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Cast MDO-PE film as thin as 15 µm:

Revolutionising mono-material packaging solutions

▶ Reduction in material consumption

A thickness range from extremely thin 15 µm to 60 microns, production speeds up to 300 m/min, a perfect thickness profile across the entire film width, and the possibility to manufacture various mono-material PE film types are the main advantages of SML's latest cast film line with an integrated MDO unit.

"The mono-material PE films produced on our new cast film line are characterised by excellent mechanical and optical properties. One of the key advantages of ultra-thin MDO-PE film is the significant reduction in material consumption," Elias Mayrhofer, Product Manager at SML states. SML cast film lines are ready to manufacture MDO-PE film as thin as 15 µm. It goes without saying that the process is completely stable, with no compromises when it comes to performance, functionality and printability.

BARRIER LAYER FOR EXTENDED FUNCTIONALITY

"For sensitive foods that require packaging with high-barrier properties, a 7-layer MDO-PE barrier film in a thickness range of 25 µm to 60 µm is another area of application covered by SML's cast film line. The barrier layer of EVOH in the MDO-PE film significantly increases the oxygen barrier, while recyclability is maintained due to its low share in the actual film structure.



A 25 µm MDO-PE barrier film reveals the following barrier properties:

- ▶ **OTR (oxygen transmission rate) at 23 °C, 0 % RH: 1 – 5 cm³/m² 24 hr**
- ▶ **WVTR (water vapor transmission rate) at 23 °C, 90 % RH: 6-8 g/m² 24 hr**

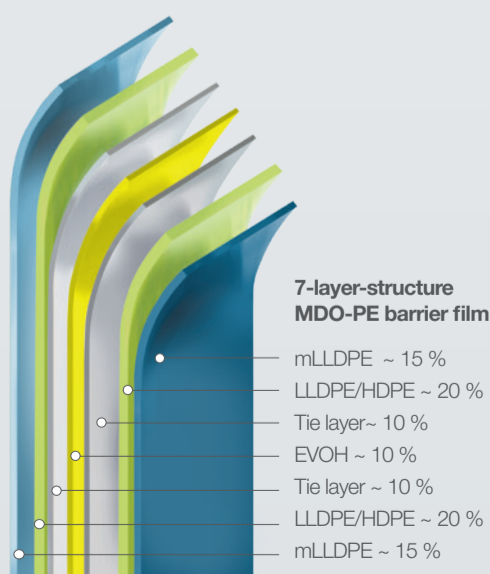
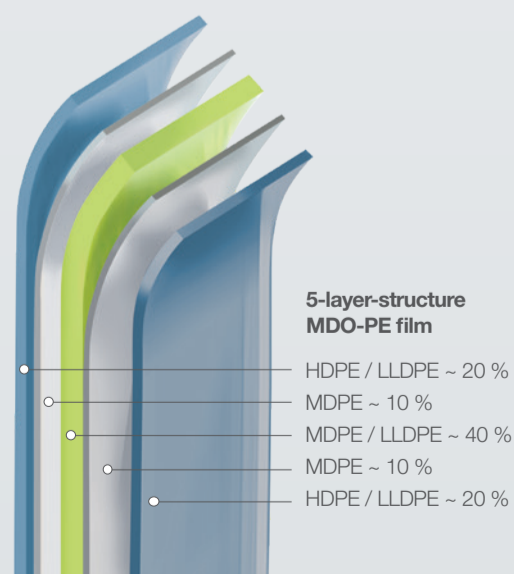
CAST TECHNOLOGY ENABLES EXCEPTIONALLY LOW TOLERANCES

Generally, SML cast film lines stand for optimum film flatness due to controlled cooling on the chill roll. Since the die bolts are individually controlled, thickness control across the entire film width is highly effective and straightforward. "Additionally, the thickness profile of the primary film in the edge area ahead of the MDO process can be adjusted easily and very precisely. This all contributes towards creating a perfect thickness profile across the entire width", Elias Mayrhofer concludes.

This ensures an ideal stretching process of the film, irrespective of the defined stretching gap.

The number and the diameter of the annealing rollers provide optimum film stabilisation and minimise any residual shrinkage, which is especially important for subsequent processes such as lamination or printing.

All of the rollers in SML's MDO unit are driven and tempered separately. Instead of oil, SML uses water to temper the rollers, which is both economical and maintenance-friendly.



ADVANCED MDO UNIT

Special attention was paid to the design of the MDO unit: the distance between the stretching rollers in the MDO unit can be reduced to as little as 3 mm, the adjustment of the stretching gap takes place in a motorised fashion. The positions of the nip rollers in the stretching area are also adjustable.

PRODUCT FLEXIBILITY AND VARIETY

SML's cast process offers tremendous opportunities for the production of forward-looking packaging solutions: in addition to MDO-PE film, the line is also capable of producing conventional and barrier film from PE or PP as well as films for metallisation.

Extrusion lines – engineered to perform

► Editorial



Karl Stöger
Managing Director

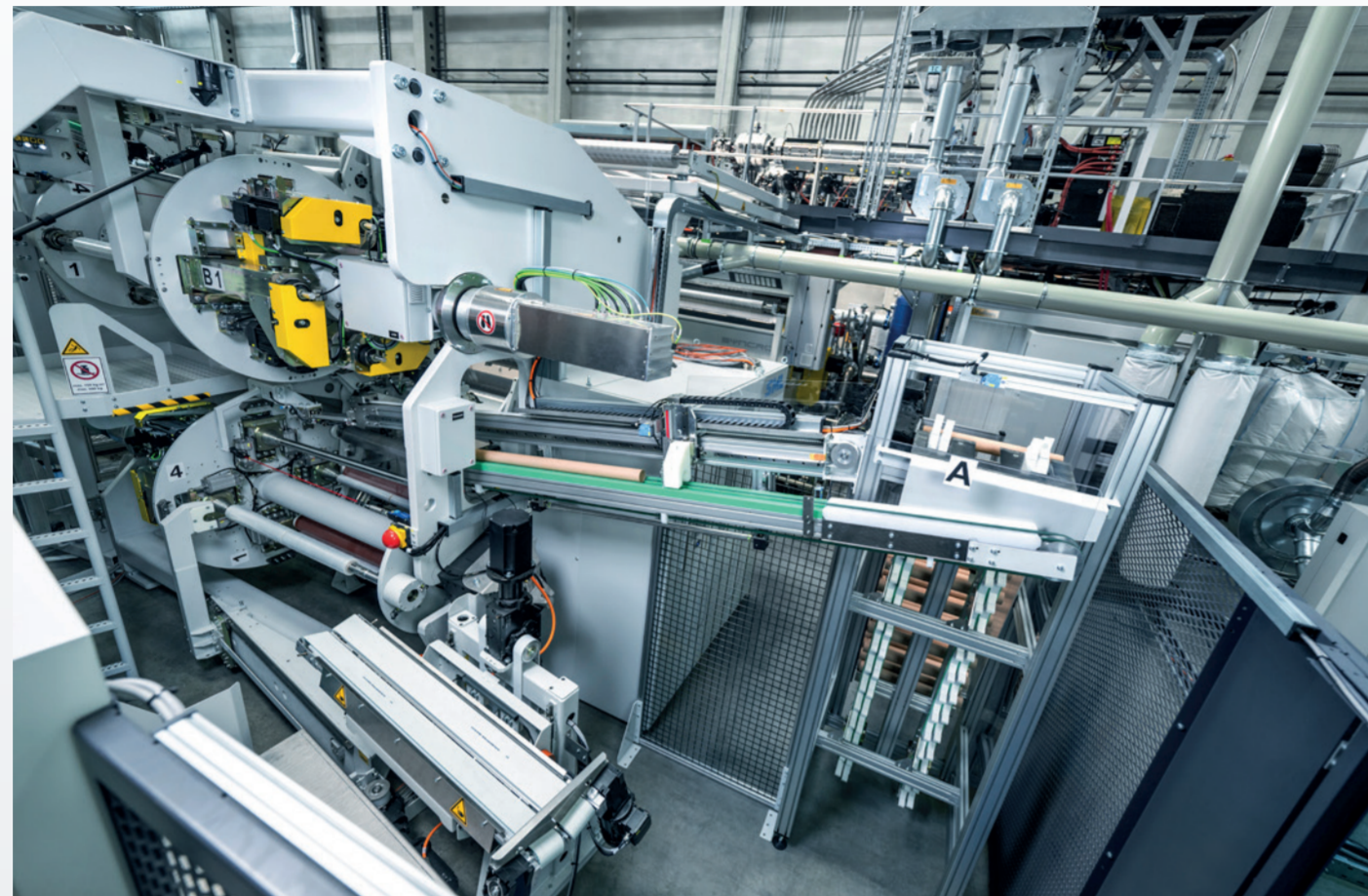
Dear Reader,

The SML Innovation Days 2024 are now over. We set ourselves the goal of releasing innovative new extrusion lines that will impress our customers by addressing the challenges they currently face in the marketplace and helping them to prepare themselves for a future full of success. The outcome was a veritable explosion of fresh ideas and novel technologies all put on display to the delight of our customers. This TechReport, which has been extended to six pages to provide a complete 360-degree review of the event, gives you a detailed account of the individual product innovations showcased in our Technology Centre during the live event.

Should you have missed the SML Innovation Days this year, there is no need to worry. Our Technology Centre is open almost 360 days a year. Several fully-fledged demonstration lines are installed on a permanent basis giving customers ample opportunity to come and see them for themselves. Feel free to arrange an appointment, regardless of whether it is just to examine the latest technology or to actually attend a live demo-run. Very specific product trials can also be arranged after prior consultation and co-ordination with our sales team and product managers. Please reach out to us no matter what your extrusion requirements are. We look forward to supporting your inquiries and to working with you towards a successful future with innovative technology making sustainable plastic products.

Yours sincerely,

EcoCompact® II stretch film line: Economic production of hand rolls on 2-inch cores



The high-performance winder W4000-4S 2T is a perfect fit for SML's 2-metre stretch film line, **EcoCompact® II**, which was recently completely revamped. The winder makes significantly higher production speeds possible, especially for the production of hand rolls on 2-inch cores.

In early 2024, SML fully revised its EcoCompact® stretch film line concept. The optional winder W4000-4S 2T plays a key role in the EcoCompact® II. "This winder has two turrets – or in simpler terms, two winders in one frame," Thomas Rauscher, Product Manager at SML, explains.

Shorter winding shafts are the main reason for the high winding speeds of the W4000-4S 2T. "The shorter shafts are not affected by critical rotational speed or vibrations at higher production speeds. A fact that takes on significance when it comes to the production of 2-inch hand rolls," Thomas Rauscher continues.

HIGHER SPEEDS MAKE HAND ROLL PRODUCTION ECONOMICAL

Usually, the manufacturing of 2-inch rolls is not economical on 2-m stretch film lines, since production speed is limited to 300 or a maximum of 400 m/min on a "conventional" winder with longer shafts. "Using a W4000-4S 2T winder on the EcoCompact® II, enables the production speed for hand rolls on 2-inch cores to be extended to 800 m/min. This leads to a significant increase in output and boosts the efficiency of hand roll inline production up to the next level," Thomas Rauscher states.

Just to give an example of the performance capability of the EcoCompact® II in combination with the double turret winder W4000-4S 2T: with 12 microns on 2" cores, a net output of over 1,000 kg/h is possible.



First SML nanolayer stretch film line for North America

The US company, Alliance Plastics, with its headquarters in Wrightstown, Wisconsin, is installing North America's first nanolayer stretch film line from SML.

"Our investment in this advanced technology is a testament to our commitment to leading the industry and providing our clients with the best possible solutions

in stretch film," Troy Wolf, the President of Alliance Films, announces with pride. "This new stretch film line will not only increase our production capacity significantly but will also set a new standard for quality in our industry."

SML's state-of-the-art nanolayer line is equipped with a feedblock for 67 layers

from Cloeren. "Its specific design boosts film performance, especially in terms of elongation, puncture and tear propagation," Thomas Rauscher, Product Manager at SML, explains.

The 67-layer line is expected to be fully operational by December 2024.

Live demonstration runs at SML Innovation Days: Manufacturing mono-material PE stand-up pouches

To showcase the enormous potential of SML's extrusion lines, the films for mono-material stand-up pouches from PE were manufactured and laminated live at SML's Innovation Days, from 9 to 10 October 2024. A state-of-the-art cast film line with integrated MDO unit and a high-performance FlexPack coating and lamination line were in operation.

Mono-material-PE structures have proven to be a forward-looking solution when it comes to replacing BOPET in flexible packaging. SML's all-PE solution combines full recyclability with maximum film performance.

The pouches produced during the Innovation Days had the following structure:

- 17 µm MDO-PE film – surface layer with excellent optical properties, reverse printed
- Primer
- 13 µm LDPE extrusion lamination
- 65 µm CPE sealant film – for a stable pouch structure

The production of all of the films for the pouches and the lamination process took place exclusively on SML extrusion lines.

ULTRA-THIN MDO-PE FILM FROM SML CAST FILM LINES

SML's latest cast film lines are fitted with an MDO unit, that was especially designed to manufacture easy-to-recycle mono-material films. The 17 µm MDO-PE film for the pouch surface showed a five-layer structure and a layer distribution of 20/10/40/10/20 % and featured the following properties:

Mechanical properties:
Machine direction MD:
> 1,400 MPa (up to 1850 MPa)
Transverse direction TD:
> 1,200 MPa (up to 1500 MPa)

Heat resistance:
Shrinkage 120 °C/30 sec, machine direction: 4 – 10 %
Shrinkage 120 °C/30 sec, transverse direction: 0 – 2 %

Optical properties:
Gloss 45 °: 70 – 85 %
Haze: < 5 %

As can be seen from above table, the 17 µm film offers excellent optical attributes. Its high stiffness guarantees a good machinability for further processing on printing and packaging machines.

CONVENTIONAL CPE SEALANT FILM

For the stability of the pouches, a 65 µm CPE sealant film was manufactured in a conventional cast process on the same line. Generally, CPE film produced on cast film lines from SML is characterised by its low gauge tolerance, high transparency and good sealing properties (with a low sealing initial temperature – SIT).

LAMINATING MDO-PE AND CPE FILM

The 17 µm MDO-PE film and the 65 µm CPE sealant film were further-processed and laminated on a state-of-the-art FlexPack coating and laminating line. The reverse printed MDO-PE film required a very small amount of primer to improve adhesion. However, to bond the two films with their different properties, only PE was used in the extrusion process, without any other adhesives. In this way the mono-material properties of all substrates were kept, optimum recyclability is guaranteed.

OPTIONAL BARRIER LAYERS FOR EXTENDED FUNCTIONALITIES

To extend the functionalities of the pouch, there are three different ways to integrate oxygen barriers such as EVOH/PVOH in its structure:

- in the structure of the MDO-PE film
- in the structure of the CPE film
- as an additional layer in the PE extrusion lamination layer – PE /tie/EVOH/tie/PE

Regardless of which option is used for the integration of a barrier function, the final result is always a recyclable mono-material PE structure.

CLOSE COOPERATION WITH DOW

For the development of the mono-material PE structure of the pouches, SML closely co-operated with the raw material manu-



Key facts about SML's cast film line with integrated MDO unit:	
► Products:	MDO-PE, MDO-PP, MDO-PET, CPE, CPP, barrier film
► Film thickness range:	15 – 250 µm (depending on the product)
► Output range:	up to 1,200 kg/h

facturer Dow. With a wide range of PE-based granulates, Dow offers customised solutions for the diverse requirements of the packaging industry. "The collaboration between Dow and SML allows us to demonstrate our broad toolbox of products that incorporate design for recyclability for packaging with our next-generation AFFINITY™ sealant and our ELITE™ and INNATE™ performance resins, enable the circular economy with REVLOOP™ post-consumer

recycled grades, and support efficient line productivity thanks to DOWLEX™ polyethylene resins and ATTANE™ ultra-low-density polyethylene (ULDPE) copolymers," said Laurent Ziché, marketing manager at Dow. The combination of SML's advanced extrusion technology and Dow's material expertise makes it possible to realise sustainable and high-performance packaging that meets the growing demands for environmental compatibility and functionality.



Key facts about SML's FlexPack coating and laminating line:	
► Substrates:	MDO-PE, CPE, MDO-PP, CPP, BOPET, BOPP, paper, aluminium foil, metallised film, barrier film
► Products:	flexible packaging, technical applications, medical applications
► Extrusion material:	HDPE, LLDPE, LDPE, EAA, DIE, EVOH, Ionomers
► Coating weight:	5 – 50 g/m² (depending on the product)
► Coating layers:	up to 5 layers
► Max. line speed:	450 m/min shaftless



Extrusion technology live in operation:

More than 280 visitors at SML Innovation Days 2024

Around 280 industry professionals from all over the world came to the SML headquarters in Upper Austria on 9 and 10 October 2024 for specialist presentations, expert discussions and live demonstration runs.

The topics covered on SML Innovation Days were varied and diverse; they ranged from new technologies for recyclable, flexible packaging to innovative stretch film products, and from coating lines for liquid packaging board to solutions for data-based process optimisation.

"The Innovation days were a perfect opportunity to show the outstanding technical capabilities of SML to a range of high-ranking industry experts. In the relaxed and inspiring atmosphere of our headquarters, we discussed the latest developments in our industry face to face and let our visitors experience state-of-the-art extrusion technology live in operation up close."

Karl Stöger, CEO of SML states.



Maximum efficiency:

Inline pre-stretch production live at Innovation Days

Enhanced speed up to 900 m/min.

SML was presenting its inline pre-stretch unit to an expert audience for the very first time – up close in operation at Innovations Days 2024. Integrated in a SmartCast Infinity stretch film line, the system is setting a new standard for efficiency in production. The advantages of the inline manufacturing of pre-stretch film are evident: Ultimately, they result in significantly lower production efforts.



The aim of pre-stretching is to reduce the thickness of stretch wrap film, for example from 23 mic to 8 mic, and simultaneously to achieve a stiff and rigid product. "Historically, it has been common practice to manufacture pre-stretch film in two separate production stages: film production and offline pre-stretching on a separate rewinder", Thomas Rauscher, Product Manager at SML, explains. This was, for a long time, the most economical solution to achieve extremely thin and stiff stretch film.

ner. The production speeds attained of 800 m/min or even 900 m/min were astonishing, and has taken the inline solution to a whole new level of efficiency!" Thomas Rauscher states.

ADVANCED WINDING TECHNOLOGY ENABLES INLINE PRODUCTION

"With the SmartCast Infinity we have developed an inline pre-stretch unit followed by an ultra high-speed winder. The whole process runs in an absolutely stable man-

READY-TO-SELL PRODUCTS STRAIGHT FROM THE LINE

The greatest advantages of the inline production of pre-stretch film are the savings in terms of labour and logistics costs, as

the product is ready to sell when it comes off the winder. All of this leads to a significantly more efficient production process.

APPROVED FOR SMARTCAST INFINITY AND ECOCOMPACT II

The manufactured pre-stretch film can be wound up on 2 -inch, 2 1/2-inch and 3-inch cores. The units are designed for the production of "typical" pre-stretch products, such as hand rolls, with folded



edges and with oscillated winding as a standard. Core separation at the winder for the usage of different standard core lengths is available as an option. "We have built, tested and approved our inline pre-stretch unit for 2 m and 3 m wide lines. So, it is optimally suited for our SmartCast Infinity and EcoCompact II stretch wrap film lines", Thomas Rauscher concludes.

SML's SmartCast Infinity stretch wrap film line with the integrated pre-stretch unit is available for customer visits and trials at SML's Technology Centre. For more information, please contact Thomas Rauscher, rat@sml.at



SML high-performance PP-sheet lines:

Now equipped to manufacture premium foamed sheet

New types of thermoforming products from foamed sheet are lightweight, microwaveable, cost-effective and fully recyclable. Due to their excellent insulating properties they are a perfect alternative to products made of EPS. SML's advanced high-performance PP sheet lines are an optimum solution for the manufacturing of foamed sheet from PP in higher volumes.

(B layer). Compared with regular PP sheet, this corresponds to a reduction of 40%. "The lower material input results in significant savings for sheet manufacturers and in lighter packaging," Martin Kastner explains.

EU regulations, such as the single-use plastics directive and the imminent ban on expanded polystyrene (EPS), spell the need for the development of innovative and future-oriented packaging solutions. With this in mind, SML continues to perfect technologies for the production of foamed sheet from PP, especially with regard to food packaging.

MARKET REQUIREMENTS

"In direct response to customer requirements, we have optimised and upgraded specific components of our high-performance PP sheet lines for the manufacturing of high volumes of premium foamed sheet. Of course, we did this without compromising the lines' high efficiency and product quality with regard to classic PP thermoforming sheet", Martin Kastner, R&D Engineer at SML, explains.

40 % MATERIAL SAVINGS WITH FOAMED PP SHEET

When it comes to SML's High-Performance PP-sheet lines, the total density of PP foamed sheet, which can be achieved, is as low as 0.55 g/cm³, referring to a sheet made from standard polymers with an A/B/A structure, consisting of 20% conventional PP in the outer A-layers and of 80% foamed PP in the inner core layer

QUALITY FEATURES OF FOAMED PP SHEET:

- ▶ Excellent heat insulation. The microcells in the foam have an insulating effect, which keeps food warm for longer. The finer the cell structure, the better the thermal insulation.
- ▶ Microwaveable. Food can be re-heated in the tray in accordance with food safety standards.
- ▶ Fully recyclable mono-material
- ▶ Fat and oil-resistant. For a wide range of different food and non-food applications.
- ▶ Excellent mechanical properties. A high stiffness and dimensional stability, thermoformable on conventional thermoforming systems.

HIGH-PERFORMANCE EXTRUSION SYSTEM

SML's High Performance PP sheet line is equipped with a coextrusion system that comes with a powerful 180/33 single-screw extruder as the main extruder on which the foamed B-layer can be manufactured. It achieves a plasticising capacity of up to 1,250 kg/h with a mixture of virgin PP and up to 80% regrind. An HSE 75/37V semi-high-speed extruder



High stiffness and dimensional stability

serves as the co-extruder (for the A-layers). The complete extrusion system of the line delivers a maximum plasticising capacity of up to 1,850 kg/h.

FOAMING TECHNOLOGY PACKAGE – CUSTOMISED FOR PP

For the production of foamed PP sheet, the screw of the main-extruder was given a special design. Furthermore, the extrusion system is fitted with a foaming technology package customised for PP in the melt pipes of the main extruder. The addition of small quantities of inert gases such as CO₂ or N₂ and a nucleating agent into the melt enables the creation of huge quantities of fine microcells in the core-layer (B-layer) of the A/B/A sheet.

MARKET-PROVEN ROLL STACK TECHNOLOGY

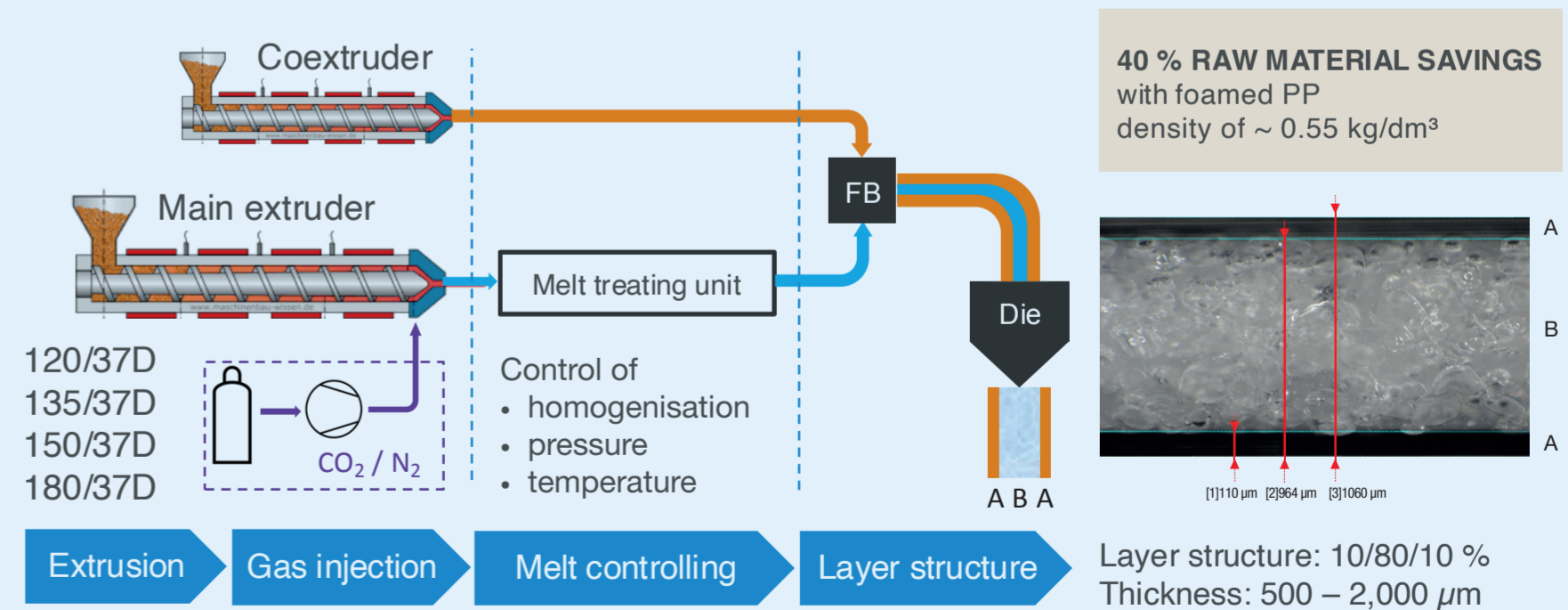
The roll stack is a key element in any sheet line. On its High Performance PP sheet lines, SML's advanced roll stack technol-

ogy is adapted 100% to the processing of conventional and foamed PP.

- ▶ Smart Parallel Gap (SPG) roller technology for perfect thickness profiles. Quick changes of sheet thickness with minimal die adjustment.
- ▶ Thin shell roller. Superior heat transfer coupled with a greater cooling capacity, resulting in a higher specific output.
- ▶ Quattro gap. Four roller gaps for better cooling and optimum surface properties, especially for thick sheets.

Due to the special material properties, thermoforming companies are starting to discover the full potential of foamed sheet for future-oriented packaging solutions. SML has been involved in the development of corresponding technologies for years, and meanwhile several lines for foamed sheet are in operation at customer sites.

Extruder for physically foamed PP



Innovation in process technology: Multifilament anti-mosquito yarns

A process developed for SML's Austrofil CF spinning lines allows the manufacturing of a completely new type of functional multifilament yarn with ingredients which are deadly to mosquitos. The yarns designed for use in mosquito-nets have excellent haptic properties and are harmless to humans. Manufacturing can take place in a straightforward process.

Malaria continues to be a serious problem in many tropical countries, claiming hundreds of thousands of lives every year. "Mosquito nets are an important tool in the fight against malaria. Compared to conventional nets made of monofilament yarns with anti-mosquito ingredients, nets from the newly developed functional multifilament yarns are of a significantly higher quality," Thomas Pucher, Product Manager at SML, states. SML co-operated with an additive manufacturer to develop this new product. The key benefits of the multifilament anti-mosquito



yarns from SML's Austrofil spinning plants include a very pleasant haptic, greater effectiveness against mosquitos as a result of the larger yarn surface, and, last but not least, premium-quality mosquito nets with reduced weight for a better handling.

Ingredients like permethrin and deltamethrin. They cause 98 % of the mosquitos to die at first contact. UV-stabilisers, different colours and flame-retardant agents can also be added to the new anti-mosquito yarn.

MULTI-FUNCTIONAL PP YARN WITH UP TO 150 FILAMENTS

The multifilament yarns from SML's Austrofil spinning lines are manufactured on a PP basis using a POY or FDY process. They come in threads of 50, 100, 150 and 200 den and a yarn can contain 20 to 150 filaments. Effective protection against mosquitos is provided by active ingredients



SIMPLE AND SAFE PRODUCTION PROCESS

The technical team at SML has perfected a manufacturing method which prevents the anti-mosquito ingredients leaching from the yarns during production. "This helps to save material costs since the loss of ingredients is significantly reduced. It also helps to keep the whole process simple," Thomas Pucher, explains. In comparison with the production of conventional monofilament anti-mosquito yarn, which relies on comprehensive suction systems, solvent recovery and operators in protective clothing, the process developed by SML requires only a regular suction system to satisfy work safety standards.

Recycling in compliance with EU regulations: Established SML technology for coated paper packaging

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Paper packaging is becoming more and more popular, but if you take a closer look most of these packaging solutions come with a thin layer of plastics. With its extrusion coating lines, SML offers an established technology for the extrusion of ultra-thin coatings for paper packaging in compliance with EU and national recycling regulations.

In order to raise recyclability, legislation in many countries now aims to avoid packaging solutions based on a mix of different raw materials. There is a need for new packaging products such as mono-material plastic packaging or paper packaging with extended functionalities.

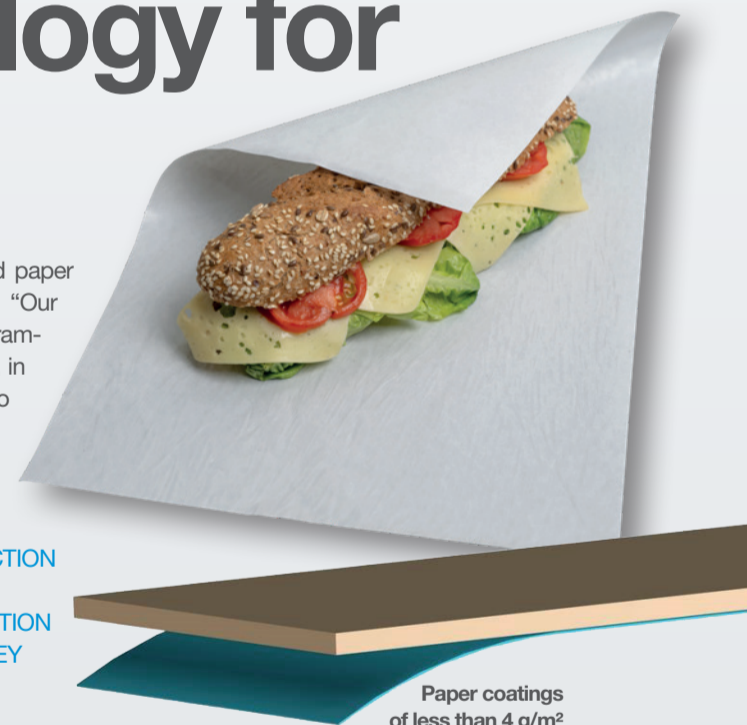
Coating can significantly improve the properties of paper packaging. This is especially true when it comes to protection from grease and moisture, printability and sealability. "Faced with the new EU regulations, the main challenge is that the plastic content in paper packaging may only make up a fraction of the total packaging to be classed as recyclable paper packaging. The plastic content shall be less than five per cent," Johannes Danter, Product Manager at SML, explains.

SML extrusion coating and laminating lines, like the FlexPack series, are highly suited to

the production of extrusion coated paper with the lowest coating weights. "Our lines manufacture coatings with a grammage of less than 4 g/m², which is, in most cases, absolutely sufficient to achieve the five-percent-target for paper recycling," Johannes Danter states.

FOR THE SUCCESSFUL PRODUCTION OF COATED PAPER PACKAGING MATERIAL WITH A LOW PROPORTION OF PLASTIC, THE FOLLOWING KEY CRITERIA ARE DECISIVE:

- ▶ A high paper quality with very few impurities
- ▶ A perfectly pre-treated paper surface – inline either with flame or corona treatment
- ▶ A high melt quality. In its coating and laminating lines, SML uses well-proven high performance barrier screws to generate melt with a maximum homogeneity.
- ▶ An extrusion die with automatic bolt adjustment and an EBR deckling system for maximum flatness and minimum coating weights.
- ▶ Ozone treatment as an optional tool to increase adhesion by accelerating the oxidation rate for PE at higher line speeds.



Paper coatings of less than 4 g/m² grammage

For decades SML has continued to further develop coating and laminating lines for multiple purposes. "The technology, the processes and the systems to manufacture coated paper packaging with a minimum share of plastic is all but new to us. Most SML FlexPack lines, that were manufactured for the food industry, are either ready to produce coated paper or can very easily be upgraded with minor adaptations," Johannes Danter explains. In addition to "standard" paper coating based on fossil or bio-based polyethylene, paper-based packaging with a barrier layer that includes EVOH can also be manufactured on SML's lines for coating and lamination.

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