

# Leistritz

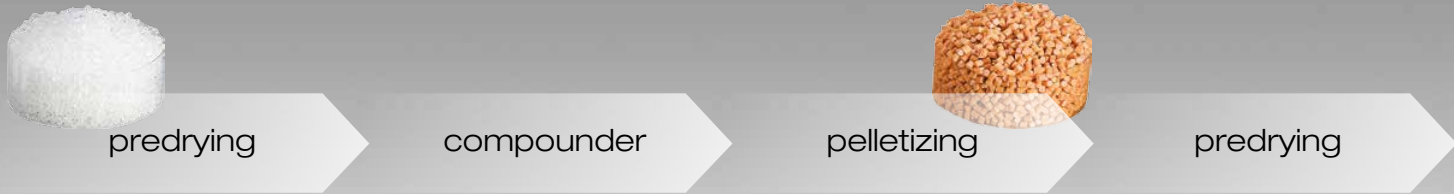
LEISTRITZ EXTRUSIONSTECHNIK GMBH

refreshing  
extrusion  
technology

■ FILM EXTRUSION



## Example of a standard compounding process (multi-stage) → raw material → film



## Direct extrusion (single-stage): raw material → film

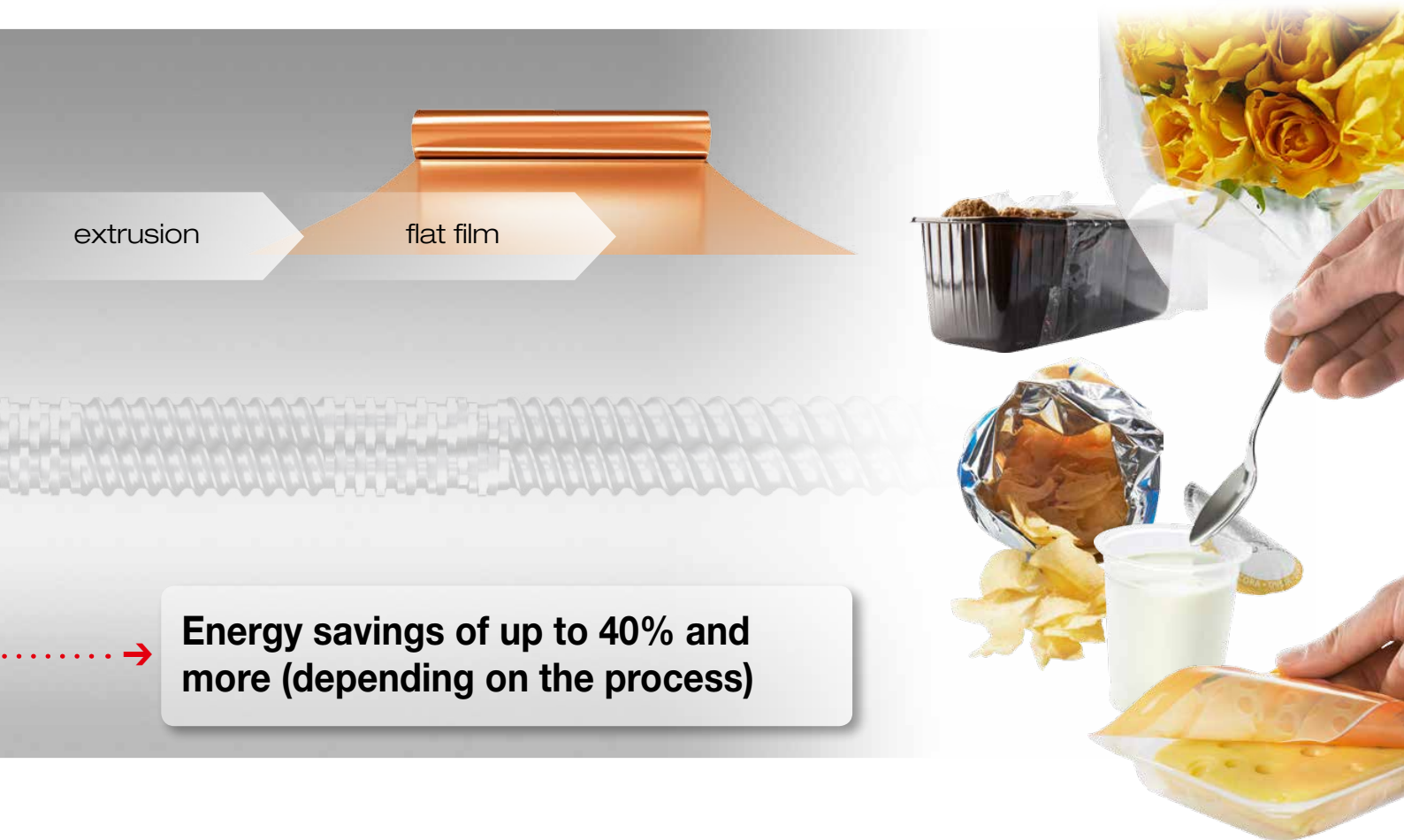


## Twin Screw Extruders in a Direct Extrusion Process

Direct extrusion or inline-compounding facilitates the production of extruded parts in a very economical way by merging various process steps. The stage after the compounding step is shaping. Here the extrudate is processed to semi-finished products. Typical examples for this procedure is the production of sheets made of wood flour/PP, acoustic and insulation films with BaSO<sub>4</sub> or the processing of undried PET, PP, PS to flat or biaxially oriented films.

### Advantages of direct extrusion

- More gentle material processing: the polymer is only exposed to one heating and shearing step
- More economical production: complete process steps are eliminated (e.g. pelletizing and melting) → higher added value, material and energy cost savings
- Cost benefits through direct incorporation of raw material: Virgin polymers, powder, flakes... are fed instead of pre-compounded pellets
- Formulation can be exchanged and adjusted more flexibly
- High throughput with minimum space requirements



**Energy savings of up to 40% and more (depending on the process)**

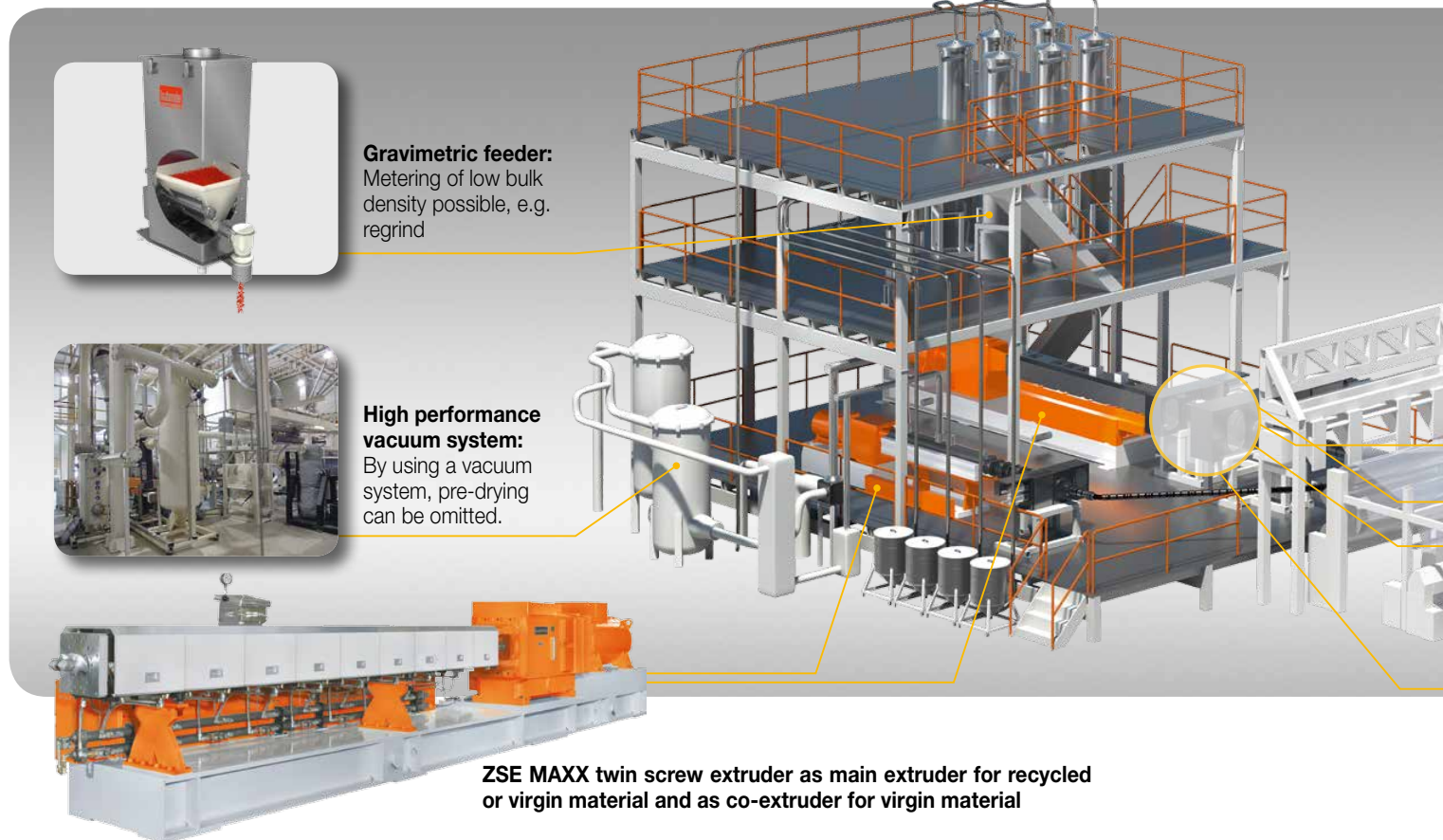
## Advantages of twin screw extruders in comparison to single screw extruders

- Reduced polymer degradation leads to improvement of product quality (clarity, firmness)
- The filling degree can be determined by setting the throughput and torque parameters independently → additional degree of freedom
- Self-cleaning effect of twin screws make formulation changes more convenient
- Better incorporation of formulation components with different bulk densities and physical properties (e.g. liquids, oils, powders, pellets, flakes...)
- Trouble-free processing of film shreds and ground production waste, edge trimmings of up to 100%
- Processing of film waste that is coated with a non-stick or heat-sealable layer
- Better degassing performance
- Better temperature adjustment: Each barrel temperature can be controlled separately
- Multipurpose screw geometry – processing of various materials with only one screw geometry in a wide process window

# Calender Film

In the first production step for calender films the pellets are melted in the extruder. Afterwards a film die directs the melt onto a calender stack. This procedure facilitates a high production speed and high film transparency. Polymers which can be processed this way are PET, PP, PE, PS, PC, ABS, PMMA and PLA. Film thicknesses from 150 µm are possible.

## Example of a PET film extrusion line with main components in the extrusion process



## PET Film

PET calender films are used in the packaging industry as well as for technical applications. PET is a semi-crystalline material: Depending on its type and processing conditions it is mainly amorphous and therefore transparent (A-PET) or mainly crystalline and opaque (C-PET). The film thicknesses for thermoforming applications range from approx. 150 µm to max. 1.2 mm. In contrast to working with a single screw, the raw material does not have to be pre-dried when using twin screws. In order to prevent hydrolytic degradation a special vacuum technology is applied. The compounder saves the complete energy consuming predrying step.

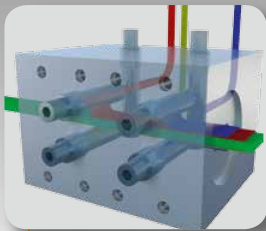
Oftentimes this kind of film is produced as a composite, using recycled material for the middle layer. This results in a further advantage of the twin screw: easy processing of e.g. PE-contaminated PET (by glue, labels...).

## Processing advantages when producing PET calender film

- High level of flexibility: both recycled materials and blends can be processed
- Low IV degradation due to special vacuum technology

Energy savings of up to 40% and more by eliminating whole process steps

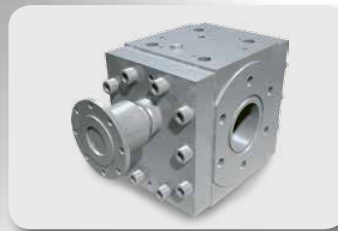
Extrusion process combinable with various downstream equipment (downstream provided by customer)



**Feed block:**  
For providing the composite structure



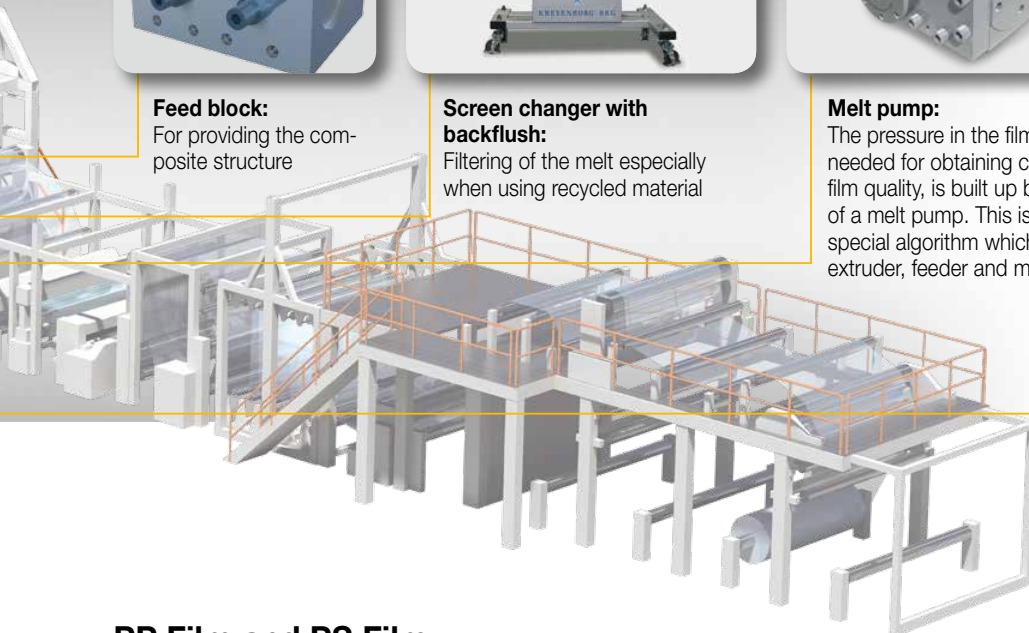
**Screen changer with backflush:**  
Filtering of the melt especially when using recycled material



**Melt pump:**  
The pressure in the film die, needed for obtaining constant film quality, is built up by means of a melt pump. This is done by a special algorithm which controls extruder, feeder and melt pump.



**Film die**



## PP Film and PS Film

Compared to PE films, PP films have a higher transparency, better stiffness and abrasion resistance. They are more resistant against oils and greases and have an increased temperature stability. PP calender films usually have thicknesses ranging from 200 to 2,000  $\mu\text{m}$ .

If PS film is produced with standard PS, the result will be a crystal clear, brittle and very stiff film. Its properties can – depending on their application area – be optimally adjusted by means of modification with e.g. impact resistors. PS films have a very good formability when exposed to heat. Therefore, they are mainly used as packaging material.

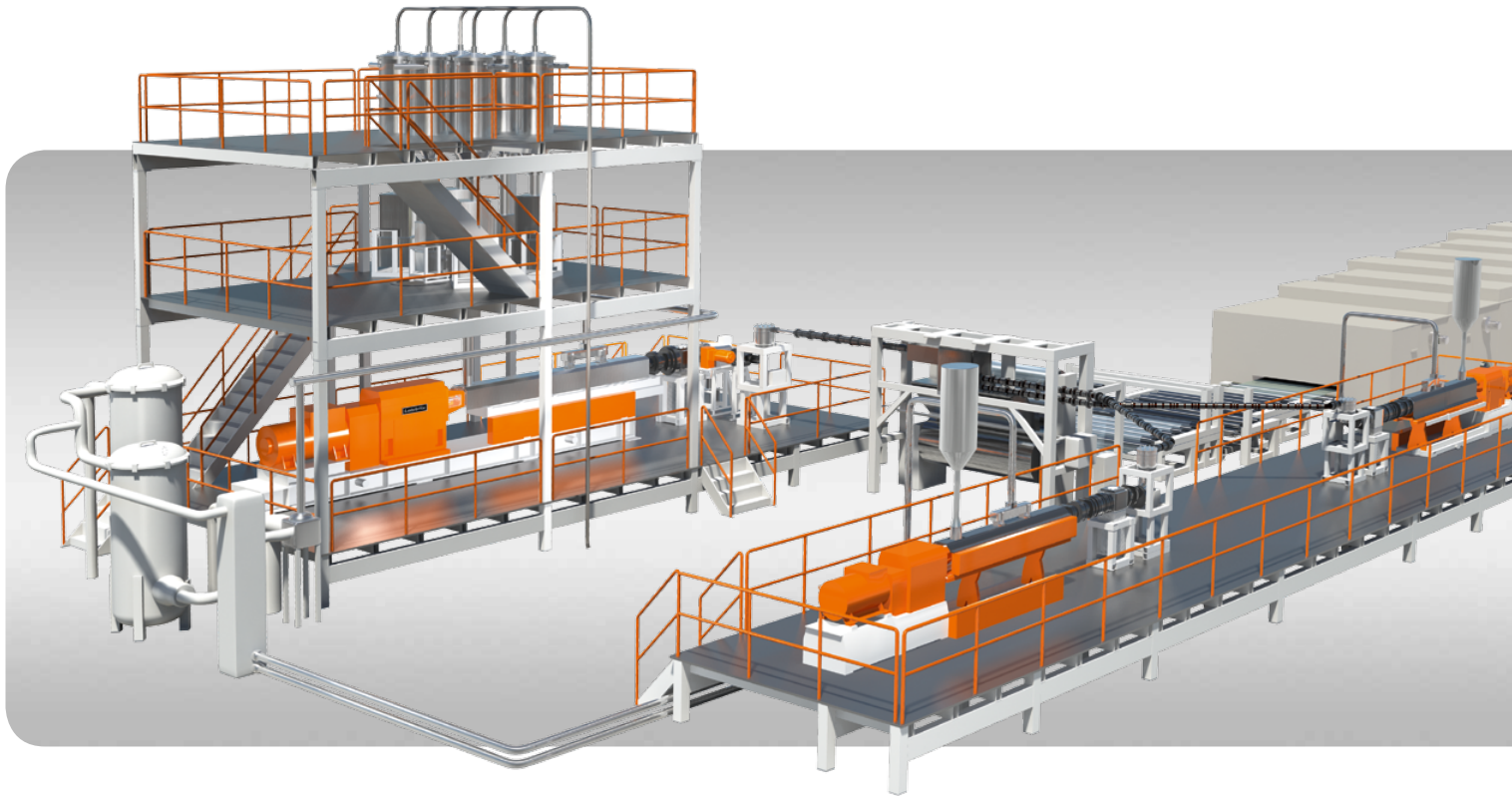
In combination with fillers and further additives like  $\text{CaCO}_3$  or  $\text{TiO}_2$ , PP and PS can be processed in a direct extrusion process.

## Some application areas are:

- Food packaging, e.g. yoghurt cups, drinking cups, disposable plates

# Biaxially Oriented Film

This kind of film is produced on a chill roll unit and directly biaxially oriented. This means the film is stretched in longitudinal and transverse direction. Thereby, its properties (firmness, barrier function, transparency) can exactly be determined. After extrusion, the melt is cooled down quickly in order to gain fine crystalline polymer. In the next step it undergoes a stretching process in which the crystallinity of the film is significantly increased. Further crystallization and fixing of the film structure is achieved by re-heating.



## BOPET

The process described above develops excellent mechanical properties of the so-called BOPET films (biaxially oriented). The optical properties are good. Oriented polyester films are tear-resistant, shock-proof, abrasion-proof and highly ductile. They have exceptional thermal properties with regards to cold strength and heat resistance (approx.  $-70\text{ }^{\circ}\text{C}$  to  $+150\text{ }^{\circ}\text{C}$ ) – also for long-term use. Usually, those films are multi-layered.

### Some application areas are:

- Aroma-tight food packaging
- Capacitors
- Aluminised films, e.g. for crisp bags or as thermal insulation material such as in survival blankets or tents

### Advantages of using a twin screw extruder

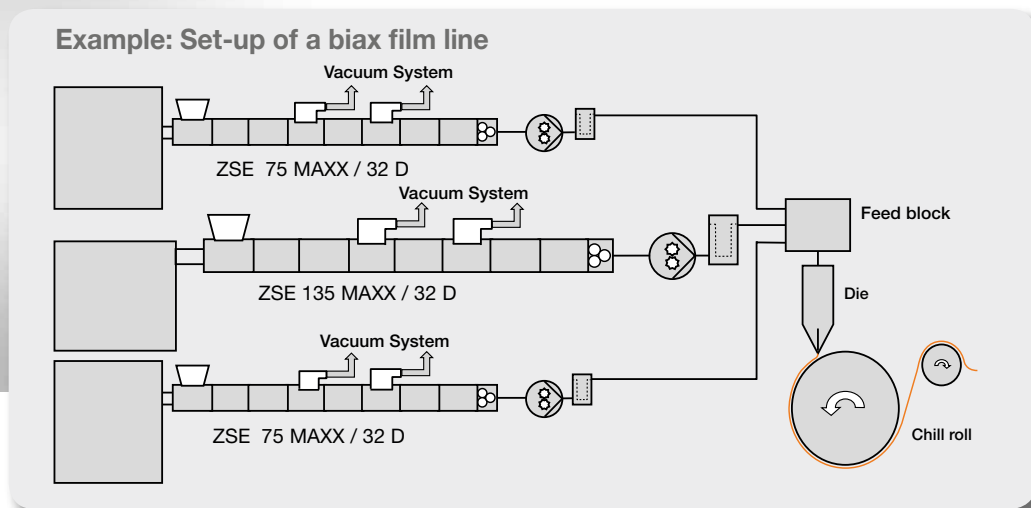
- Omission of the predrying step
- Energy saving
- Outstandingly homogenous melt
- Well-directed and homogenous incorporation of product specific additives

## BOPA

Just like PET polyamide is hygroscopic. This special characteristic has to be considered when producing PA film. Leistritz allows for this by using a vacuum system. The advantage is that the whole predrying step is omitted. The importance of PA film for packaging purposes is based on its high strength, heat resistance and sterilising capability. In addition, it has very good barrier properties against gases, especially oxygen and flavouring agents. In combination with e.g. PE, PA films are used in flexible multi-layer films. The PA layer serves as a gas and aroma barrier and gives the composite increased mechanical strength.

### Some application areas are:

- Vacuum packaging of food, like meat, sausages, cheese
- Non-food segment



## BOPP

BOPP films take up 90% of polypropylene film production. By means of biaxial stretching, mechanical properties like tensile strength and puncturability are greatly improved.

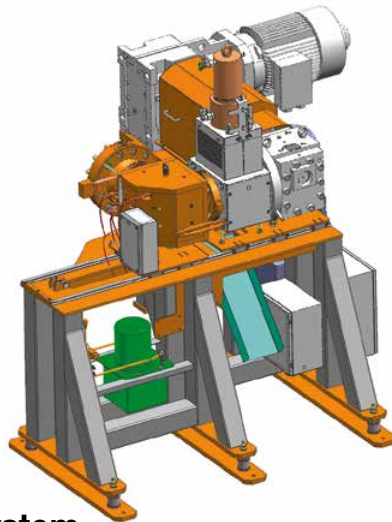
PP films are not heat-sealable without further processing. This is done by co-extrusion. Co-polymers made of ethylene and a high amount of propylene or of vinyl acetate, ethylene and propylene serve as sealing layers.

### Some application areas are:

- Food packaging, e.g. of bakery products or confectionery, snack or potato products, pasta or dried fruit
- Packaging of stationery, textiles, cosmetic and medical products
- Adhesive tapes
- Capacitors

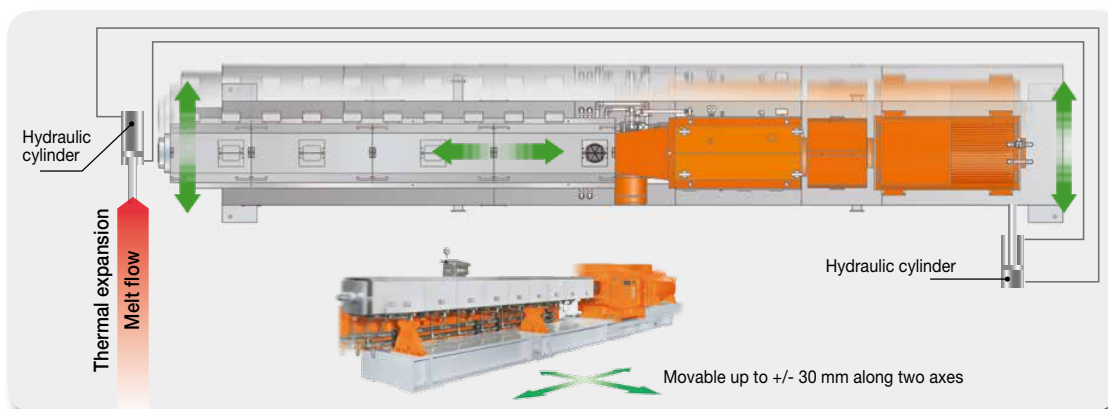
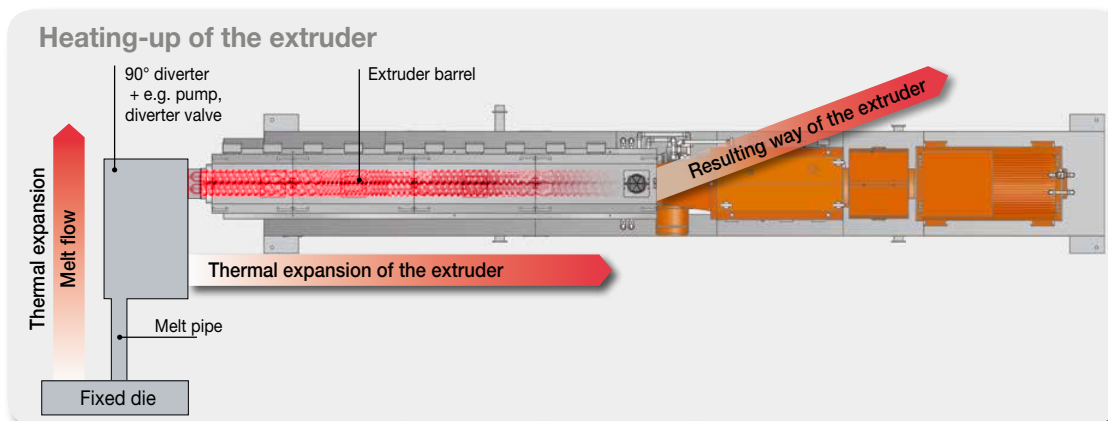
## 90° Diverter on a Frame

The 90° diverter can be installed subsequent to the material discharge adapter. As the name implies, it serves for diverting the discharging melt. This facilitates a flexible assembly of the plant. Additional advantages are that it allows for direct access to the chill roll and that the screws can easily be extracted.



## Longitudinal Compensation System

The longitudinal compensation system serves to prevent mechanical tension resulting from thermal expansion. It absorbs the thermal expansion of the processing unit as well as the downstream equipment up to the fixed point. The extruder is moved in the resulting direction via hydraulic cylinders. It can be moved up to +/- 30 mm along two axes. The special thing about this hydraulic solution is that it does not need any additional energy. Due to its two closed piping, this system does not require any maintenance.

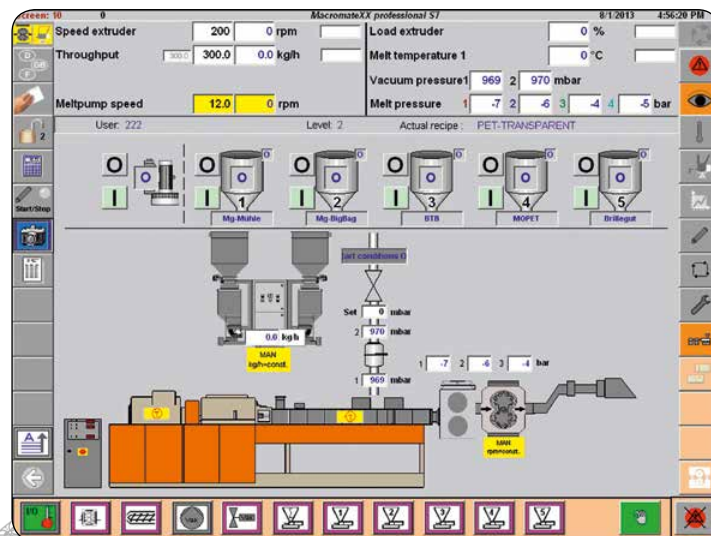




## Control Unit

Economic and optimum interaction of material feeding, extruder and downstream equipment distinguishes the Leistritz controls from others. With the data gathered and entered at the HMI (human machine interface) the whole extrusion process can be monitored, controlled, documented and analysed.

Depending on machine and customer requirements, the control system MacromateXX professional S7 (made of Siemens hardware) is individually programmed by Leistritz.

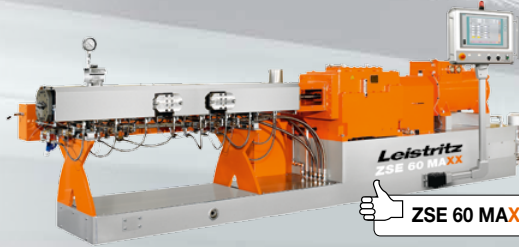


The screens of the control panel are pre-configured according to the layout of the actual extrusion line. Only the relevant parts of the extrusion line are displayed. The exact control of all involved components is essential, especially for direct extrusion of films, sheets and profiles. Parameters dependent on the automatic start-up procedure and production mode, like feeding throughput, extruder speed and melt pump speed, are controlled and determined here. The aim is to achieve a constant pressure and throughput at the discharge die. Leistritz attaches great importance to easy plant handling and has a comprehensive visualization concept for each plant component.

# ZSE MAXX Series for Film Application



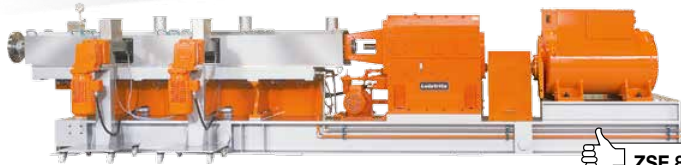
 ZSE 50 MAXX



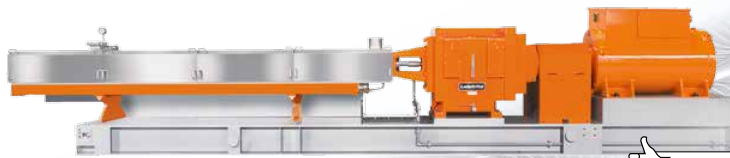
 ZSE 60 MAXX



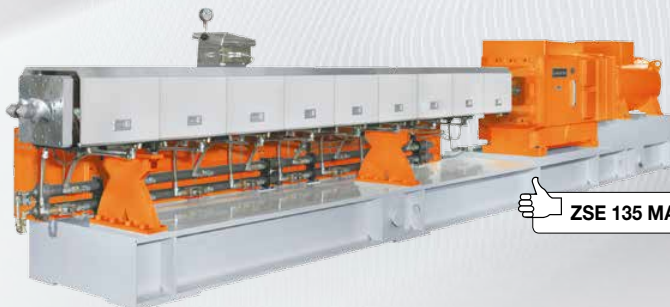
 ZSE 75 MAXX



 ZSE 87 MAXX



 ZSE 110 MAXX



 ZSE 135 MAXX



 ZSE 160 MAXX

PP

GPET

PS

# ZSE MAXX Series for Film Application



**ZSE 40 MAXX**

APET

CPET

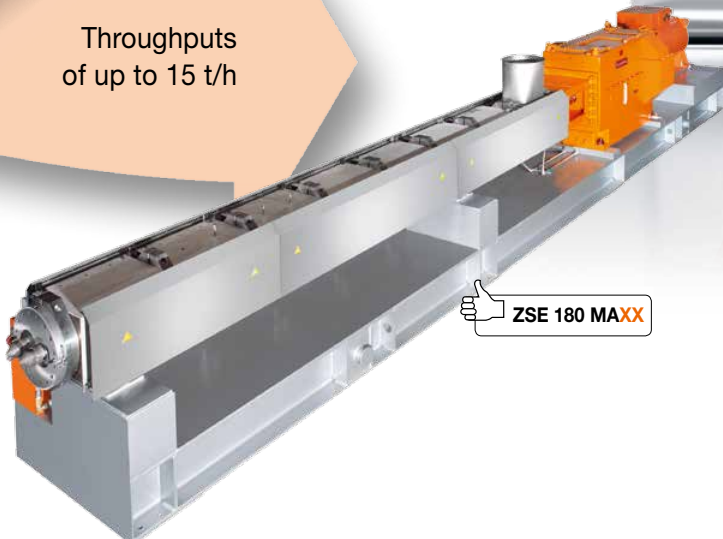
BOPET

BOPA

BOPP

ZSE MAXX	Torque (in Nm)	Screw diameter (in mm)
40	1,128	41.4
50	2,144	51.0
60	3,750	61.6
75	7,324	77.0
87	11,432	89.4
110	22,982	113.1
135	42,148	138.7
160	64,400	158.9
180	91,460	178.8

Throughputs of up to 15 t/h



**ZSE 180 MAXX**

# Leistritz

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