

Ground-breaking Packaging Technology Developed By Mondi and Roфин

Gyula Madai, Divisional Technical & Innovation Manager at Mondi Consumer Flexibles, empties out two large sacks containing a multitude of different packaging types on to a table. Dr.Hansjörg Rohde, Technology Manager of ROFIN Laser Micro appraises the diverse array of stand-up pouches, plastic bags, lidded trays, packaging for animal food, convenience foods, vegetables, salads, beverages, candies, snacks or medical products. Today Rohde and Madai are not really interested in the contents or the mostly glossy packages; they are looking for something invisible to the naked eye: tiny perforations, created by a laser.

We are at Mondi's R&D Centre in Korneuburg, Austria, built and opened in 2006. The Centre includes two laboratories and pilot production lines with digital printing equipment. It offers expertise for various extrusion processes, offset, flexo, rotogravure and digital printing, lacquering, gluing and adhesive lamination, slitting and laser perforation plus bag and pouch production with various functional add-ons. Among the materials that the R&D Centre focuses on are biodegradable polymers, transparent barrier materials, paper and polymer membranes plus many more.



Pict. 1: Gyula Madai, Divisional Technical & Innovation Manager at Mondi Consumer Flexibles at Mondi



Pict. 2: Dr.Hansjörg Rohde of ROFIN discussing new laser applications with Gyula Madai of Mondi

Continued /

Mondi's Consumer Flexibles' large investment of over 5 million Euro is a testament to the commitment which the company has to its customers. The most attractive and efficient packaging solutions are likely to be found where the customer can profit from the expertise of the packaging manufacturer at an early stage of product development. In this way, different approaches to production can be evaluated in good time at Mondi's R&D Centre. When uncharted waters are to be explored during this process, ROFIN's application experts come into play. The scope and depth of their expertise in laser material processing helps identify promising solutions without tedious and costly detours. Rhode and his colleagues prepare samples with Mondi's original film material in ROFIN's own application laboratory, using an in-house winder in conjunction with every available laser system. Thus new laser material processes can be reliably evaluated before being deployed on the next, larger scale in Korneuburg.

Packaging Solutions for the Future

Food and pet food are excellent indicators of changing lifestyles in the developed world. Meals tend to be consumed in the workplace in a hurry, rather than prepared in a leisurely manner at home. At the same time, health considerations such as the retention of vitamins and minerals have become increasingly important. Concern also continues to grow over environmental issues, including not only biodegradability of packaging, but also associated issues such as the shipping of fruit. Food and food packaging producers therefore face a number of challenges: Intelligent protection during transport and storage, management of ripening, attractive shelf presentation and easy preparation and handling. Laser technology offers new solutions to more than just a few of these issues. For example:

MAP (Modified Atmosphere Packaging)

MAP increases the shelf-life of fresh and refrigerated food products, which is a distinct advantage for end consumers looking for the combination of convenience and freshness. The shelf-life of perishable food has a great influence on their economic value. The freshness of these products is basically determined by air-ventilation and preservation of humidity. New laser perforation technologies open up new possibilities to make micro-holes into packaging selectively. Micro-perforated films adapt to the respiration rate of the product and adjust oxygen levels to create the ideal atmosphere inside the bag. Fresh-cut salads were among the first products to benefit from this packaging technology. Meanwhile, the technology has advanced as far as enabling packaging to control the flow of certain gases – e.g. to facilitate the ripening of cheese. This requires a profound knowledge of the processes involved: The size, number and positioning of the minute holes – adapted for content and packaging – are among the critical factors that control the desired qualities. This is where Mondi Consumer Flexibles has established in-depth know-how and expanded its expertise.

Continued /

Continued /

The lasers used for MAP applications are CO₂ lasers with high pulse intensities. Unlike the selective structuring of easy opening features, the laser intensity is so high that all layers are ablated thermally, and the laser perforates a micro hole. Lasers with optimal beam quality are required, with laser power ranging from 100 to 2.000 Watts, depending on the material.

NeoSteam®

One way to ensure that microwave food retains its vitamins and minerals and is easy to prepare is to package it in **NeoSteam®** packaging developed by Mondi Consumer Flexibles. This packaging features a valve integrated into high barrier films, and is suitable for frozen or refrigerated food in pouches, bags or trays. Just like a pressure cooker, the valve regulates the pressure inside the package, allowing healthy preparation that retains flavour and vitamins alike. Using the NeoSteam® steam valve the preparation time is reduced while at the same time the product quality is enhanced. The flexible steam valve can be adapted to the individual steam properties of the product and to optimize the cooking time. This flexibility ensures that the product can be prepared quickly whilst preserving healthy vitamins and minerals. Because the valve is an integral part of the packaging film, NeoSteam® can be processed in standard filling machines. In addition, the normally tedious and costly processing stages for fitting separate valves can be omitted.

The dialogue between Rohde and Gyula Madai also involved Mondi's innovation in the field of convenience food – a combination of NeoSteam® and MAP. NeoSteam® MAP combines the sealing film for modified atmosphere treatment with Mondi's innovative steam-cooking valve. It prolongs the shelf life of refrigerated products in pouches (FFS bags) or trays (meat, seafood, fruit, vegetables, pasta and ready-to-serve meals are just a few examples). These products can then be gently and easily steam-cooked in the microwave. The traditional puncturing of the film is no longer necessary, which means flavor, precious minerals and vitamins are retained. NeoSteam® and MAP both require laser perforation of varying diameters. The goal was to find the best solution with regard to various facets of cost and performance. In the packaging industry, where web speeds of several hundred metres per minute are common, this is by no means an easy feat.

Continued/

Continued /



Pict. 3: Laser perforation for NeoSteam® packaging solutions



Pict. 4: Flexible NeoSteam® valve

Laser Perforating

The perforation pattern is generated either via special polygon mirrors for high-volume production or via fixed optics with synchronous pulse triggering. This procedure only allows perforations in lines. Up to 16 lines can be made in parallel with the laser system on a single web. In one line up to 50 holes/cm can be perforated - thus allowing not only ventilation but also for easy-tear-off applications. Typical hole sizes in films without aluminum layers range from 60 to 400 μm . Aluminum-coated films require considerably more laser power, and the thermal input is correspondingly higher.

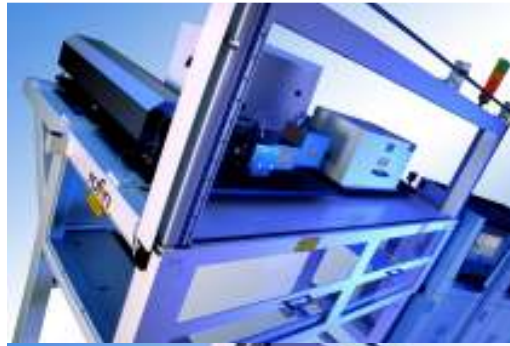
For perforation of polymer films, laser technology competes particularly with needle technologies and flame perforating. The big advantages of the laser technology are smaller holes which are even crack-proof due to the micro melted edge. Moreover, lasers work contact- and wear-free, whereas needles for example get dull or even break. Due to the special polygon technology and the extremely short laser pulses, it is possible to perforate holes at extremely high web speeds (e. g. 300 m/min).

Continued/

Continued/



Pict.5: Mondi's system equipped with a ROFIN *StarScribe* laser for developing innovative packaging solutions



Pict.6: ROFIN cross web scribing system

Easy Opening

Convenience foods require easy preparation and handling. Consumers want to open packages without using scissors or knives, and reseal them without rubber bands or cellotape. Comfortable opening hinges on three factors: Intelligible instructions, minimal use of force and controlled opening. Nobody wants to have to use tools or mop up spilled content. In this area, standards have to be applied with particular regard to the requirements of elderly people – a target group of ever-growing significance.

Easy opening means selective weakening of the mechanically supporting layer without affecting other functionalities. Mechanical scribing or punching methods are fast and considerably simpler, however, they cannot differentiate between the individual layers. The result may be that either the mechanically supporting layer is not completely separated (scribing depth too low) or the light or humidity hermetic layer is harmed (scribing depth too high). Therefore, for some time research has been going on to find a dependable method which selectively acts on the different layers. Laser structuring with CO₂ lasers offers a new solution. This technology benefits from the different optical properties of the single film layers.

Continued/

Continued/

Laser Structuring

Almost all packaging films are multi-layer structures, that is, they consist of several films, one on top of the other, with a thickness of several 10 µm each. Each layer has a different function: PET is for stiffness and aroma preservation, PE for sealing and tear-proofness, PP for vapor impermeability, Aluminum for general light hermetic sealing and paper for stiffness. Most of the polymer materials in the packaging industry, such as PET, PS or OPA, absorb the laser beam very efficiently at the typical wavelength of 10,6 µm. The result is local heating, and the polymer layer is completely ablated in the small scribing area. Aluminum layers act as perfect mirrors for all wavelengths of the CO₂ laser at low laser powers, that is, they do neither absorb nor transmit the beam. This method allows the user to localize the desired scribing structures on almost all kinds of packaging materials, provided the correct wavelength is used and the scribing is applied from the correct side.

Depending on the application either fixed optics or scanner optic systems may be used for structuring. In most cases processing is done on web-shaped material. For scribing structures in the web direction, the laser with fixed optics is positioned exactly above the web. Due to production technology reasons, most bags and pouches require cross web scribing structures. That is where lasers with fast scanner heads are used to compensate for the web speed and can apply almost any structure even at high speeds with the so-called on-the-fly-technology. Also semicircles or diagonals of opening structures on the edge of a bag may be scribed. Typical scribing speeds may be 10-15 m/s, depending on material and technology applied. This leads to material speeds of 100-250 m/min.

Safe and Reliable Processes

Under the microscope at the R&D laboratory, materials like PE and PET prove to be quite inhomogeneous: Depending on the manufacturing process, films of the same material and thickness can hold different qualities. A reliable high-quality laser process must take this fact into account, just like the effects of multi-coloured imprints. It is essential in guaranteeing the high quality customers have come to expect from Mondi Consumer Flexibles. Mondi scrutinizes the oxygen and water vapour permeability of packaging films to adapt them to their respective contents. Once the optimum settings are found for the size, amount and positioning of perforation holes for MAP or NeoSteam[®], the manufacturing process must maintain them at high delivery rates. ROFIN contributes to this task, for example, using a before/after analysis of the laser beam during reel changes. Because lasers work contactless and without mechanical wear they are ideal for maintaining production quality. However, ever more advanced packaging requires an equally more precise production process and therefore the advancement of all its components – from winders and the control of web tension to the precision of imprints and print marks.

Continued/

Continued/



Pict.7: Mondi Analytical Laboratory – OTR/WVTR test (oxygen transmission / water vapour transmission)

There is Room for Innovation

ROFIN is not only interested in the optimisation of quality assurance. For them, other areas are equally worth exploring, such as the potential of higher laser power, higher performing scanner heads, more flexibility through, for example, automatic field size adjustment and further simplification of the integration of lasers to the manufacturing process. Amongst other things, Mondi keeps a sharp eye on the wish list of their customers from the confectionary, convenience and pet food industries. While easy opening is already handled well enough by most packages, secure resealing is usually another story. Zippers and sliders are up to the job, but like separate pressure valves, they are rather costly in the manufacture and processing of packaging. Something Gyula Madai would like to change ...

Continued/

Continued/

Mondi Consumer Flexibles and ROFIN

Mondi Consumer Flexibles provides flexible packaging solutions with a variety of features such as barrier properties, professional printing and end-user functionalities like easy opening, pourability and microwaveability. Consumer Flexibles is part of the Mondi Group, an integrated paper and packaging group founded in South Africa in 1967. In 2007 it had revenues of € 6.3 billion. Its key operations and interests are in Western Europe, emerging Europe, Russia and South Africa. The Group is principally involved in the manufacture of packaging paper and converted packaging products; uncoated fine paper; and speciality products and processes, including coating, release liner and consumer flexibles. Mondi has production operations across 35 countries and had an average of 35,000 employees in 2007.

Cooperation of the packaging specialist and the laser expert was initiated more than three years ago. ROFIN, with head offices in Germany and the U.S., is a world market leader in industrial laser material processing. Every year, over 300 applications are processed in the laboratories of ROFIN's CO₂ systems business unit. Their practical experience in laser processing of organic materials such as paper or polymers is virtually unrivalled. The range of applications extends from classics such as stripping cables or degating to innovative applications in the fields of packaging or anti-forgery applications.

Contact

Mr Dave MacLellan
Sales Manager – Micro Division
Rofin-Baasel UK Limited
Sopwith Way
Daventry
Notrhants – NN11 8PB

Telephone - +44(0)1327 701 100
Fax - +44(0)1327 701 110
E-Mail - sales@rofin-baasel.co.uk
Web - www.rofin.co.uk