship with energy density. The energy density of LIB cells used in existing mass-produced electric vehicles has only reached 150 Wh/kg, meaning that heavy battery packs weighing several hundred kilograms still only allow for short driving distances of 120–200 km.

In order to deliver electric vehicles with the same driving distance as internal combustion engine vehicles, manufacturers will need to quintuple the energy density that is available today. Although LIB have a theoretical energy density of 450–600 Wh/kg, the energy density limit when applying these to mass-produced electric vehicles is only 250–350 Wh/kg. As such, there is a need to develop revolutionary batteries that utilize new principles with completely different charge carriers, materials, and structures.

As suppliers of automobile batteries to automobile manufacturers around the world, domestic battery manufacturers in Japan have maintained their competitiveness on the global market. The global market for all automobile batteries (excluding lead-acid ignition batteries) in 2014 was approximately ¥700 billion, of which Japanese manufacturers accounted for 70% of LIB sales (approx. ¥650 billion) and 100% of nickel-metal hydride battery sales (approx. ¥130 billion). Automobile manufacturers and large-scale automotive parts suppliers in the US and Europe, however, are expected to supply a greater number of automobile batteries on a global basis, which will bring Japanese manufacturers into greater competition with battery manufacturers from Korea, China, and Europe.

Although the targeted commercialization date of 2030 for revolutionary batteries is still a long way off, considering the lead time to actual commercialization, researchers must determine the basic cell specifications and shift to the corporate development stage during the first half of the 2020s. As such, over the short-term (the next five years), researchers must establish the technology for durable, safe batteries (cells) that deliver the required energy density.

The research and development goal of NEDO is to develop shared fundamental technologies for revolutionary batteries aimed at commercializing electric vehicles and battery packs with the following performance and properties by 2030.

The performance and properties for electric vehicles and battery packs are a vehicle driving distance (per charge) of 500 km, a vehicle cost of ¥1.9 million (100,000 vehicles per year per company), a battery pack cost of ¥400,000 (cost per unit capacity: ¥10,000/kWh), a battery pack capacity of 40 kWh, a
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