Paper Converting and Packaging Technology
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- R2R (co)Extrusion coating and lamination pilot line
- Permeability (barrier) measurements:
  - O₂TR: MOCON Ox-Tran 2/21 MH and Ox-Tran 2/21 SS
  - WVTR: MOCON Aquatran 1G and Cup test (ASTM E96-10)
  - CO₂TR: MOCON Permatran-C 4/41
  - Grease resistance (ASTM F119-82)
  - HVTR (Hexane/Heptane Vapor Transmission Rate)
- Sealing and sealability testing:
  - Hot bar sealing and hot tack
  - Hot air sealing
  - Ultrasonic sealing
- Environmental test chambers (10-50°C / 30-98%RH)
- Bending stiffness
- Blocking
- COBB – water absorption
- Dual column material testing machine: Strength properties and adhesion measurements (90°and 180°peel)
- Coefficient of friction
- Optical microscope with polarisation contrast + microtome
- Extrusion rheometer
- Lab-scale sheet coater
- Brookfield viscometer
- Creasing – perforating machine
- Package testing:
  - Hydrogen leak detector H2000
  - PBI Dansensor CheckPoint O₂/CO₂
R2R (co)Extrusion coating and lamination pilot line
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- Coextrusion Coating
- Coextrusion Laminating
- Cast Film Coextrusion
- Surface Treatment
- Dispersion Coating
- Edge Trimming Service

Detailed information and specifications on request from contact person
• (co)Extrusion coating and casting:
  - 4 extruders
  - 5-layer technology
  - encapsulation technology

• (co)Extrusion lamination

• Dispersion coating (rod/blade)

• Coating, treatments and functionalisation of surfaces, e.g. corona, flame, plasma, IR, UV, LFS

New process being installed in 2019: R2R application of MFC/nanocellulose
(co)Extrusion process

- Plastics as pellets, dry blending is possible
- Dehumidifiers available for pellets

Multilayer technology: Selector plug + Cloeren-feedblock

T-die with encapsulation possibility
Barrier measurement

$O_2$ TR: MOCON Ox-Tran 2/21 MH and Ox-Tran 2/21 SS
WVTR: MOCON Aquatran 1G and Cup test (ASTM E96-10)
$CO_2$ TR: MOCON Permatran-C 4/41

Testing of flat films with MOCON instrument (symmetrical layer only)
- A module contains test cells (A and B) and a possible reference cell (R)
- Two samples can be measured at the same time (reference film may be measured for comparison)
- Using the foil mask reduce the measured sample area from 50 cm$^2$ to 5 cm$^2$ and increase the range 10 times higher
- Outer chamber contains the test gas (water vapor, oxygen, carbon dioxide)
- Inner chamber contains the carrier gas (nitrogen with WVTR/$CO_2$ TR and nitrogen/hydrogen -mix with $O_2$ TR)

Grease resistance (ASTM F119-82)
HVTR (Hexane/Heptane Vapor Transmission Rate)
Barrier measurements

Water Vapour Transmission Rate (WVTR)

- Gravimetric Cup – Method, SCAN P22:68 (ASTM E96)
- The Desiccant Method (anhydrous calcium chloride or Silica gel)
- Sample placed in specific test conditions
- WVTR range: over 1 g/m²/d

**MOCON AQUATRAN MODEL 1G**

**HIGH SENSITIVITY COULOMETRIC WATER VAPOR TRANSMISSION RATE TEST SYSTEM**

- Bases on coulometric phosphorous pentoxide sensor
- WVTR range:
  - Unmasked 0.0005 – 5 g/m²/d
  - Masked 0.005 – 50 g/m²/d
- Test temperature range: 10 – 40 °C
- Relative humidity range: 35 – 90, 100 %
- DIN 53122:2
Barrier measurements

Oxygen Transmission Rate ($O_2$TR)

**MOCON Ox-Tran 2/21 MH + SS**

**STANDARD OXYGEN TRANSMISSION RATE TESTING SYSTEM**

- Bases on coulometric sensor
- $O_2$TR range:
  - Unmasked: $0.05 – 200$ cm$^3$/m$^2$/d (100% $O_2$)
  - Masked: $0.5 – 2000$ cm$^3$/m$^2$/d (100% $O_2$)
  - Masked: $5 – 20000$ cm$^3$/m$^2$/d (10% $O_2$)
- Test temperature range: $10 – 40$ °C
- Relative humidity range: 0 (SS), 35 – 90 % (MH)
- Edge leakage adaptors for coated papers/boards
- ASTM D3985 (films), ASTM F1927 (films)
Barrier measurements

Carbon Dioxide Transmission Rate (CO$_2$TR)

**MOCON PERMATRAN-C 4/41**

**STANDARD CARBON DIOXIDE TRANSMISSION RATE TESTING SYSTEM**

- Bases on infrared sensor
- CO$_2$TR range:
  - Standard: 4 – 4 000 cm$^3$/m$^2$/d
  - Masked: 40 – 40 000 cm$^3$/m$^2$/d
- Test conditions: $T = 10 – 50 ^\circ C$, $RH = 0 \%$
Grease resistance (ASTM F119-82)
- ASTM F119-82
- Visual analysis of penetration of test grease, e.g. olive oil, rapeseed oil, coconut oil, butter,…
- Analysis of time in which the grease has penetrated through the sample (minutes/hours/days/weeks…)

HVTR Hexane/heptane transmission rate
Hexane or heptane evaporation
- Gravimetric Cup – Method
- Sample placed in specific test conditions
Sealing and sealability testing

Hot Bar Sealing and hot tack measurement
Hot Air Sealing
Ultrasonic Sealing
Hot Bar Sealing and hot tack measurement

**Kopp SPGE 20 Cold and Hot Tack Testing System**

- Dimensions of sealing bars: 5 x 100 mm
- Sealing temperature up to 300 °C
- Sealing and cooling times: 0,2 – 99,99 s
- Sealing force: 0 – 1000 N
- Seal strength and hot tack testing:
  - Sample dimension (approx.):
    - MD 15 cm x CD 7 cm (1/6 x A4)
    - Thickness (max.): 0,5 mm
  - Tractive speed: 2,5 – 25 m/min
  - Tensile strength measurement range: 0,5-200 N
Hot Air Sealing

- Hot air sealing machine to simulate e.g. side sealing of carton cups. Hot air sealing can be used for web materials such as board, paper and even plastics.

- **Measurement procedure:** Two samples from each side are rapidly moved via hot air blowers to the center where the bar sealing is done.

- **Parameters and specifications:**
  - Temperature (°C): up to 550 (hot air blowers)
  - Hot air blower speed (frequency transformer, Hz): 20 – 60
  - Heating time (s): up to 5
  - Open time (s): up to 5 (adjusted by prolonging the start of bar sealing)
  - Sealing force (N): 100 - 1000
  - Pressing time (s): up to 5
  - Sealing bars size of 0,3 cm x 15 cm (on top) and 1 cm x 15 cm (bottom)
  - Sample size of 10,5 cm (MD) x 15,5 cm (CD)
Ultrasonic Sealing

- Parameters:
  - Pressure 1 - 5 (bar)
  - Welding time 0,1 - 9,9 (s)
  - Holding time 0,1 - 9,9 (s)
  - Amplitude 1 – 9
  - Sample size MD 15 cm x CD 7 cm (1/6 x A4)

- Results:
  - The used efficiency of max. (%)
  - The used energy when sealed [Ws]
  - Adhesion (0 - 5)

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>No adhesion</td>
</tr>
<tr>
<td>1</td>
<td>Weak adhesion</td>
</tr>
<tr>
<td>2</td>
<td>Adhered but no clear tear</td>
</tr>
<tr>
<td>3</td>
<td>Under 50% fibre tear</td>
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<tr>
<td>4</td>
<td>Over 50% fibre tear</td>
</tr>
<tr>
<td>5</td>
<td>100% fibre tear</td>
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</table>
Other characterization methods for coatings and packaging materials

Environmental test chambers (10-50°C / 30-98%RH)
Coefficient of friction (Qualitest FX7100-V)
Strength properties and adhesion: Dual column material testing machine (90° and 180° peel, Hounsfield H10KM)
Hydraulic Test Press for heated die installation, scoring and die cutting of paperboard (Gralex HTP 20)
Creasing – perforating machine (Cyklos GPM 450)
Optical microscope with polarisation contrast + microtome
Bending Stiffness
Extrusion rheometer (Müller)
Lab-scale sheet coater (K202 Control Coater)
Brookfield viscometer
Package testing:
  • Hydrogen leak detector H2000
  • PBI Dansensor CheckPoint O2/CO2
**Surface friction properties**

**QUALITEST FX-7100-VS**

**COEFFICIENT OF FRICTION (COF) TESTER**

Measurement ranges: 0-200, 0-500 and 0-2000 gf
Variable speed: 25 – 500 mm/min
ASTM D1894
Sample size MD 25 cm x CD 9 cm

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**Strength properties and adhesion**

**Hounsfield H10KM**

Accuracy ± 1% of indicated force in accordance: BS160, ASTM E4 and DIN 51221.

Three load cells with maximum force of 100N, 1000N and 10000N.

90°-peel test (L-peel test), 180°-peel test (U-peel test) and T-peel test.

5 force recorder ranges (100%, 50%, 20%, 10%, 5%) and force display ranges (100% or 10%).

Speed from 0,5 mm/min to 500 mm/min.

Maximum width of sample 410 mm and maximum length of sample 1100 mm.
Hydraulic Test Press

Hydraulic Test Press for heated die installation, scoring and die cutting of paperboard (tray forming)

Creasing – perforating machine

Working width 450 mm
Width of crease 1,2 / 1,5 / 1,8 mm
80 – 400 g/m² (creasing), 80 – 250 g/m² (perforating)
Optical microscope and microtome for surface and cross-sectional analysis

Bending stiffness
Max. 5000 mN and angle 0°-30°
Bending length: 50, 25, 20, 15, 10, 5 mm
Sample size: 70 mm x 38 mm
(ISO 2493: 15° or 7.5° and board: 50 mm, paper: 10 mm)
Müller rheometer

L/D-ratio is 25 mm and screw diameter is 30 mm

Slit die, dimensions: \( L = 110, \ W = 20 \) and \( h = 0.75 \) mm

Maximum output about 10\( \mathrm{kg/h} \) melt LDPE 250\( \mathrm{Cels} \), maximum rpm 100

Temperature measurement and control

PC-measurement, calculation and report program for rheology parameter

K Control Coater K202

Coating area \( \approx 250 \text{mm} \times 300 \text{mm} \)

Standard coating speed

Coatings are applied by wire wound bars (6 different grooves)
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