



# TECHNOLOGY report

# SML

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## PET sheet extrusion - Where is it going to ?

Over the years, PET or polyester, has become one of the packaging industry's most successful polymers and SML has profited greatly from investments in sheet extrusion lines. All in all, the company has completed 85 installations in this field and has thus gradually strengthened its leading position with regard to both its technology portfolio and market share. Clear proof of SML's specialist competence and experience is provided by the sale of 32 lines in the past three years, seven extrusion concepts for both flakes and pellets, and five different winding solutions.

As a supplier of turnkey extrusion lines, SML is committed to the realisation of designs that incorporate the best technology available for the planned application and thus secure maximum customer satisfaction.

### Future trends and SML solutions.

The demands made on equipment performance are rising steadily and a typical benchmark is provided by the relative output per 1m of sheet width. At present, SML lines can handle 1,400 kg/h per metre (i.e. 2,100kg/h per 1,500mm of sheet width). In order

to achieve this output, the shell thickness of the cooling rolls has been optimised, the maximum diameter of the cooling rolls increased (can now exceed 700mm), and the internal water flow rate improved.

Moreover, SML can meet top extrusion performance requirements by means of an innovative roll stack. Nip force, drive power and water capacity is available for the handling of an output of up to 3,500kg/h per 2,500mm of sheet width. However, as high-capacity lines are faster and wider than their conventional counterparts and multiple webs need to be managed, this poses a major winding technology challenge.

Some customers prefer to wind multiple webs onto one winding shaft and therefore, apart from higher line speeds, they are looking for enhanced winding quality approaching slitter rewinder

performance. Short rolls demand automatic reel handling with minimum cycle times and thus where necessary, SML's automatic winders 1100 and 2000 employ friction winding shafts and portal robots.

A further general trend is towards the increased use of recycled material. The enormous consumption of PET bottles having resulted in the emergence of a significant market for secondary bottle flakes. Today, most sheet producers



PET roll

EDITORIAL |



**Karl STÖGER, Managing Director**

Dear Reader,

a common question when meeting customers and suppliers is to ask about how ones business is going. Is the industry out of the woods yet? In recent months, my answer has been a spontaneous "yes". Business is on the increase. Of course we expect to face up with new challenges all the time but the overall economic situation has been improving steadily over the past six months. The world keeps turning and people keep improving their living standards. The worldwide use of plastics is growing again. It has actually surpassed the consumption of steel. No wonder, because plastics come in many different specifications with a variety of properties and can be shaped for a sheer endless selection of applications.

Supplying extrusion lines for thermo-plastics is SML's profession. We are well acquainted with a wide range of polymers. In this edition of the techno-

logy report we dedicate a lead article to Polyester (PET) and ask where the PET sheet extrusion is going to. We come across seven different extrusion concepts available for PET, each one has its own justification, but which one will prevail in the future?

Two very common polymers are polyethylene (PE) and polypropylene (PP). These straightforward and uncomplicated polymers are used a lot in extrusion of film and sheet. But with specially designed extrusion lines and a subsequent stretching apparatus it is possible to produce a real value added product out of these standard polyolefines. One square meter of battery separator films for lithium-ion batteries costs approximately 1.20 EURO. This year SML will supply several extrusion lines for this product. Learn more about it in the article on page 3.

Hope you enjoy reading!

Yours sincerely



Calendering unit

cannot afford to use only virgin raw materials. As a consequence of the fierce competition among processors, the entire industry is recycling maximum amounts of in-house scrap and using washed, post-consumer bottle flakes from external sources. Indeed, these facts now play a major role in the design of PET extrusion machinery.

The production of good quality PET sheet is dependent upon material humidifying, which is vital to the retention of a suitable IV-value. Residual moisture leads to hydrolytic degradation and a loss in viscosity, which in turn creates insufficient melt stability. Low viscosity material is either difficult or impossible to run in the calendar and it should be noted that thick films require

a higher IV than thin ones. The conventional method of dry air pre-drying is still state of the art for premium products, but lacks the flexibility to handle all forms of PET in any desired percentage. Therefore, alternative methods of drying and plasticising have been developed.

Today, vacuum reactors that can also cover the crystallisation process are in increasing use and have recently been supplemented by IR-dryers (infrared). Moreover, in some cases, extruders are being utilised without a pre-drying phase, which is possible due to the employment of co-rotating twin screws with several venting zones. However, as none of these technologies is able to match the quality of a conventional pre-dryer, combinations of various systems are frequently to be found, while existing machines are often upgraded in order to improve production flexibility and product quality.

In such situations, some kind of pre-drying is recommended, particularly where washed flakes with a high moisture content are involved, as this provides fail-safe and simple production. In addition, pre-drying



Winder 1100

reduces the problems that can arise from the use of inexpensive feedstock of inconsistent quality.

Another trend is the use of post-consumer material for food packaging. New EFSA regulations cover such applications (in Europe, other countries also use FDA) and thus secure public health.

Decontaminated materials are available, but some processors are looking for greater flexibility. However, avoiding the purchase of decontaminated feedstock involves passing stringent tests and obtaining approval for the extrusion equipment, which is a difficult and expensive

business. New decontamination systems with differing technologies are available on the market, but are still in their infancy. Nonetheless, it would already appear that vacuum systems used upstream of the extrusion phase are more successful than vented extruders alone.

SML's technical experts are committed to designing systems that will offer constant customer satisfaction and the company's long list of successful references demonstrates its ability to eliminate hazards and deal with even the most technologically demanding projects.

**Berthold DRÖGE, Technical Director**

## New generation: Shaftless winder model 3000

# Advancement through Ideas!



SML's most innovative winder in 4 station design (simple in mechanism and easy to operate)

SML's winder 3000 has a good reputation as an inline-slitter for the production of stretch film rolls on 2inch and 3inch cores. The unique innovation: The individual winding cores are supported

by a pair of arms each. Thus no winding shaft is needed and critical shaft speed is no issue. Our winding principle has set new standards in functionality and winding quality. The model 3000 winder

has been sold many times in the last 4 years.

SML's most innovative winder now moves to the next generation. We have improved the design fundamentally. The number of winding stations was increased from 2 to 4 stations. Thus the indexing of the turret at roll change is reduced from 180 to 90 degrees. Moreover cycle time with 4 winding stations can be reduced from 30 to 20 seconds, because the unloading of bobbins and the loading of new cores can be done simultaneously.

All electrical drives and electrically operated solenoid valves have been moved from the indexing turret to the winder's basic unit. The rotary commutator joint is not necessary any more. The mechanical design of the turret thus is extremely simple and easy to service. There remain only pneumatical control conduits for the opening and closing of the winding arms, which are supplied by a multiple rotary air feeding

joint in the axis of the turret. By this improvement of design also the adjustment of the winding arms for different bobbin width has been facilitated very much.

### The new design additionally scores in the following categories:

- **Increase in efficiency:** 4 station design enables extremely short rolls with only 20 seconds cycle time.
- **Improved bobbin quality:** Maintaining good winding quality during indexing due to special auxiliary contact roller and shorter angle of indexing due to 4 station design (180->90 degree).
- **Cost saving:** Reduction of minimum core wall thickness to 3,0mm possible.
- **Innovation:** optional solution for core-less winding available.

Upon appointment the new winder W3000 can be demonstrated on our in-house stretch film line. We are looking forward to your visit.

**Robert PREUNER, Head of R&D Department**

# Battery separator films

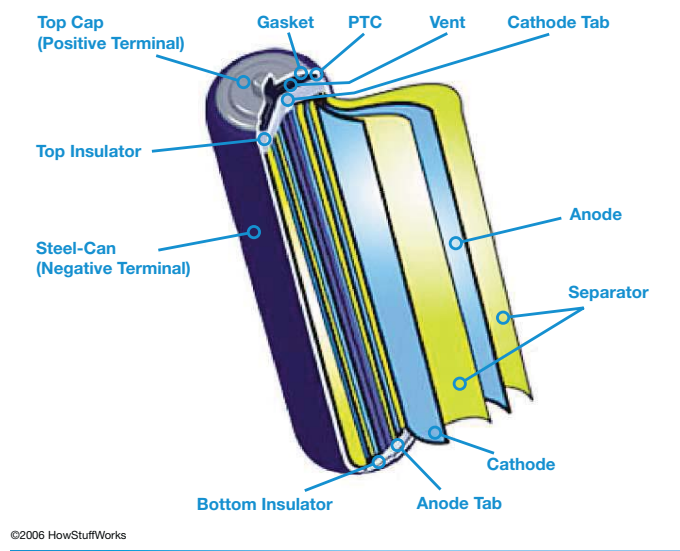
In the coming three months, SML is to deliver several cast film lines for the manufacture of battery separator films, which are used in lithium-ion batteries. The lines in question produce PP and PE films. The battery separator film represents the component installed in a battery for the physical separation and electrical insulation of the anode and cathode. For acid electrolytes, a porous PP or PE film is employed, while PP/PE nonwovens are used for alkaline systems. The separator film is a high-quality component and accounts for some 20% of the overall costs of a battery.

## What requirements must a battery separator film fulfil?

- Chemical and electrochemical stability with regard to electrolytes and electrode materials
- Physical stability in the face of the mechanical loads incurred during battery assembly
- Sufficient porosity to guarantee electron exchange
- A perfect balance between small film thicknesses and optimum mechanical capabilities
- Ideal wetting characteristics for the complete filling of the battery with electrolyte

Should the temperature of the battery rise to above 130°C, it shuts down au-

## Cylindrical lithium-ion battery



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tomatically, as the film begins to shrink and the pores close, thus making ion exchange no longer possible. This is also the advantage of a laminate using PE film, which in the case of overheating melts at an earlier point in time and thus stops the ion exchange between the anode and cathode more quickly,

thereby preventing excessive overheating of the battery. As a rule, the films integrated into the battery have a thickness of 16 – 25µm, however the objective is the use of even thinner films (down to 8µm). As compared to PP films, PE films and laminates (PP/PE/PP) are utilised to a lesser degree.

## Extruded film production

The film is formed by means of a flat die and then subsequently cooled, stabilised and wound on the line. Stretching of the film at the die outlet produces longitudinal lamellas, which are required for the formation of micropores. These are created by further stretching, which also enhances the tensile strength of the film. The pores are slotted, have dimensions of less than 0.1µm and porosity of approximately 40%.

## Applications

Separator films are used mainly in lithium-ion batteries:

- 1) PP-based films are utilised where high-performance is required, as in laptop batteries and the automotive industry
- 2) PE-based films are employed primarily in batteries for mobile phones, MP3 players and hands-free phone sets, etc.

Lithium-ion batteries occupy a leading position with regard to energy density and at the same time constitute a highly efficient power storage unit. Hence the fact, that in future, the market for these products will continue to expand strongly.

Alexander BRUCKMÜLLER, Product Manager, Cast Film Extrusion & MDO

## Basic sheet winding: SML's new cantilever winder model 600

Our winder design team had to fulfil an unusual task, to design a very basic, simple and cost-effective cantilever type winder for sheet. Make it just what the customer needs, easy to operate, economical, modular, CE safe and – a.s.a.p! Not an easy job for designers who are used to develop high tech winders like our models 2000 and 3000. But they did it well, and here is the outcome: A low-priced winder designed and built in Europe meeting the highest quality and safety standards!

The winding shafts are supported single sided, like the name 'cantilever' implies. Sensitive tension control through elec-

trical drives have been chosen, since the maximum winding diameter is less compared to A-frame winders. For wide sheet lines with multiple webs, several winders are arranged in staggered formation.

We have integrated bayonet nut connector couplings to the winding shafts, thus allowing a quick exchange between 3inch, 6inch and 8inch shafts.

By nature, the winder 600 is a manual operated one. An accumulator is installed upstream. Since the winding shaft is fixed to the winder, it does not need to be handled by the operator during roll



change. The finished roll is taken out of the winder using a hand lift truck. Like on our winder 500, the cut is performed automatically and the web lay on to the new prepared core is done manually. This winder is equipped with the well-proven PP420 display, which sends all settings to our SMILE control system,

where they are stored with the general recipe.

Technical data	
Sheet width	up to 1400mm
Line Speed	up to 70m/min
Roll diameter	up to 1000mm

Berthold DRÖGE, Technical Director

# SML celebrates its 15<sup>th</sup> anniversary

In June 1995 the family owned company Starlinger & Co GmbH acquired the plastics machinery division of Lenzing AG and established SML Maschinen GmbH.

Fifteen years later, the firm SML has developed into a leading global player for engineering and manufacturing hi-tech extrusion machinery. The Starlinger group consists of several key companies across Europe that are specialised in making equipment for the plastics, rubber and textile industries as well as components for machinery. Being owned by someone who understands

the business of machine building has been a big benefit for SML. In the entire Starlinger group, the emphasis is on

sustainable development and strong partnerships with customers. Though we are commercially successful, short



term profits are of lesser importance. Our owners look ahead and pay attention to the medium and long term goals of their companies. SML has always been fitted with an ample budget for research and development to reach its primary goal, which is attaining technological leadership in our defined fields of extrusion.

On this occasion, we shall also thank our many customers around the world. You have trusted us and gave us the business we needed to grow. The hundreds of contracts you have awarded us were the basis of hundreds of successful plants installed all over the world. Because of all these projects that we realised together, SML can celebrate a wonderful 15th anniversary this year.

**Thank you so much!**  
Karl Stöger, Managing Director

## SML captures the South American BCF market

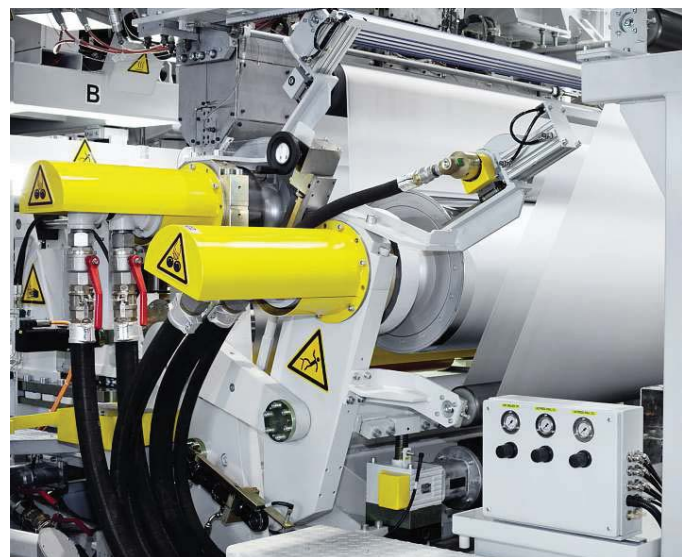
Another Austrofil BCF spinning line for tricolor yarn has been sold to a South American carpet producer. The main reasons for the customer to acquire a further SML Tricolor line were the significant savings in raw material. Due to the high bulk, the yarn count (titer) can be reduced and therefore less raw material is needed for a comparable carpet quality.

## First SML photovoltaic film line has been delivered ...

SML lived up to customer's expectations and designed in close cooperation with the client an extrusion line dedicated to the production of EVA-encapsulant film for the photovoltaic industry.

The line is delivered to NovoPolymers NV, which is an innovation driven Belgium company with a strong focus on the development and production of environmentally sound sheets and films for primarily the solar panel industry.

"We are happy and proud to announce an annual capacity increase up to 3000 tons of encapsulant sheet capacity, equivalent to 500 MegaWattpeak (MWp) of Photovoltaic Modules by the purchase of the SML line", says Johan Declerck. (Director of Novopolymers).



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### EVENTS 2010

EVENT	LOCATION	BOOTH NUMBER	DATE
CHINAPLAS	Shanghai, China	Hall W1, booth C51	April, 19 - 22
PLAST ALGER	Algier	T.15	May, 3 - 5
ITMA ASIA & CITME	Shanghai, China	Hall W2, booth B05	June, 22 - 26
K 2010	Düsseldorf, Germany	H16, B47	Oct., 27 - Nov., 3

### IMPRESSUM

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