

Coating technologies and coating line concepts for the production of adhesive products

Andrea Glawe

KROENERT GmbH & Co KG



Agenda

- **Experience of KROENERT**
- **Coating methods and applications**
 - **Self-metered technologies**
 - **Pre-metered technologies**
- **Design of a coating line**
- **Summary**

The KROENERT group

- ❖ Foundation 1903
- ❖ Privately owned
- ❖ Approx. 220 employees
+ 15 apprentices
- ❖ KROENERT
 - Research + Development
 - Tests in Technology Centre
 - Sales
 - Engineering + design
 - Production + installation
 - Erection + commissioning
 - Service + spare parts
- ❖ Bachofen+ Meier (BMB)
 - Sales + service
- ❖ DRYTEC
 - System supplier of thermal drying,
UV/IR curing and remoisturising
solutions
- ❖ Number of supplied machines about 35
per year
- ❖ Annual turnover about 70 Million EUR



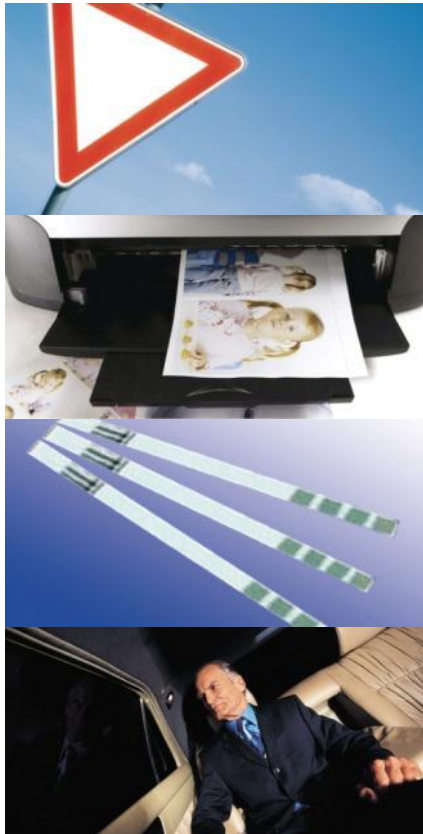
Experience of KROENERT

Experience in the company group

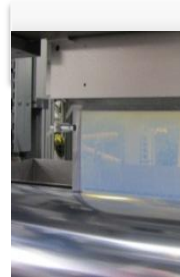
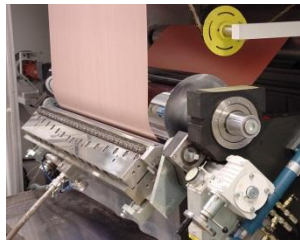
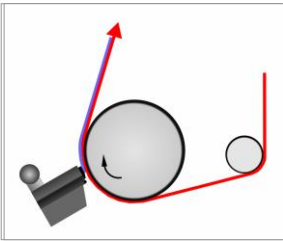
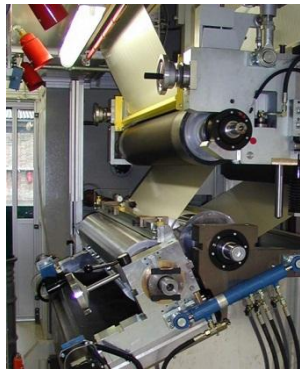
- ❖ Machines for roll to roll processing of paper, films, metal foils and laminates
- ❖ Application of coating media
 - diluted in water/solvents
 - 100% solid compounds
 - waxes, paraffin's, hotmelts
- ❖ Coating media, e.g.
 - lacquers
 - adhesives
 - silicones
 - PVdC
 - resins
 - polymers
 - pigments



Application for coating and printing processes



Requirements for precise coating and printing



Which coating and printing technique is suitable???

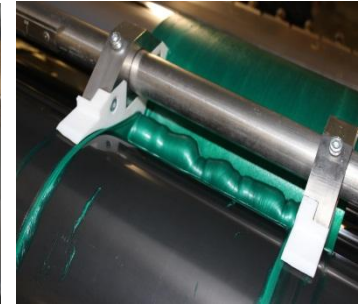
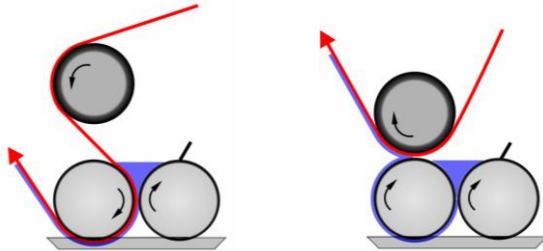


High performance of the coating necessary:

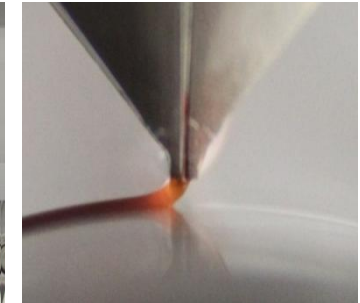
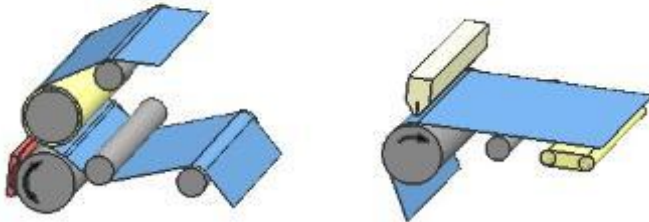
- Coating absent of defects
- Cross-Web Distribution less than +/-1%
- Wet thickness less than 1 μm – dry less than 100 nm
- Coating thickness must remain constant over 24h of production
- Printing texture with highest resolution

Overview about coating technologies

Self-Metered Coating Techniques



Pre-Metered Coating Techniques



- ⇒ **Self-Metered-Coating** means that the applied **coating weight depends** on the **process** => e.g. Dip-Coating, Roller-Coating, Knife-Edge-Coating
- ⇒ **Pre-Metered-Coating** means that the applied coating weight does **NOT** depend on the process => e.g. Slot-Die-Coating, Spray-Coating

Knife coating processes

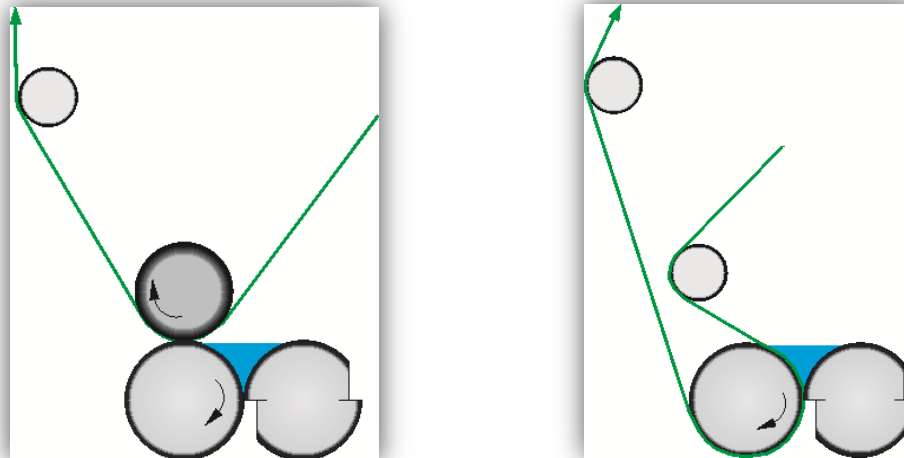
Commabar technology with heatable commabar in direct or indirect mode

Viscosity range: 0,1 up to 1.000 Pas theoretical possible

Temperatures: heatable roller as well as commabar requested accuracy +/- 1 K

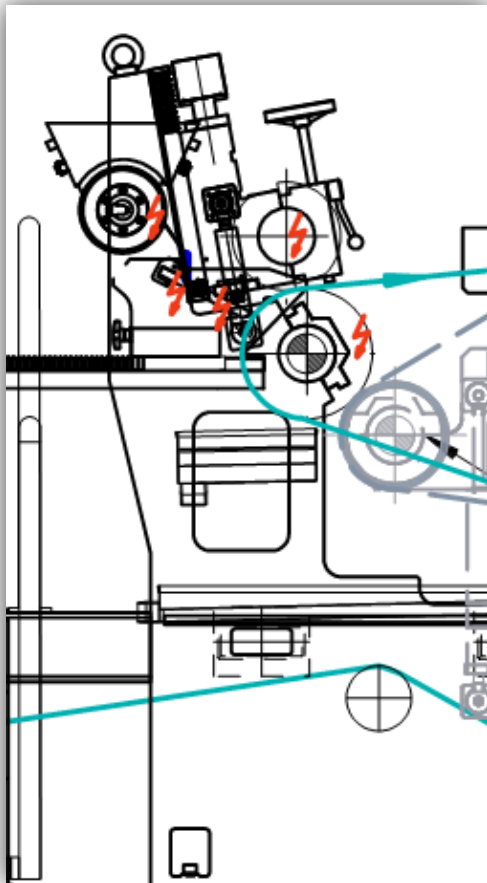
Coating weight: 10 – 1000 g/m² depending on viscosity and technology

Accuracy: very high - > non-bending commabar



Knife coating processes

Combination of commabar and roller application – indirect or direct



Hotmelt feeding with commabar direct for higher viscos coating materials

Hotmelt feeding with indirect commabar for low viscos coating materials



Tests in the KROENERT TC with resins above 500 Pas to define the application technology

3-roller techniques, different designs for indirect coating method

reverse and inline running direction

Viscosity range:

- 1 – 1.000 mPas

Coating weight range:

- Less than 0,1 g/m² up to max. 120 g/m² wet

Advantages:

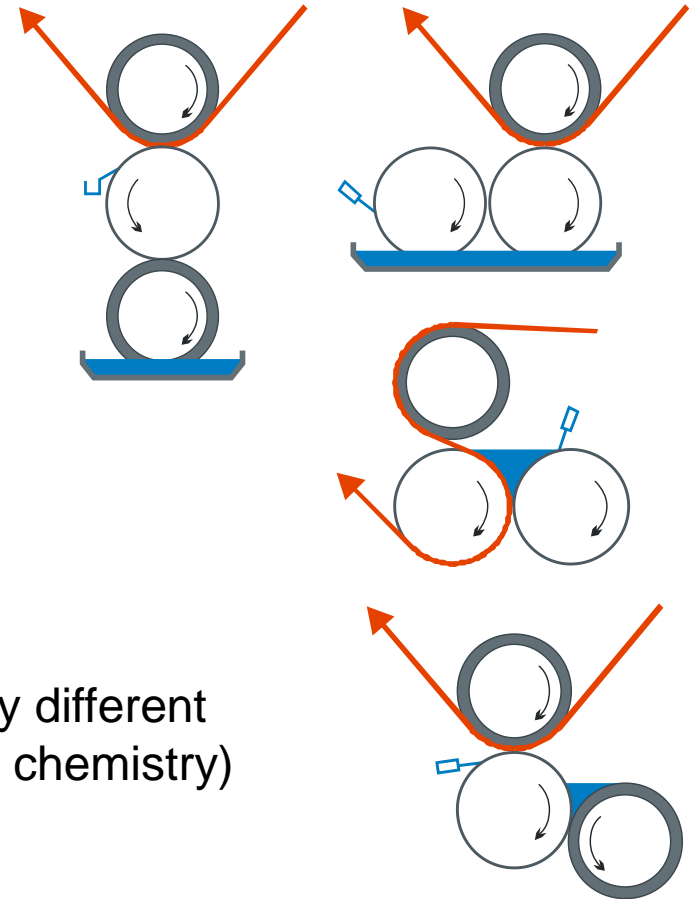
- Large variation of coating weight
- Flexible design of roller position
- Flexible slurry supply to the system

Disadvantages:

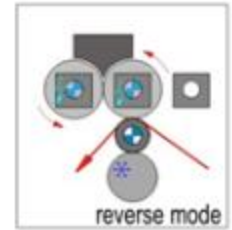
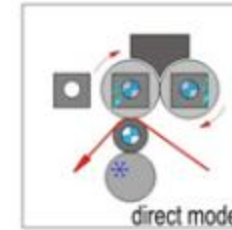
- Evaluation of coating weight depends on many different parameters (roller speed and gap but also the chemistry)

Coating accuracy defined by:

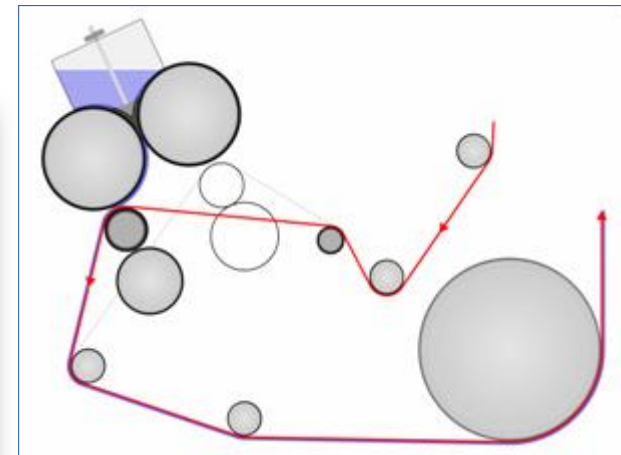
- Running precision of rollers
- Cylindricity of rollers



Direct or indirect 3-roller application with nip feeding



- Viscosity range: up to 400 Pas possible but with high pressure between rollers or three/four roller system for thin layers.
- Temperatures: up to 250 °C, accuracy of +/-1 K necessary
- Coating weight: 10 – 100 (300) g/m² depending of viscosity and coating technology



Direct or indirect 3-roller application with nip and dipping basin feeding



Hotmelt feeding in the nip for higher viscos coating materials

Hotmelt feeding by dipping for low viscos coating materials

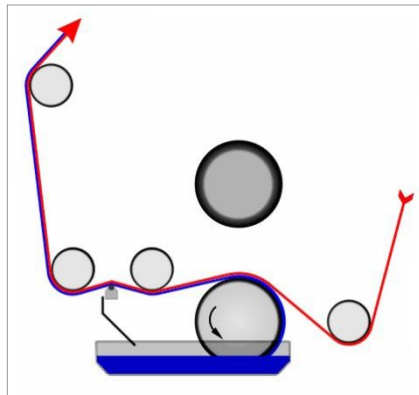
Roller application with meyer racel

- Use with low viscose coating slurries at high coating weight range.
- Slurry application with kiss roller.

Function:

- Very fast change of the coating weight by changing the meyer road.
- High process safety due to easy operation.
- Easy cleaning.
- Ideal for small coating volumes respectively often change of coating weight.

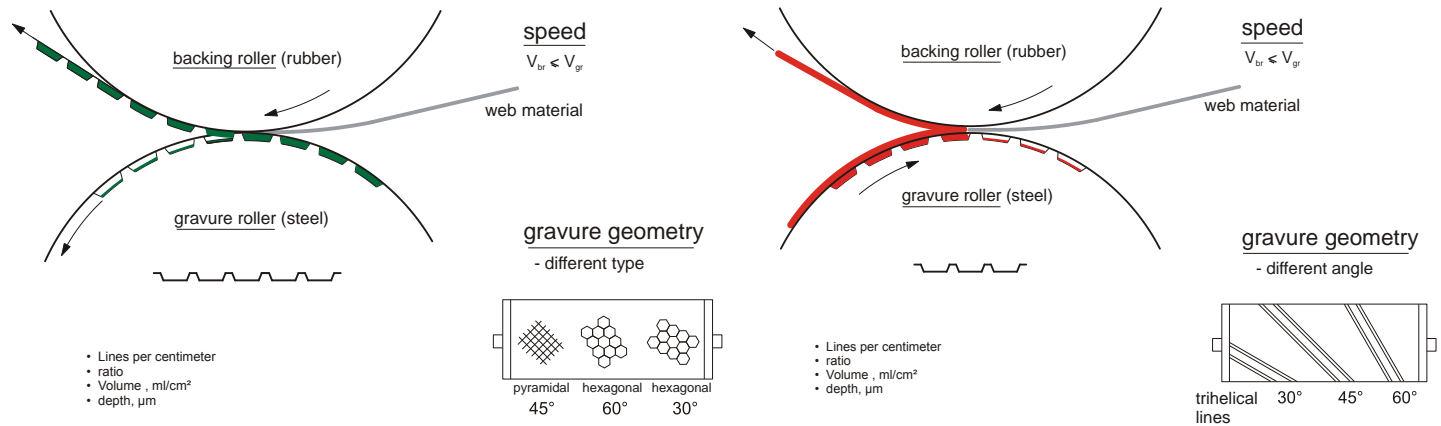
1-roller application with
1 meyer racel / road



**Standard design for most
coating demands.**



Pre-metered technologies with engraved roller systems

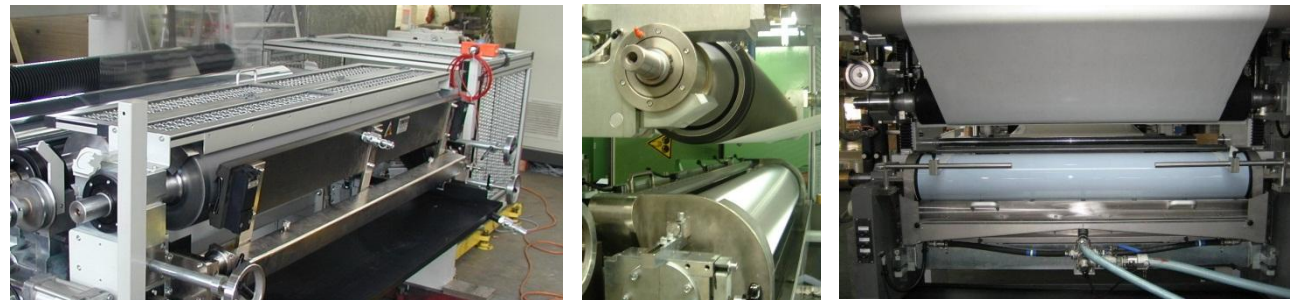


Printing technology

- ❖ Inline running
- ❖ Engraving for min 2 pt textures
- ❖ Hexagonal cell engraving
- ❖ All kinds of line-engraving
- ❖ Structures engraving

Coating technology

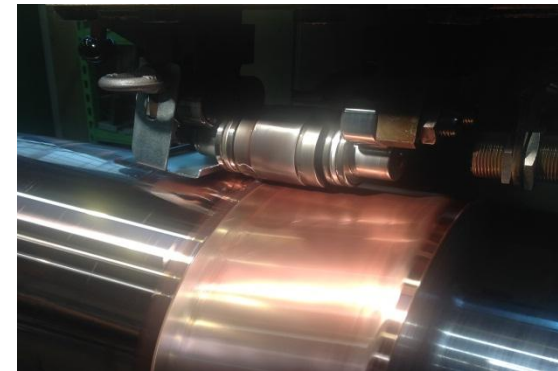
- ❖ Inline or reverse running
- ❖ Often anilox roller design



Engraved roller coating

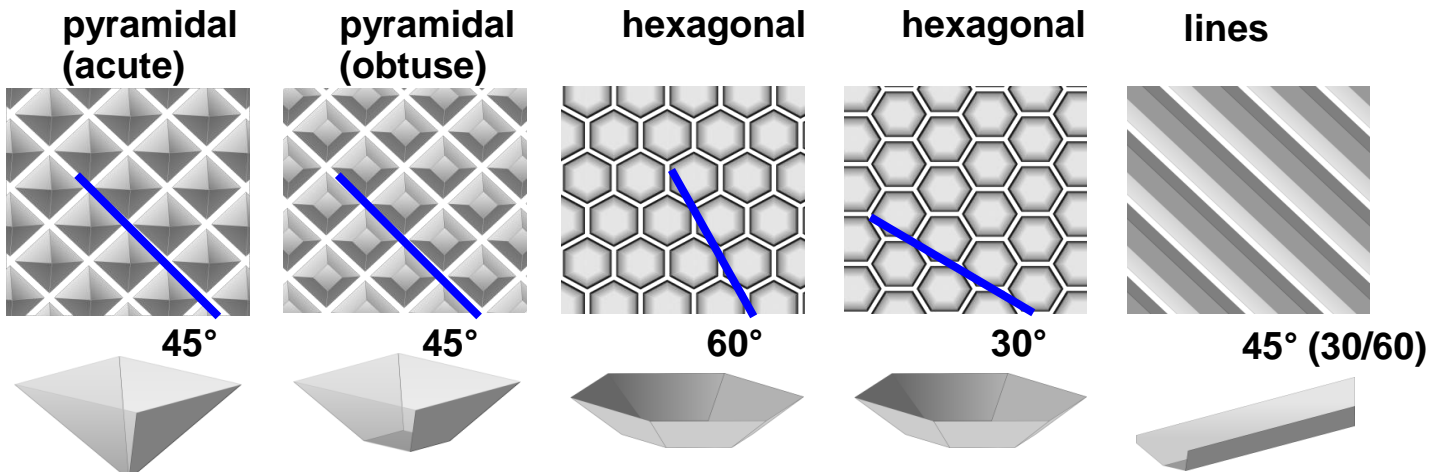
Gravure roller selection

- cellular volume [ml/m²]
- grid number [L/cm]
- grid depth [μm]
- grid angle [°]
- ligament / aperture ratio [-]
- anilox roller type: chrome, ceramic



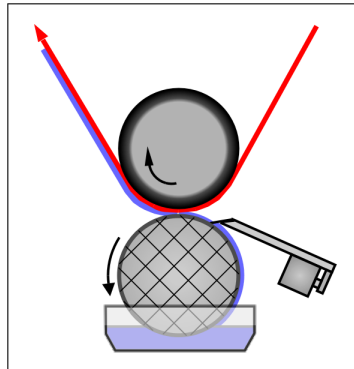
Source: Ungricht, Roll embossing technique

Gravure roller geometrics (examples)

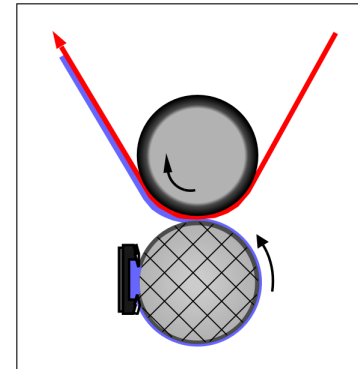


Different mass supply systems for roller application

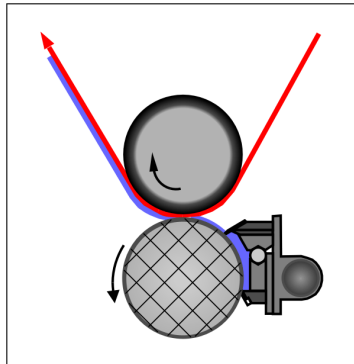
Conventiell
gravure
printing racle
with
oszillation



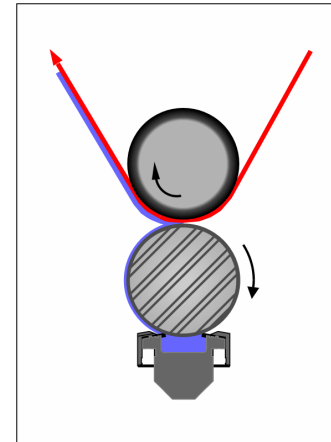
T-chamber for
gravure printing
and coating in
direct and
reverse mode
possible



Gravure printing
pan less pressure
chamber system
for direct coating
and printing
MPG 300



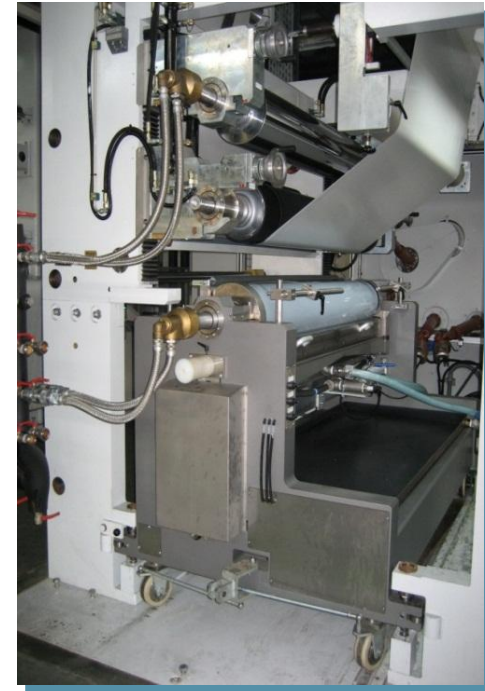
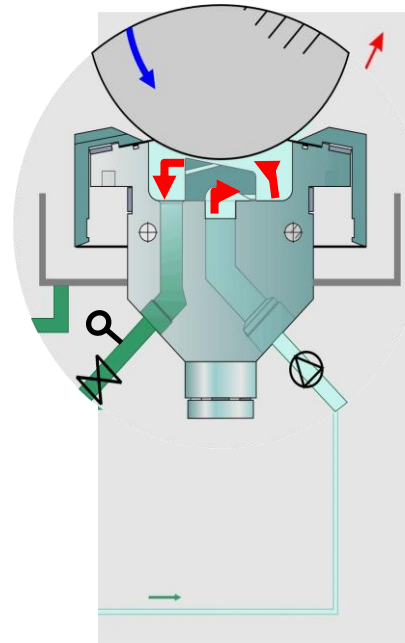
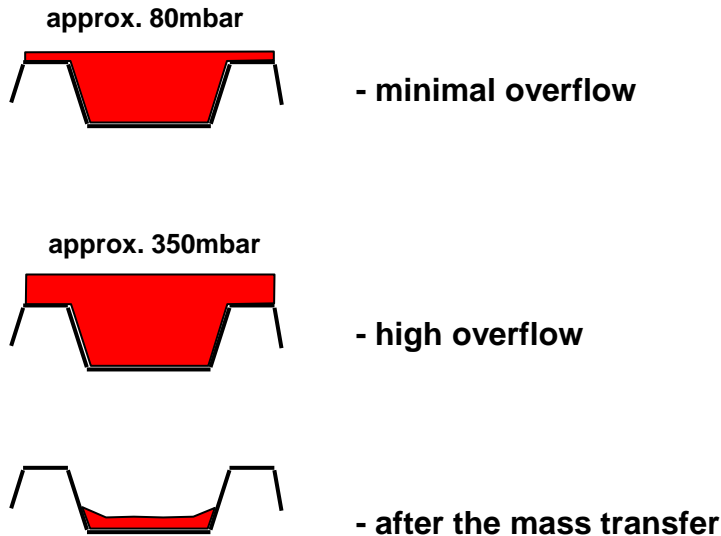
Pan less
pressure
chamber system
for reverse
coating
MPG 300



⇒ **Printing – contact with the substrate**

⇒ **Coating – contact or contact less**

Pressurized chamber technology



- ⇒ the **application mass** can be varied by setting **different pressures** in the pressure chamber.
- ⇒ the pressure variance is approximately **60 - 500 mbar** for negative adjusted doctor blades.
- ⇒ The closed system offers the advantage, that the medium does not react with the environment.
- ⇒ The MPG-process allows to avoid air pockets in the application pattern up to very high speed.

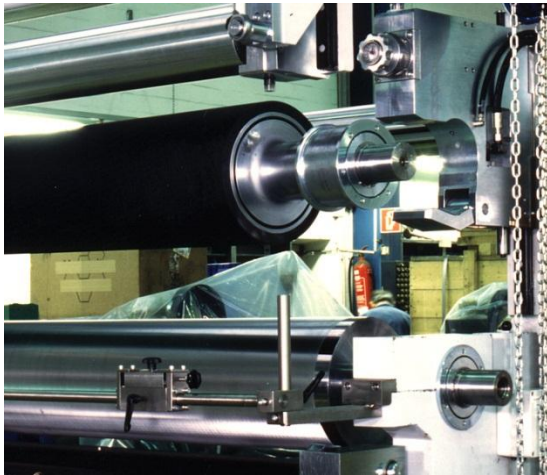
Pre-metered roller technology

Process with sleeve-technology for fast and easy coating width variation

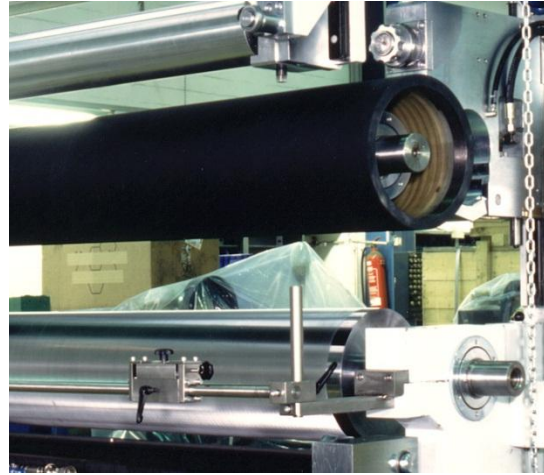
- short change time within one minute
- high flexibility in rubber quality and hardness
- reduce of costs



Opening of the roller bearings



Change of the sleeves



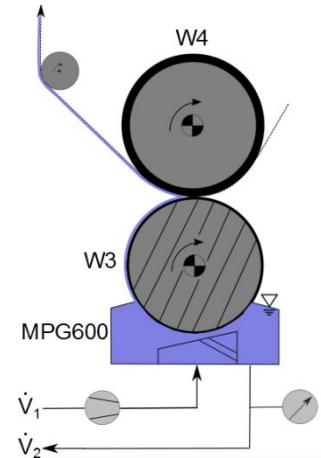
Tests with roller technology for adhesive application

Start-up

- ❖ Application of a closed and constant adhesive film.
- ❖ Substrate paper and PET with silicone surface.
- ❖ Water based adhesive.
- ❖ Avoid foaming during circulation of coating chemistry which was happen at customer side
- ❖ Target 8 g/m² dry with 20 % solid content fluid.

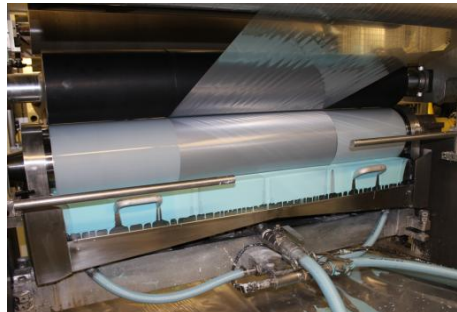
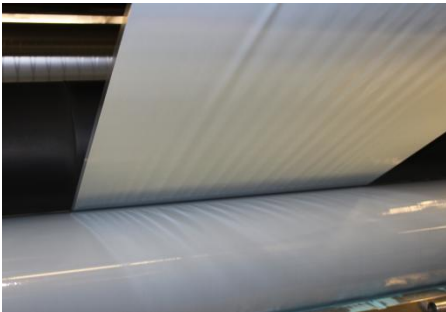
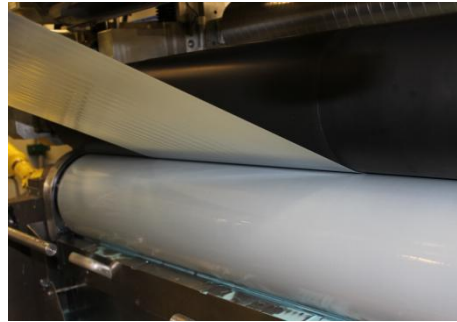
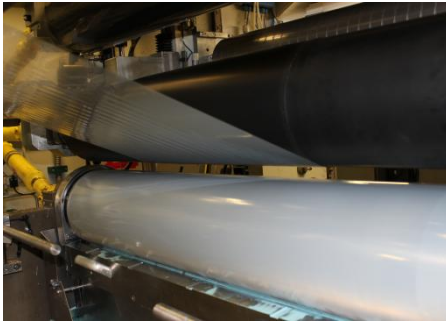
Realized tests

- ❖ Engraved roller technology.
- ❖ Direct, reverse roller application.
- ❖ Coating chemistry supply with pressure chamber MPG.



Tests with roller technology for adhesive application

Realization of coating trials



- ❖ Paste supply system with storage container and one additional sedation container



Results

- ❖ No foaming of coating chemistry.
- ❖ Reaching of a closed and very constant film.
- ❖ Coating thickness 8 g/m² at 30 m/min.

Printing applications for defined adhesive layers

Flexo printing technology

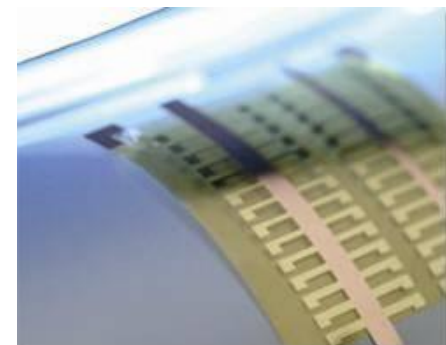
Laser engraved FLEXO PRINTING SLEEVES

Laser engraving for min 2 pt textures

Hexagonal cell engraving

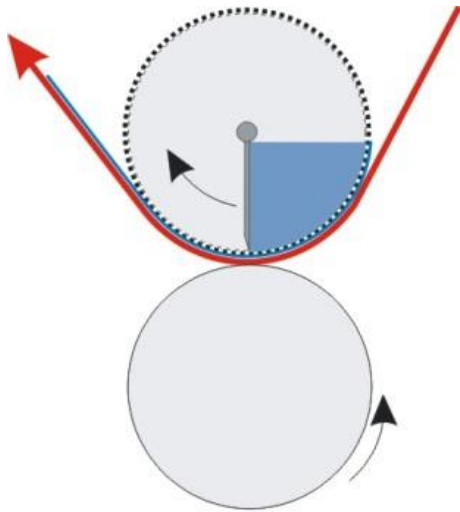
All kinds of line-engraving

Structures engraving



Printing applications for defined adhesive layers

Rotary screen printing technology



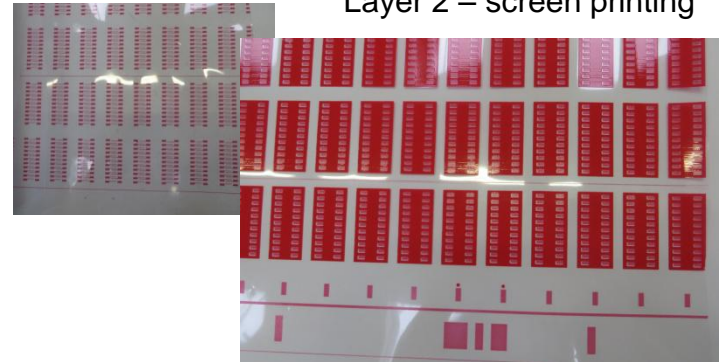
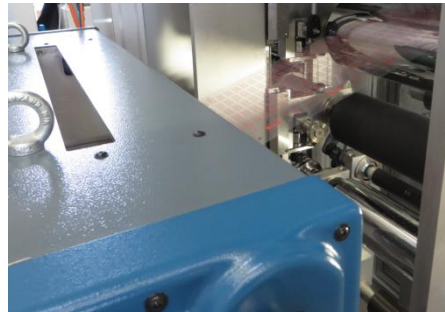
Precise printing processes possible

Compact pattern up to very fine and thin lines

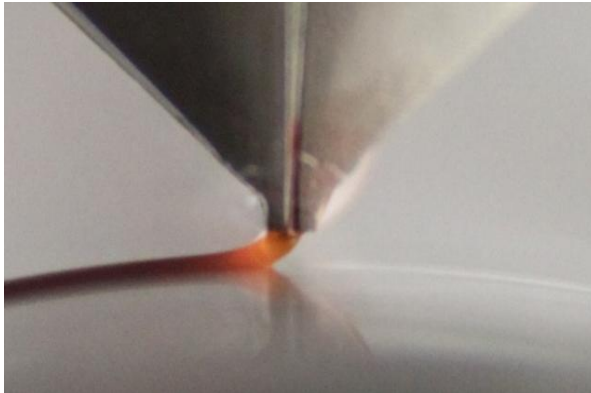
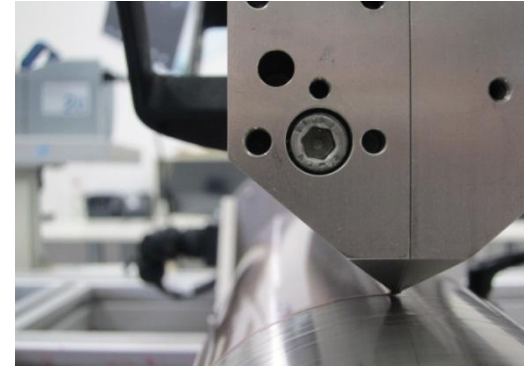
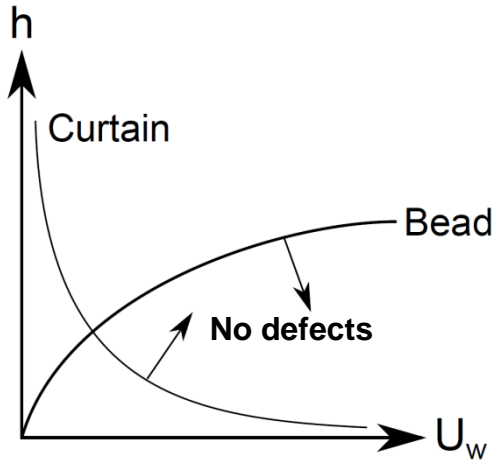
Register steering

Layer 1 – engraving roller printing

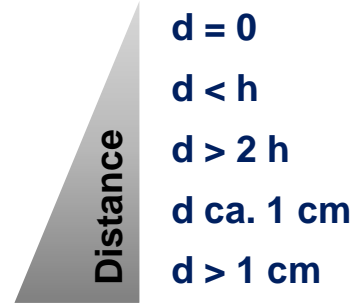
Layer 2 – screen printing



Slot die technology in different setups



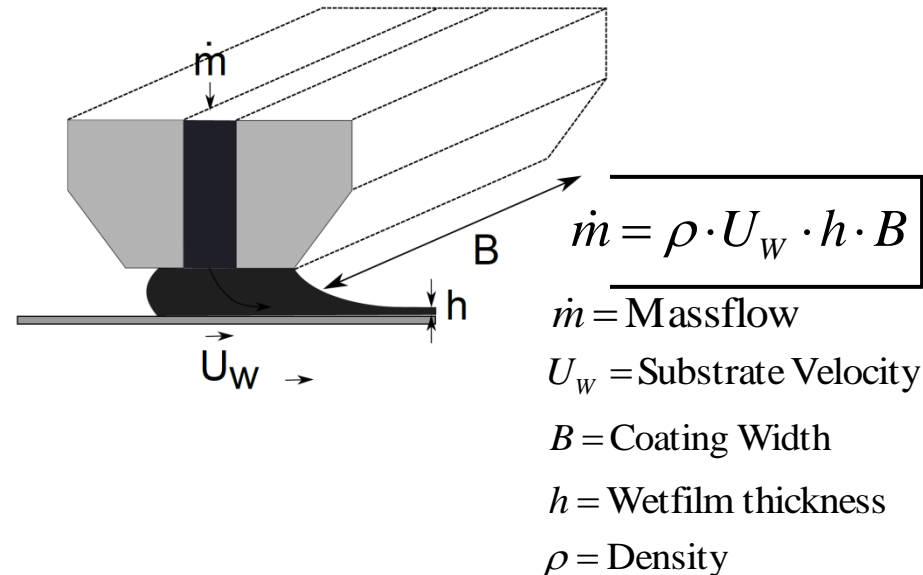
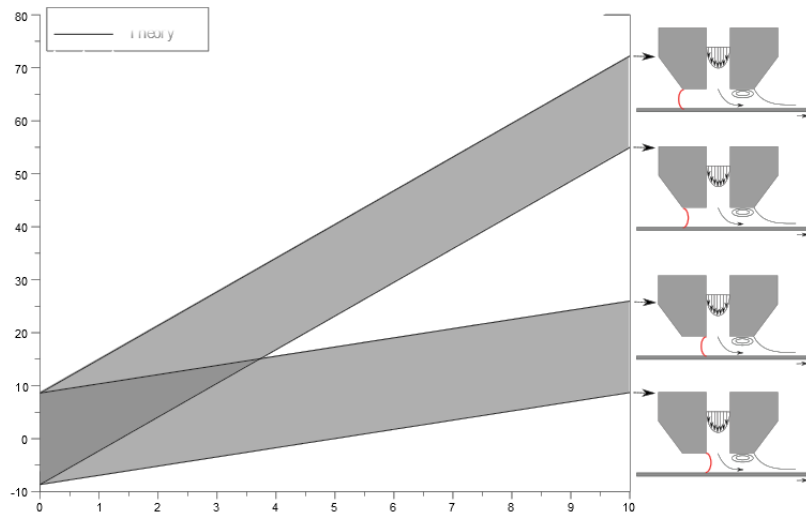
- Web-Tension-Mode
- Extrusion-Coating-Mode
- **Bead-Coating-Mode**
- **Short-Curtain-Coating-Mode**
- Long-Curtain-Coating-Mode



⇒ **!!!Process not understood => Trouble with the coating ☹**

⇒ **!!!Lets understand the process ☺**

Slot die technology – coating window for bead-coating



The calculation of coating windows helps to control the process

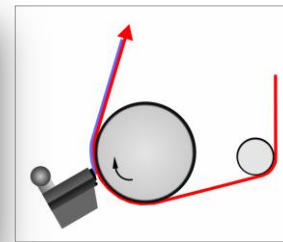
The following parameters are important

- Fluid parameters (viscosity, surface tension)
- Process parameters (distance between slot die and substrate, wet film thickness, substrate velocity)
- Lip length of the slot-die

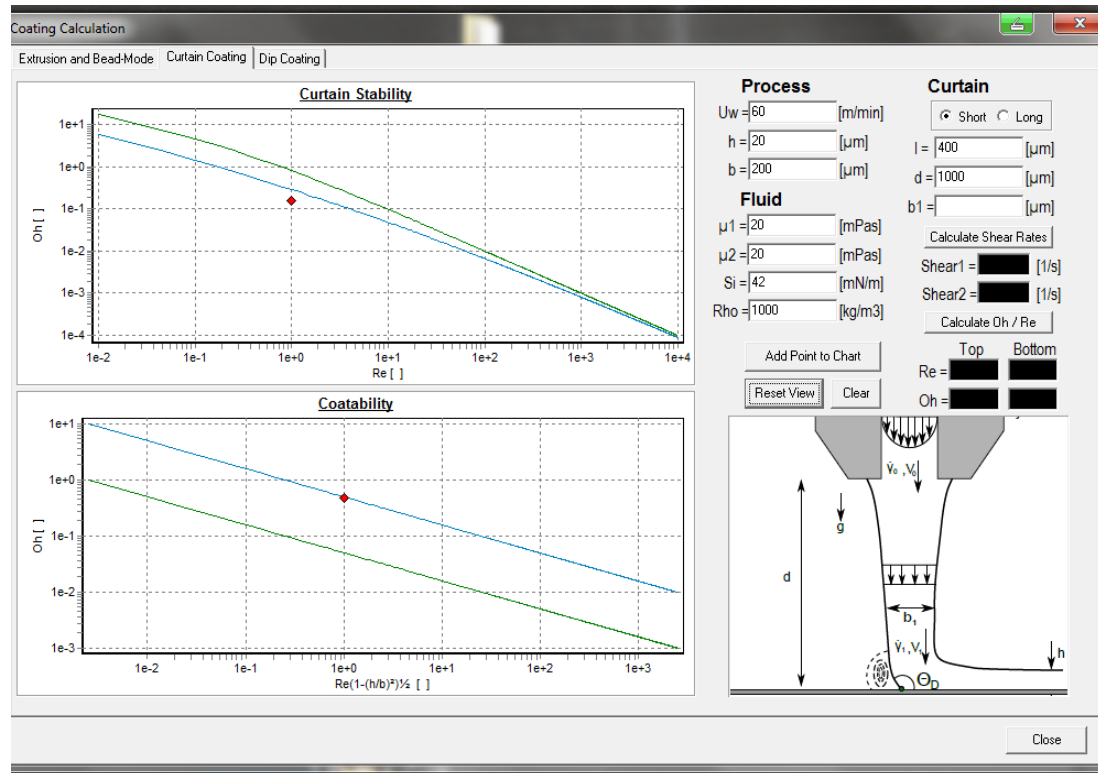
Experience in accuracy and adjustments

Coating accuracy depending on requested coating thickness, substrate tolerance and coating chemistry

- Coating weight variation $\pm 1 \%$
- Coating thickness accuracy $\pm 0,5 \mu\text{m}$
- Coating thickness adjustment $\pm 0,1 \mu\text{m}$ steps
- Coating accuracy start and stop with intermitted coating $\pm 0,6 \text{ mm}$
- Tolerance of the coating length $\pm 0,5 \text{ mm}$
- Coating width $\pm 1 \%$
- Precision of speed adjustment $\pm 0,1 \text{ mm}$
- Tension



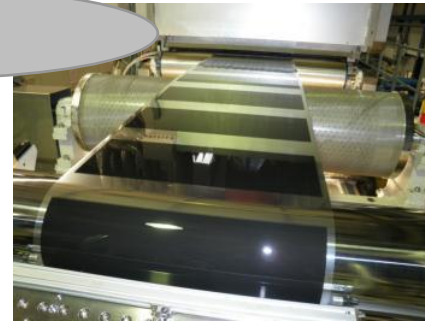
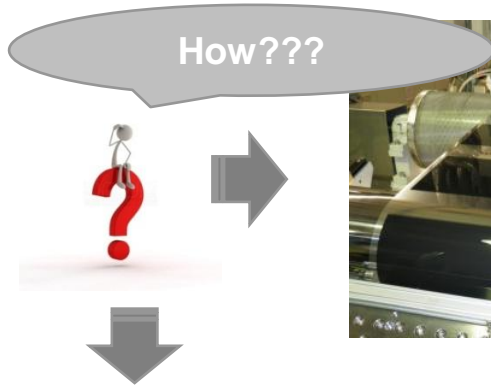
Slot die technology – software for slot die evaluation



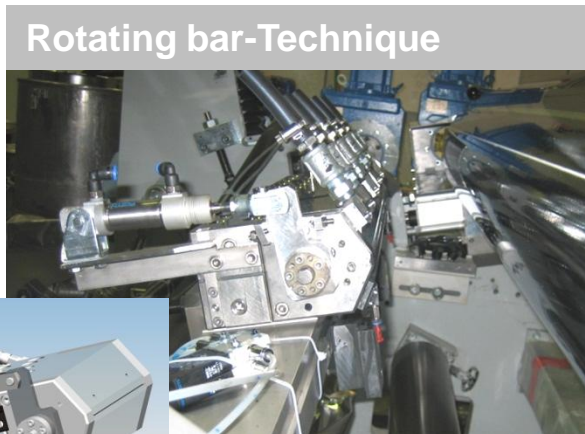
⇒ The coating window for a slot die operating in the short-curtain-coating-mode can be calculated in order to support the coating on the coating facility.

Pre-metered technologies

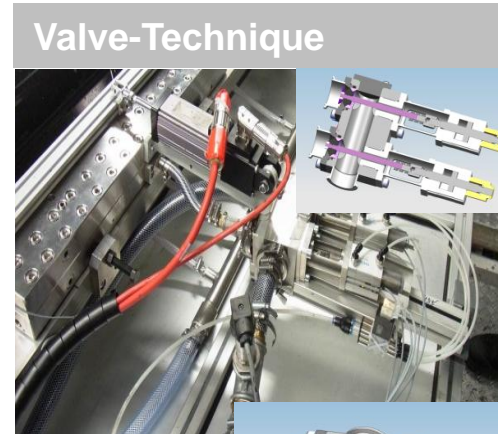
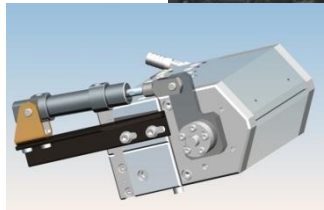
Slot die technology – intermitted coating operation



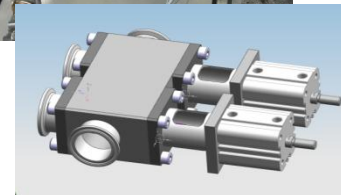
KROENERT
development
with partner
TSE Troller



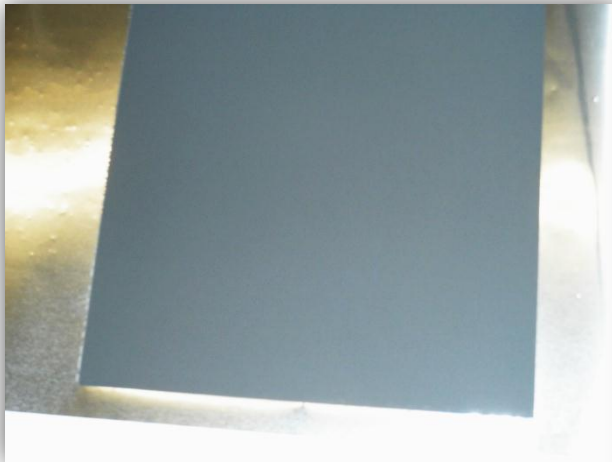
Rotating bar-Technique



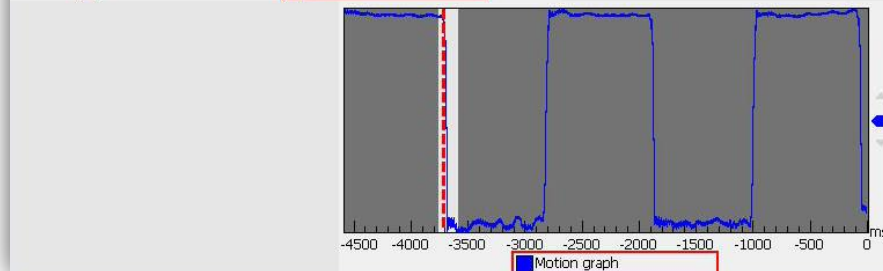
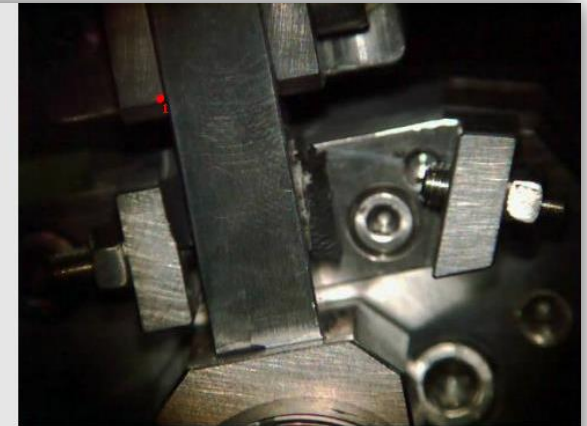
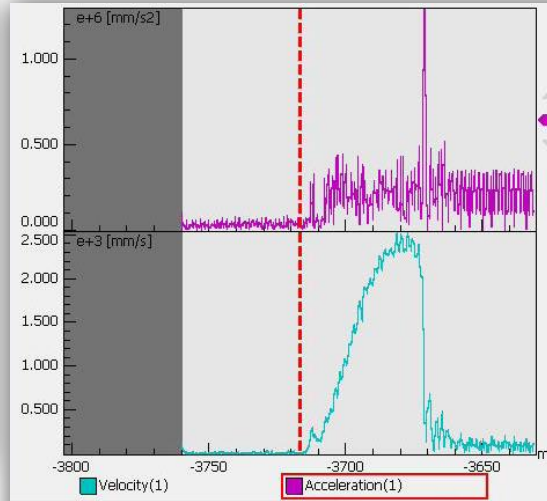
Valve-Technique



Slot die technology – intermitted coating operation



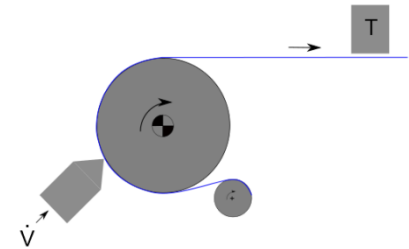
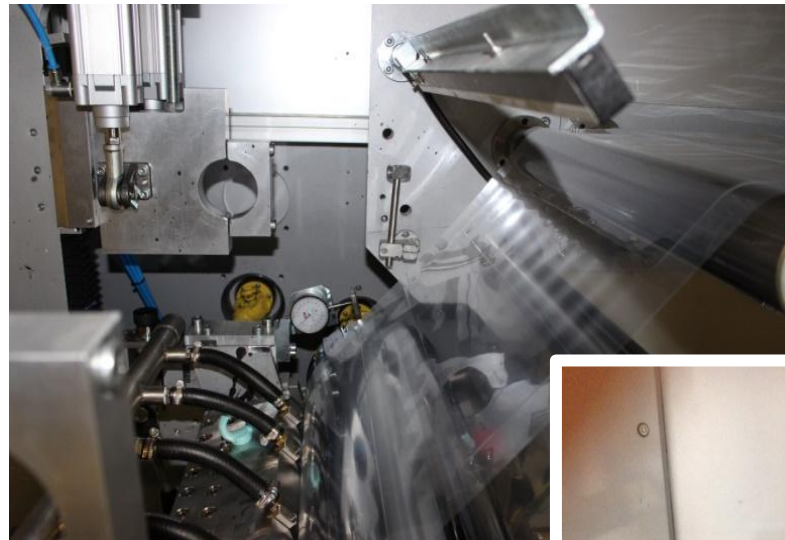
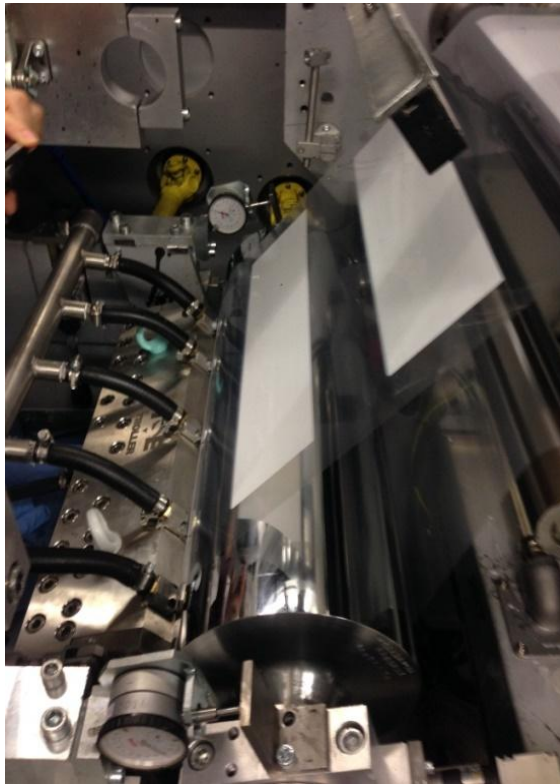
Edge accuracy



Measurement of the rod movement with high speed camera

Pre-metered technologies

Slot die technology – intermitted coating operation test with adhesive application



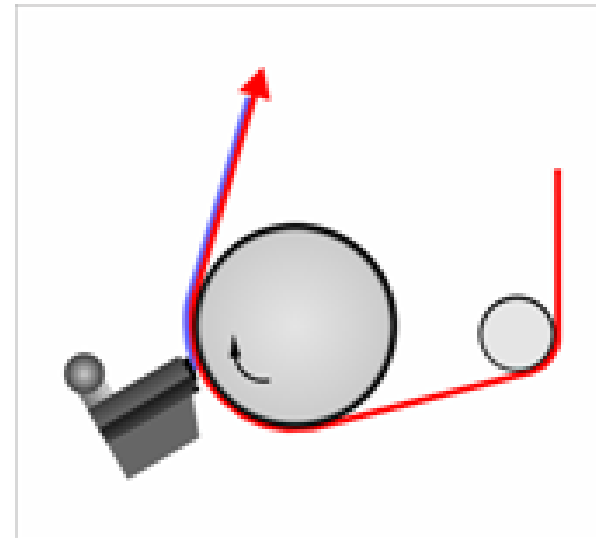
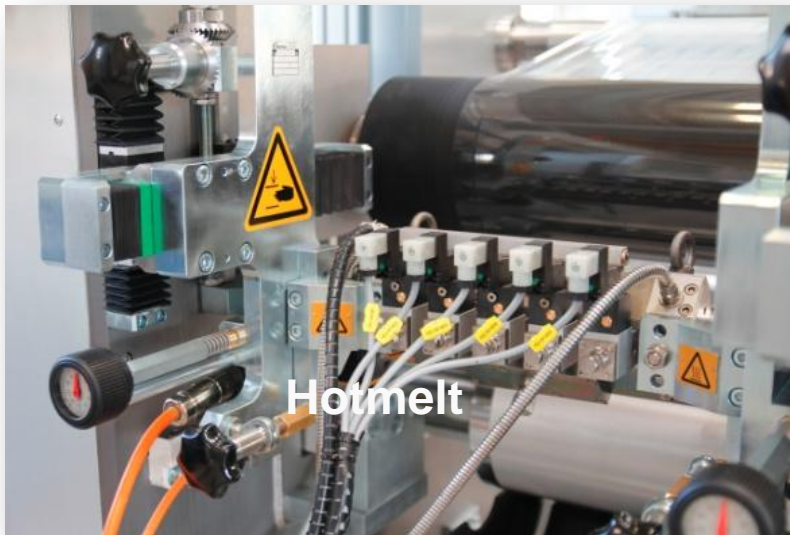
First dosing with
pressure vessel.

Better results with
eccentric spiral
pump.



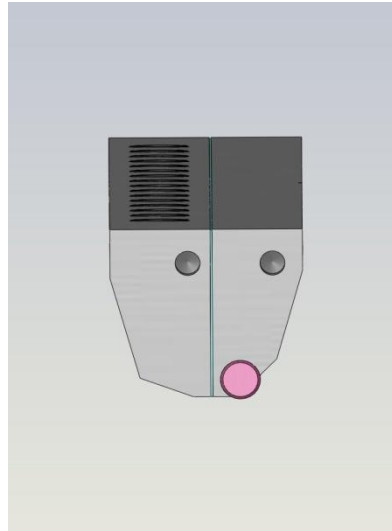
Slot die technology for hotmelt application

- Viscosity range: up to 500 Pas
different feeding technologies depending on the viscosity
- Temperature: up to 400 ° C
- Coating weight: 10 – 400 g/m² depending on viscosity and substrate



Slot die technology for hotmelt application

Slot die with rotary rod versus standard technology



- Rotary rod has no influence on the distribution accuracy.
- No dosage with rotary rod only smoothing of the coated layer.
- Challenging coating accuracy +/- 3 %. Guaranteed 5 %.
- Rotary rod only useful up to 50 g/m² coating weight.

Coating line concept

Order from customer side

Order confirmation

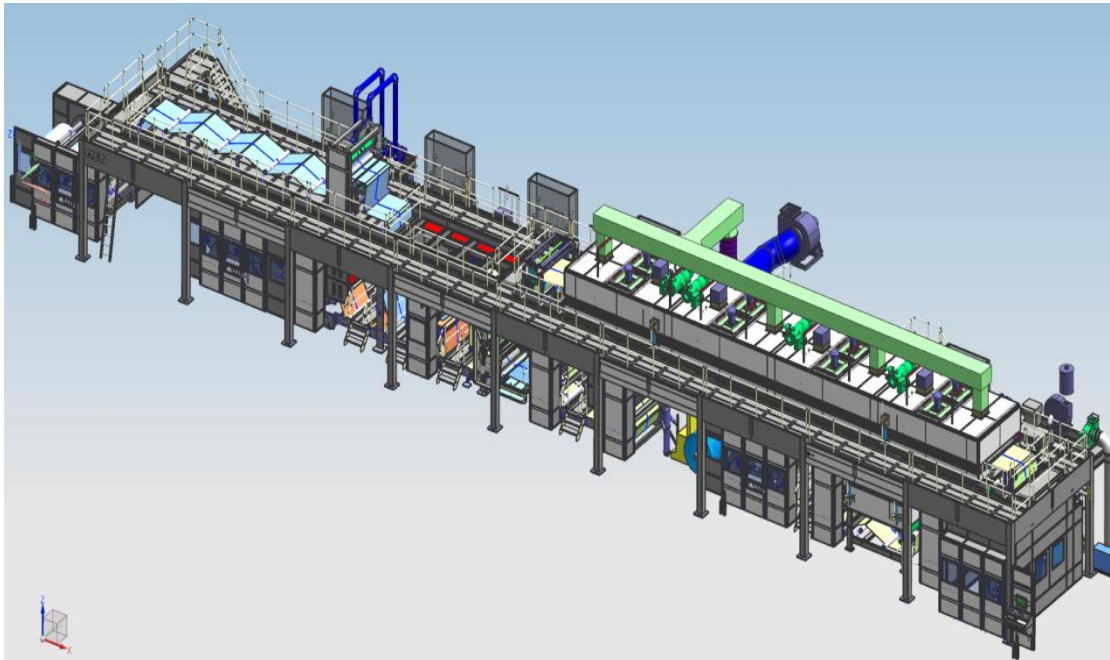


Definition of a project leader

Transfer of the project from the sales department to the engineering department

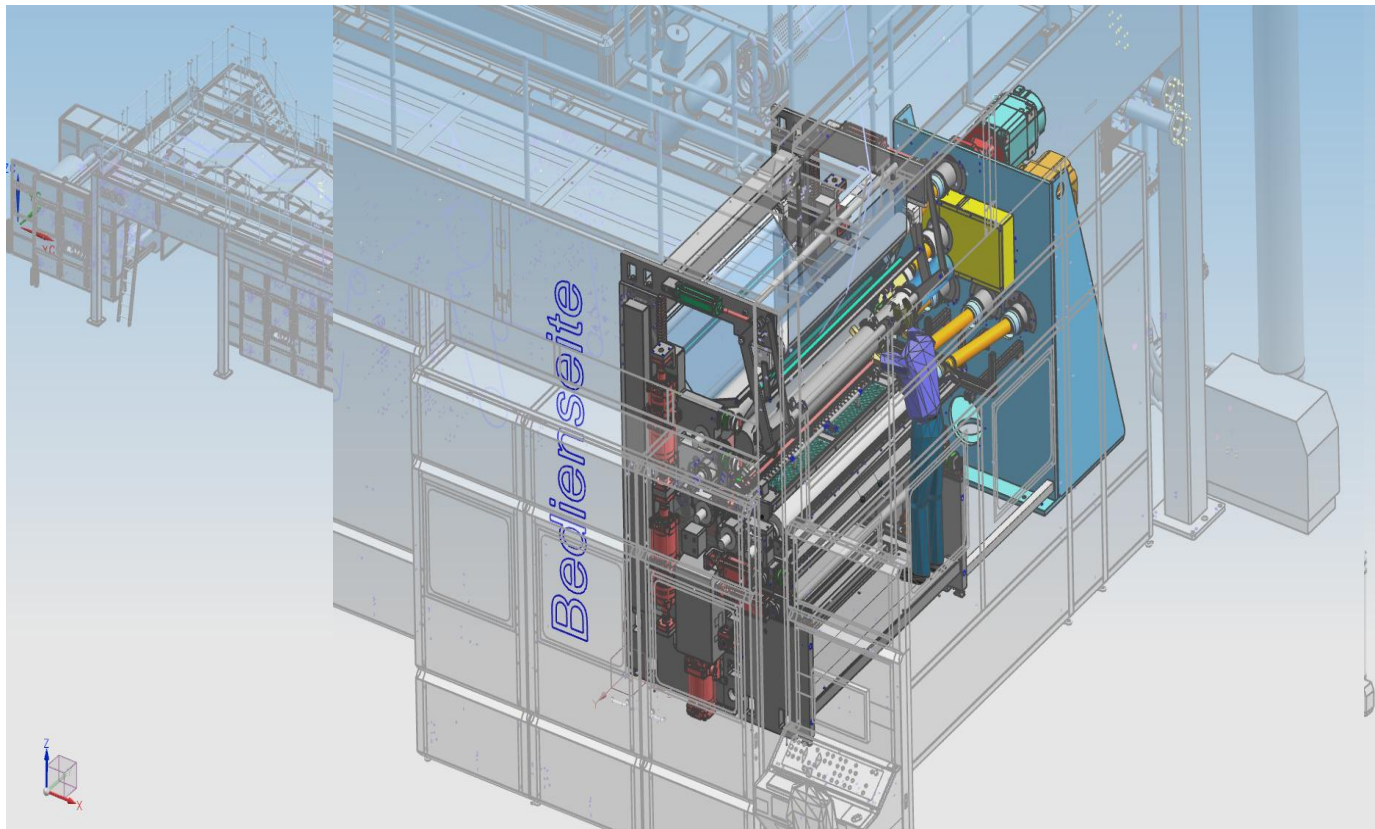


Technical discussion and final design confirmation on the basis of a 3D-modell



Different experts are engineering the different machine parts

The whole machine model will be departed in different components and discussed with the customer



Design of the manufacturing drawing

Quality control of all incoming parts and installation of the coating line and exception ...



Coating system



Dryer and vacuum roll



Rewinding unit

Design of the manufacturing drawing

Quality control of all incoming parts and installation of the coating line and exception ...



The complete coating line – MCO500

Versatile coating lines in the Technology Center



Purpose of the KROENERT Technology Center

Purpose for our customers:

- ❖ Test runs under production conditions with various coating methods
- ❖ Process optimization
- ❖ Process development

Purpose for KROENERT:

- ❖ Optimization of existing processes and development of new technologies
- ❖ Determination of guaranteed process specifications
- ❖ Development of process expertise (from know-how to know-why)



Do you have any remarks and questions?

Andrea Glawe
andrea.glawe@kroenert.de



**Thanks for
your attention**



Hamburg – Gate to the world