



▶ **Leading edge technology for hot-fill, PET cups**

Foamed PET sheet for cups for hot-fill applications

Hot drinks and street food are often sold in disposable cups and trays, which must combine heat insulation properties with minimum costs and low environmental impact. At present, these cups and trays are made from differing materials such as cardboard and rigid or foamed PS and PP. However, as the highly popular PS is the object of ecological debate in a number of countries, alternatives are necessary. Roughly a year ago, SML and a partner company started a development project with the aim of employing low-cost APET resin for the production of ecologically compatible, foamed cups for hot-fill applications.

THE INITIAL SITUATION

As a rule, PET is not employed in the production of containers for hot-fill applications. This is because APET cups lack dimensional stability when subject to heat at the required temperatures.

THE SOLUTION IS A CUP:

- ▶ Made of foamed sheet
- ▶ That is suitable for hot-fill
- ▶ Produced from a standard APET resin and recycling material at low cost

Conversely, crystalline polyester (CPET) could easily meet this stipulation, as it is employed to pack convenience foods, which are heated in ovens at over 200°C. Unfortunately, CPET is expensive and therefore is not used for

hot-fill commodities. As a consequence, a number of companies are attempting to solve this problem with an approach that involves the use of additives to increase heat stability. However, such additives are also expensive and must be employed in high concentrations, which again leads to an uneconomical process.

THE DEVELOPMENT OF A PET CUP FOR HOT-FILL APPLICATIONS

In July 2017, SML started testing a newly developed sheet line at its headquarters in Lenzing, Austria. Amongst others, the aim was to manufacture a foamed APET sheet for thermoformed cups that would be suitable for hot-fill applications. The line is designed for the production of 3-layer sheet and is equipped with two extruders with a maximum output of over 1 t/h. The sheet has an overall density as low as 0.62 kg/dm³ and an A/B/A structure with a centre layer that is physically foamed. No special additives are required to enhance the heat stability of the sheet, which is thus suitable for the economic production of low-weight cups with good insulation properties. The sheet is thermoformed by SML's project partner, which is a company that possesses advanced tooling and thermoforming technology.

The cup in the photo has a foamed layer containing 40 per cent post-consumer bottle flakes and is able to retain its shape even when being filled with boiling water. At the same time, it can be held without burning the fingers. Therefore, in view of

this extremely positive result, the next objective is to render this development suitable for industrial production.



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Editorial

Karl Stöger
Managing Director



Dear Reader,

A year from now, SML will relocate to new office and factory buildings, which are currently under construction in Redlham, about 12 km away from our current location Lenzing. The move to invest in a completely new and much larger plant here in Upper Austria underlines our strong commitment to the region as a prime industrial location as well as to maintain the recognised quality associated with "Made in Austria". And primarily this is because of the highly qualified people that we are able to find and employ here. In addition, the decision for this investment demonstrates our belief in the continuing expansion of the plastics industries which we are serving. With the new premises we will double the size of our production areas, technological development centre and office space, and thus make ourselves ready for future growth and technical advancement.

Although the rising amount of plastics in our waste streams is questioned by various environmental protection organisations and NGOs alike, I am of the opinion that, despite the justified critical voices, plastics will long remain an indispensable part of the packaging industry. The rise in global consumption of plastics products is enormous, as indicated by the annual growth rates in the polymer raw materials sector, amongst machine manufacturers and plastics processors. Nonetheless, in the coming years it will be important that we develop and produce modern, recyclable packaging. This must be manufactured with the help of sustainable processes and it is essential that disposal and recycling take place in a regulated manner in order to protect and preserve our environment for coming generations.

We at SML are convinced of the positive features that characterise plastics and are equipping ourselves for the future with our new factory in Redlham. There, we will not only increase our production capacity, but also create additional jobs and continue to fulfil our role as an important partner to the plastics processing industry.

Yours sincerely,

Karl Stöger

SML bit.Wise

Innovation around the product through digital business competence

With the launch of the new bitWise process data analytics and integration framework, SML has embraced the potential promised by the fourth industrial revolution and the digital transformation, moved beyond the hype and is delivering tangible customer value today.

The founding of a Digital Business Competence Center (DBCC) at SML underlines the company's commitment to supplement its innovative, high-performance extrusion lines with digital solutions and services, and thus answer the increasing demand of customers for data integration and data-driven product extensions.

The new bitWise platform provides concrete solutions and has already

enabled initial customers to integrate SML extrusion lines with custom MES and ERP applications. This not only increases end-to-end process visibility, but also allows our customers to apply for financial subsidies or tax benefits which are currently granted for Industry 4.0 solutions in a number of countries. Using flexible architecture and open standards such as OPC UA and REST-APIs these types of integration now can be implemented far more quickly, enabling specific national grant stipulations and individual integration needs to be met with minimal effort on the part of the customer.

PRODUCT TRACKING

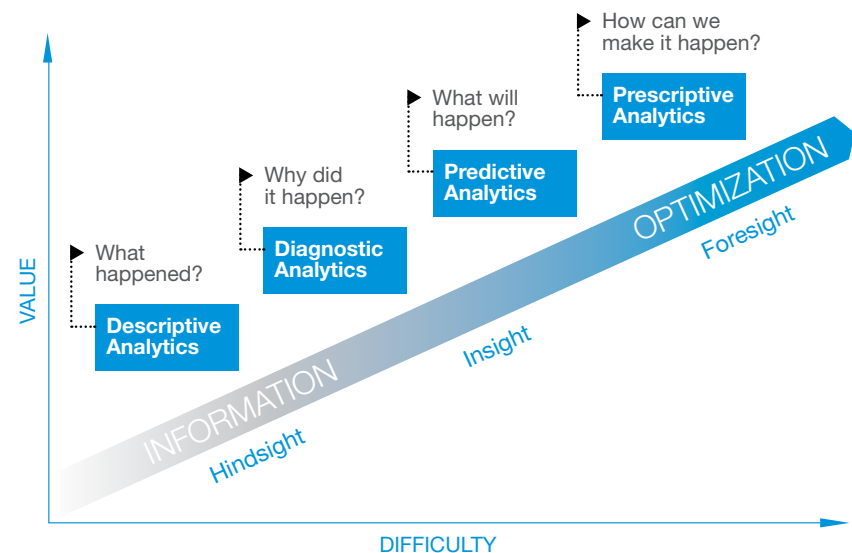
The end-to-end tracking of products is a common requirement in many industries. Accordingly, another key feature of

the new bitWise platform is the unique identification of every film and sheet roll produced, which creates an audit trail that links all production parameters and related data such as quality measurements.

The use of a cutting-edge, special purpose, time series database ensures outstanding performance and the highly efficient storage of ever-larger data volumes. This facilitates data-driven decisions based on vast amounts of data, which can even be gathered across numerous extrusion lines and plants. Moreover, a

modern, web-based user interface adapted to both desktops and mobile clients, allows easy remote access and places the right information at the user's fingertips in any location.

With bitWise at the core of its digital business strategy - maximising customer business value by combining the company's extensive process and engineering competence with advanced data analytics - SML has embarked on the exciting journey from hindsight, to insight and foresight.



SML MDO technology with inline adjustable gap geometry

During the past four years SML has delivered a range of new machine direction oriented (MDO) cast film lines with an inline adjustable stretching gap. The new MDO is employed for both hygiene films produced according to the cold stretch process and applications with PET, PA, PP and PE films manufactured using hot stretching.

BREATHABLE FILM LINES OPERATING WITH THE NEW MDO UNIT SHOW ENORMOUS OUTPUT INCREASES

SML offers cast film lines for LLDPE breathable films with a maximum roller width of 4m and a top production speed

of 500 m/min. Film weights range from 10 to 40 grams/m² and the introduction of the MDO unit with inline adjustable gap is the main factor in an enormous increase in output.

HIGH TENSILE PET ADHESIVE TAPE FILM PRODUCED USING THE NEW MDO UNIT

PET adhesive tape films can be manufactured with a thickness of 65 microns and a 2.5m film net width, which demonstrates the capability of the new MDO to handle enormous stretching forces. These films can be produced with an output of 1,000 kg/h at a stretching ratio of 1:4. The resultant adhesive tape

films possess good transparency and high gloss, which result from the high degree of orientation. This induces finely dispersed film crystallinity and a wavelength that permits light permeation.

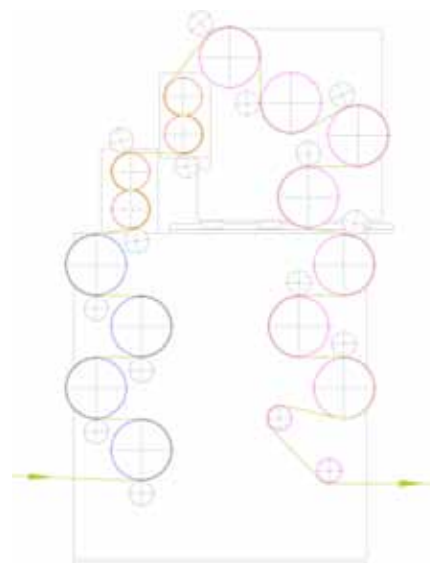
EIGHT ROLLERS FOR THE CENTRAL ORIENTATION MODULE WITH AN INLINE ADJUSTABLE GAP

Orientation is carried out between the holdback and pull units, whereby the

as a perfect hold point and a source of high stretching forces. In addition, the nip rollers 1 and 4 prevent the entrainment of air between the roller surface and the film, thus ensuring uniform heat transfer across the roller width and reduced necking of the film in the stretching gap. The design of the pull unit with one steel and one rubber stretching roller is identical to that of the holdback unit, but in a mirror image version. All the rollers are equipped with individual line drives.

ADVANTAGES OF AN INLINE ADJUSTABLE STRETCHING GAP

The impact of the film orientation on the crystalline structure of the film is determined by the actual stretching speed, which is an arithmetical number. This figure is calculated by dividing the stretching gap length with the residence time of the film. The shorter the stretching gap and the higher the line speed, the greater the actual stretching speed.



stretching gap is adjustable from 70mm to 350mm. Gap adjustment is effected smoothly and precisely by means of servo positioning drives. The holdback unit before the gap features a combination of one rubber and one steel stretching roller. Encasement around the two rollers amounts to almost 360 degrees and serves both

Orientation creates the crystallinity of the oriented film in an exothermic process. Heat is generated through the orientation triggered sliding of the crystalline lamellae. This promotes uniform film orientation, but the film will break if the critical limit of the stretching speed is exceeded. The best film properties can be obtained by means of a defined, optimum film stretching speed in the stretching gap. Various test runs in this field have proven that the required mechanical film properties (tenacity, elongation) and achievable film shrinkage values can be set at a slow line speed, which saves precious raw material. Subsequently, the line speed and output may be increased by simultaneously varying the gap length in order to maintain the established optimum stretching speed. The underlying principle involves the use of the optimum stretching speed determined for each application during all stages of production.

Extrusion lines – engineered to perform

SML machines produce separator films for Li-Ion Batteries

A lithium-ion battery cell consists of five main components formed by the casing, an anode, a cathode, electrolyte and a separator. Separator films are one of the most expensive and important parts of the battery and for roughly eight years, SML has been delivering extrusion lines for their production.

THE SEPARATOR – REQUIREMENTS AND APPLICATIONS

The separator is a key component in all Li-ion batteries, which are used in e-vehicles, plug-in hybrids, consumer electronics, stationary battery storage systems and power tools. It is located between the anode and cathode and separates them in order to control charging and discharging, and prevent internal short circuits. Therefore, the separator plays a key role with regard to battery performance, safety and reliability and has to meet very specific requirements:

- ▶ **Low weight**
- ▶ **High porosity for the excellent transmission of lithium ions**
- ▶ **Uniform pore distribution and size**
- ▶ **Good mechanical properties and chemical resistance**

A DRY SEPARATOR PRODUCTION PROCESS

Two different methods are available for separator production. On the one hand,

there is the wet process and on the other, the dry process for which SML delivers its extrusion lines.

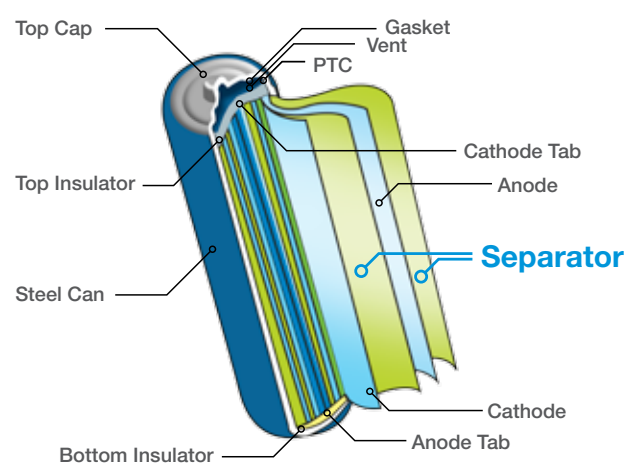
In the dry process, the melted polymer is first extruded as a uniaxially oriented film. The casting line consists of an extrusion unit with up to two extruders and a single or multi-manifold die. Upon leaving the die, the melt is stretched by a ratio of up to 1:100. For film annealing, the line is

equipped with a roll stack with as many as ten rolls and film thickness is controlled by an automatic regulation system. The final unit in the line is the winding station. The structure and orientation of the pre-film depends upon the processing conditions and the characteristics of the resin. In the course of the annealing process, the film is annealed at a temperature slightly lower than the polymer's softening temperature with the aim of improving its crystalline structure. During stretching, the annealed film is first deformed in the machine direction by a cold stretch, which creates the pore structure by stretching the film at a lower temperature with a faster strain rate. Hot stretching follows during

The separator is a key component in all Li-ion batteries



Roll stack of cast film line for separator film



Adhesion is what it is all about!

One of the most important factors in lamination or coating is the bonding between the extrusion layer and the substrate. As not every coating or laminating layer adheres to every substrate, SML has placed a special focus on this area and has researched into the possibilities for modification of both the substrate and the coating material in order to improve the bonding force, or even create adhesion where previously none existed.

SUBSTRATE-RELATED MEASURES

The most commonly used tool with regard to the substrate is corona treatment. In principle, this involves a high voltage discharge via an electrode onto the substrate surface. The applied energy changes the molecular structure of the surface and thus increases its wettability. Flame treatment is similar, but in this case passes with a gas burner activate the substrate surface.

For the coating of thick, bulky materials such as needle felt or products that can contain moisture from upstream production processes, e.g. woven fabrics, the incoming web can be preheated with hot rollers, hot air or infrared panels in order to both dissipate the moisture and improve the penetration of the coating layer into the substrate.

In the case of combinations such as PE-LD and PET film, which do not adhere chemically, a water-based anchor coating can be employed with a primer station and this method is frequently used for printed products in the flexible packaging industry.

IMPROVED BONDING WITH THE EXTRUDED COATING LAYER

Time in air gap (TIAG) is a well-known parameter in the extrusion coating field. It defines the period that elapses between the exit of the polymer from the flat die and



contact with the substrate surface. During this interval the melt can oxidise, which is important for the creation of bonding forces. At higher line speeds the melt has insufficient time to oxidise and therefore the die distance has to be adjusted by means of a vertical extruder carriage in order that the TIAG can be increased and the problem solved.

Another method of improving melt oxidation is to blow ozone onto the extruded melt curtain directly in front of the lamination nip. This is a very effective way of raising bond-

ing strength, but some customers are concerned about the use of ozone, which can be harmful to humans. Therefore, this solution requires an efficient extractor system.

Equally common is the use of coextrusion by means of feedback technology. In this

process, tie layers such as EAA or EMA create the missing link needed to bond two material types that are usually incompatible. Most tie layers are corrosive and therefore corrosion-resistant equipment is essential in order to prevent system damage.

SML is able to compare the various methods on its demonstration line, and together with its customers subsequently select the best possible solution for the achievement of market-conform bonding strength in the various extrusion coated and laminated products.

Multi-functional

Cast Film Line installed at ExxonMobil in Shanghai

Through joint efforts, ExxonMobil and SML have been working on developing a new concept for a multi-functional cast film line, which has now been successfully implemented in Shanghai. The extremely versatile line will be introduced to the market prior to Chinaplas in April 2018.

"This new machine at our Shanghai Technology Center (STC) is an important global asset for the development of advanced cast film formulations based on our broad portfolio of performance polymers," said Dirk Michiels, global polymer technology manager, ExxonMobil. "Moreover, we can test our materials under real production conditions at the same speeds as those used for customer lines."

A SINGLE MACHINE, MULTIPLE APPLICATIONS

The challenge facing SML was clear, as a single machine had to be capable of manufacturing products for all the relevant cast film applications such as: stretch wrap film, CPP films, breathable and embossed hygiene films, protective and elastic films, as well as mono-oriented films. Accordingly, the machine's 1,500mm roll width is designed for quick product changes, testing without an excessive use of raw materials, and the up scaling of test results to larger production lines.



THE MACHINE'S KEY SPECIFICATIONS ARE AS FOLLOWS:
▶ Five extruders in sizes from 60 to 90mm
▶ Gross output of up to 1,300 kg/h
▶ A 7-layer variable geometry feed block
▶ Mechanical line speed of 650 m/min
▶ Final net film width of 1,000mm

Most importantly, despite the complexity of the entire line, the machine is simple to operate and all relevant components are easy to access. Different web paths through the machine, combined with variable operation modes, allow efficient changes from one solution to another. Additionally, ancillary functions such as material pre-drying, corona treatment and melt embossing are incorporated to increase the line's product range.

A special feature is the machine direction orientation unit (MDO), which can be operated in-line for breathable hygiene, MOPP and in-line, pre-stretch films. An additional unwinding unit on top of the MDO provides off-line testing from roll to roll.

SML is very proud to have been selected to accompany ExxonMobil on its path into the future and to be represented in the Shanghai Technology Center with this multifunctional cast film line. "The ExxonMobil STC Open House during Chinaplas 2018 will provide a unique opportunity to present our latest cast film technology to the market," said Martin Kaltenecker, senior sales manager, SML.

Karat invests in three more SML Austrofil spinning lines



SML and the Ukrainian yarn and carpet producer Karat launched their successful partnership in 2012. Now, six years later, Karat is operating five SML machines at its plant in Ukraine and three more are to be delivered this year.

In recent years Karat has become a well-established yarn and carpet producer in the world market and therefore the company requires more capacity. Accordingly, three new SML Austrofil machines, consisting of two BCF and one FDY, will be installed in a new Karat production hall during the current year.

SML TECHNOLOGY FOR HIGH-QUALITY YARNS

SML's BCF technology enables the production of top quality yarns in a high-speed process. The yarns possess extremely high crimp, which is a major factor in achieving material savings. Accordingly, Karat's success in over 30 markets such as the USA, Japan, China, India, Europe, and the CIS countries demonstrates the fact that the products from SML lines are just what customers are seeking.

This year, the Ukrainian company has again shown its faith in SML's spinning technology and is investing in its first Austrofil FDY line. Small wonder, if one considers the fact that with this technology, SML has led the way in the high-tenacity polypropylene yarn segment for more than twenty years.

Addresses

SML - Head Office
 Bundesstrasse 1a
 A-4860 Lenzing, Austria
 Phone: +43-7672-912-0
 E-mail: sml@sml.at
 www.sml.at

SML - Machinery Far East Sdn Bhd
 (1029958-P)
 1201 Block B, Menara Amcorp
 No.18 Jalan Persiaran Barat
 46050 Petaling Jaya
 Selangor, Malaysia
 Phone: +60-3-7955-9098
 E-mail: yen@sml.at

SML - Moscow Office
 Ogorodny proezd, 5
 Building 6, office 504
 127254 Moscow, Russia
 Phone: +7-495-618-8007
 E-mail: kna@sml.at

SML - Beijing Office
 Unit 1410, Landmark Tower
 No. 8 North Dongsanhuan Road
 Chaoyang District
 100004 Beijing, P.R. of China
 Phone: +86-10-6590-0946
 E-mail: sml@sml.bj.cn

SML - North America Service Inc.
 Suite 204
 85 Eastern Avenue
 Gloucester MA 01930
 USA
 Phone: +1-978-281-0560
 E-mail: jom@sml.at

SML's new headquarters are under way!

SML started the construction of completely new buildings to move the whole company to Redlham, Upper Austria.



During the past 22 years, the demand for SML machinery has grown steadily and company CEO, Karl Stöger, explains:

"The infrastructure of our current facility does not match our anticipated further expansion and therefore we have decided to create a base for future enlargement and technological progress through the building of a new headquarters in Redlham."

Events 2018

Event	Location	Booth No.	Date
CHINAPLAS	Shanghai, China	2C59	April, 24 - 27
NPE	Orlando, USA	W6185	May, 7 - 11
EXPO PLAST PERU	Lima, Peru	100	May, 23 - 26
PLAST MILAN	Milano, Italy	Hall 15/C71	May, 29 - June 1
ICE SOUTH EAST ASIA	Bangkok, Thailand	450	September, 5 - 7
PLASTICS & RUBBER INDONESIA	Jakarta, Indonesia	B-5517	November, 14 - 17