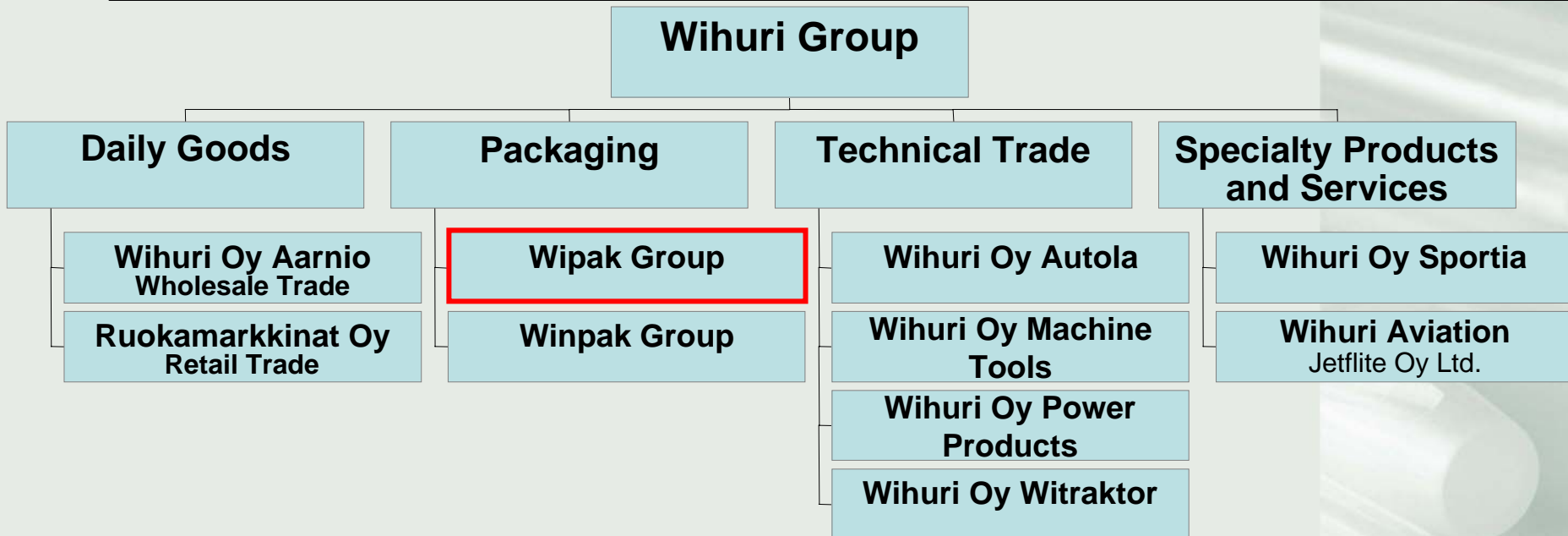


28.-29. September – Zurich
7th Inter. Vacuum Insulation Symposium

**Barrier films for
Vacuum Insulation Panels (VIP)**

Dr.-Ing. Dirk Kaczmarek

WIHURI GROUP – CORPORATE STRUCTURE



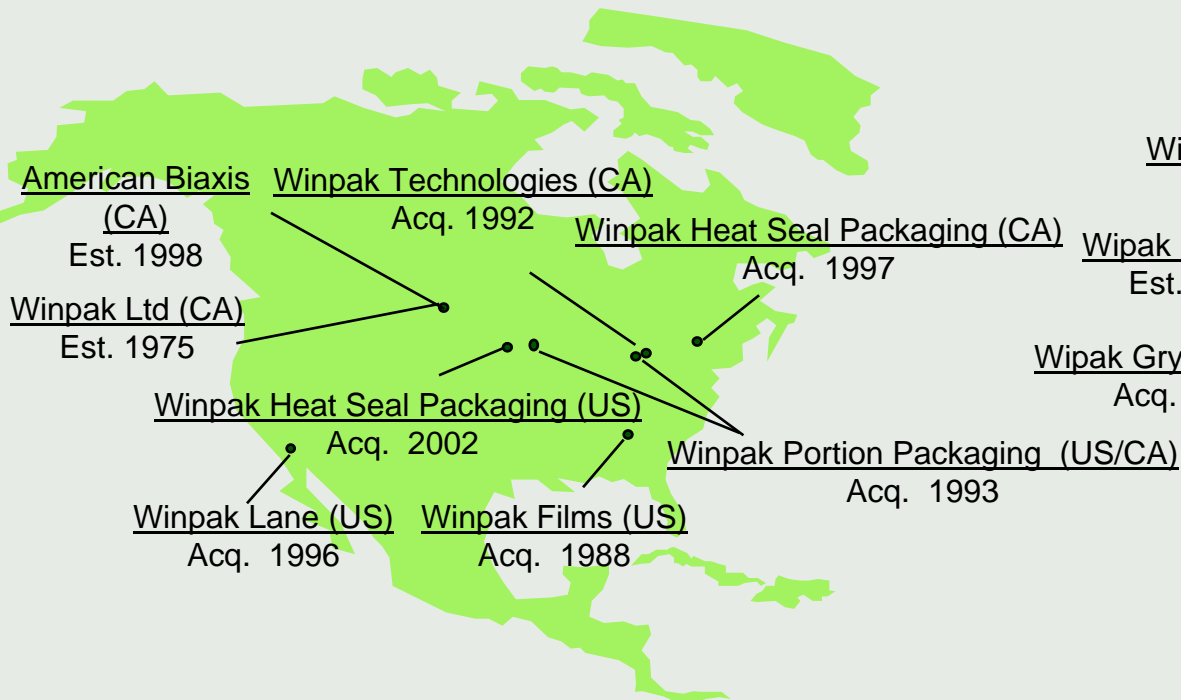
WIPAK & WINPAK –

TURNOVER: 675 MILLIONEN EURO - EMPLOYEES 3.600

WINPAK GROUP

Turnover: 335 millionen Euro

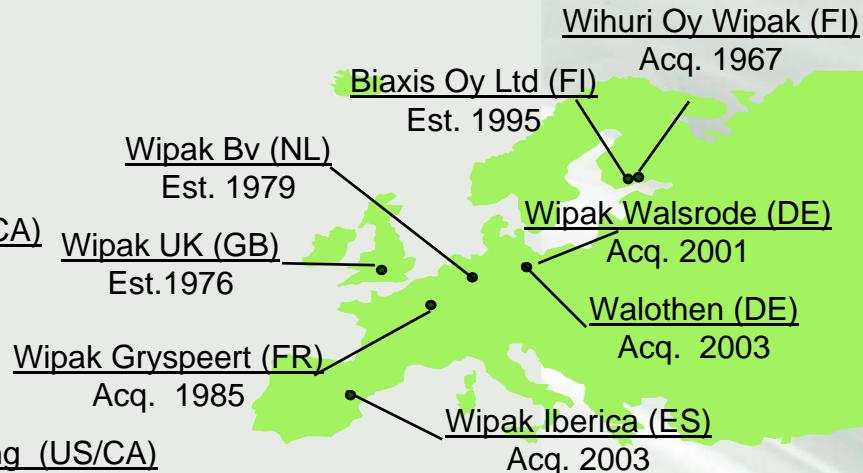
Employees: 1.800



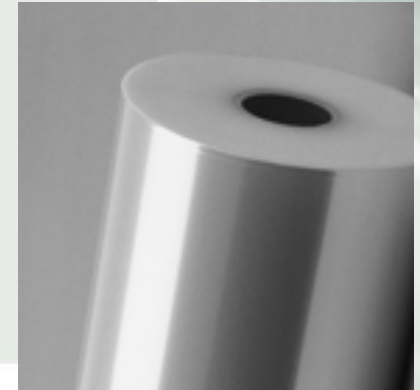
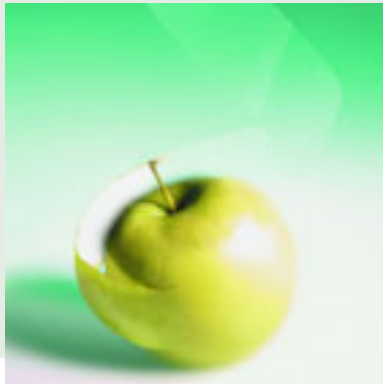
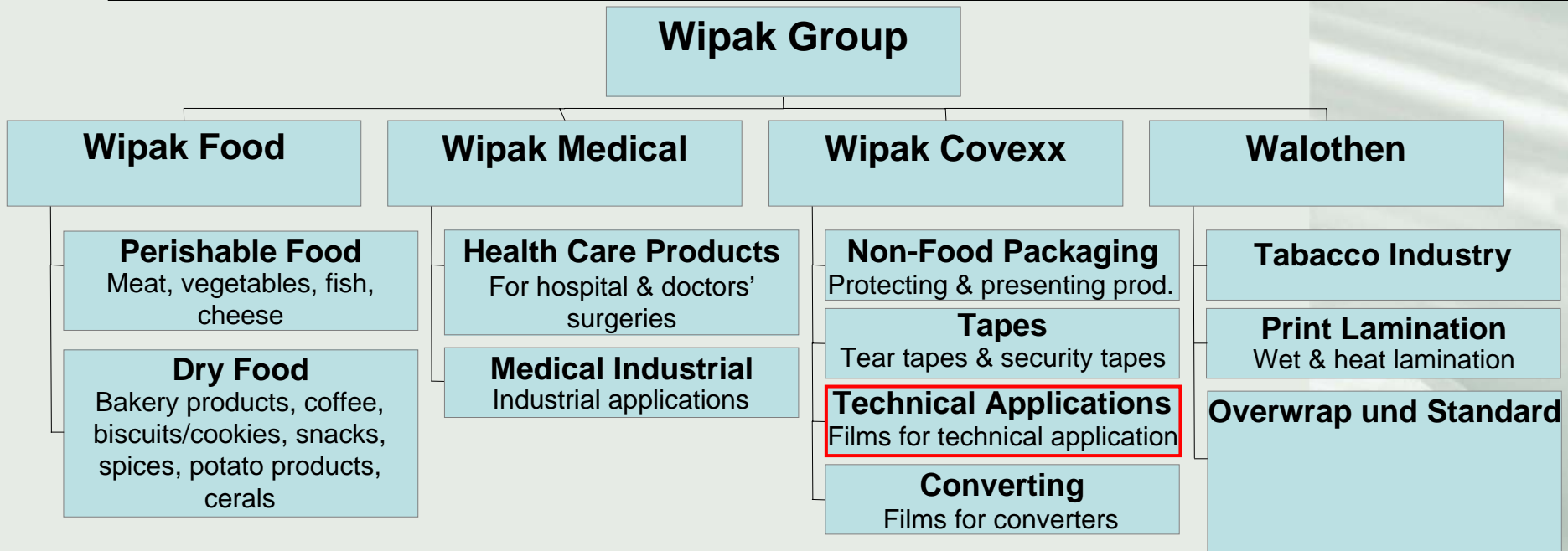
WIPAK GROUP

Turnover: 365 millionen Euro

Employees: 1.800



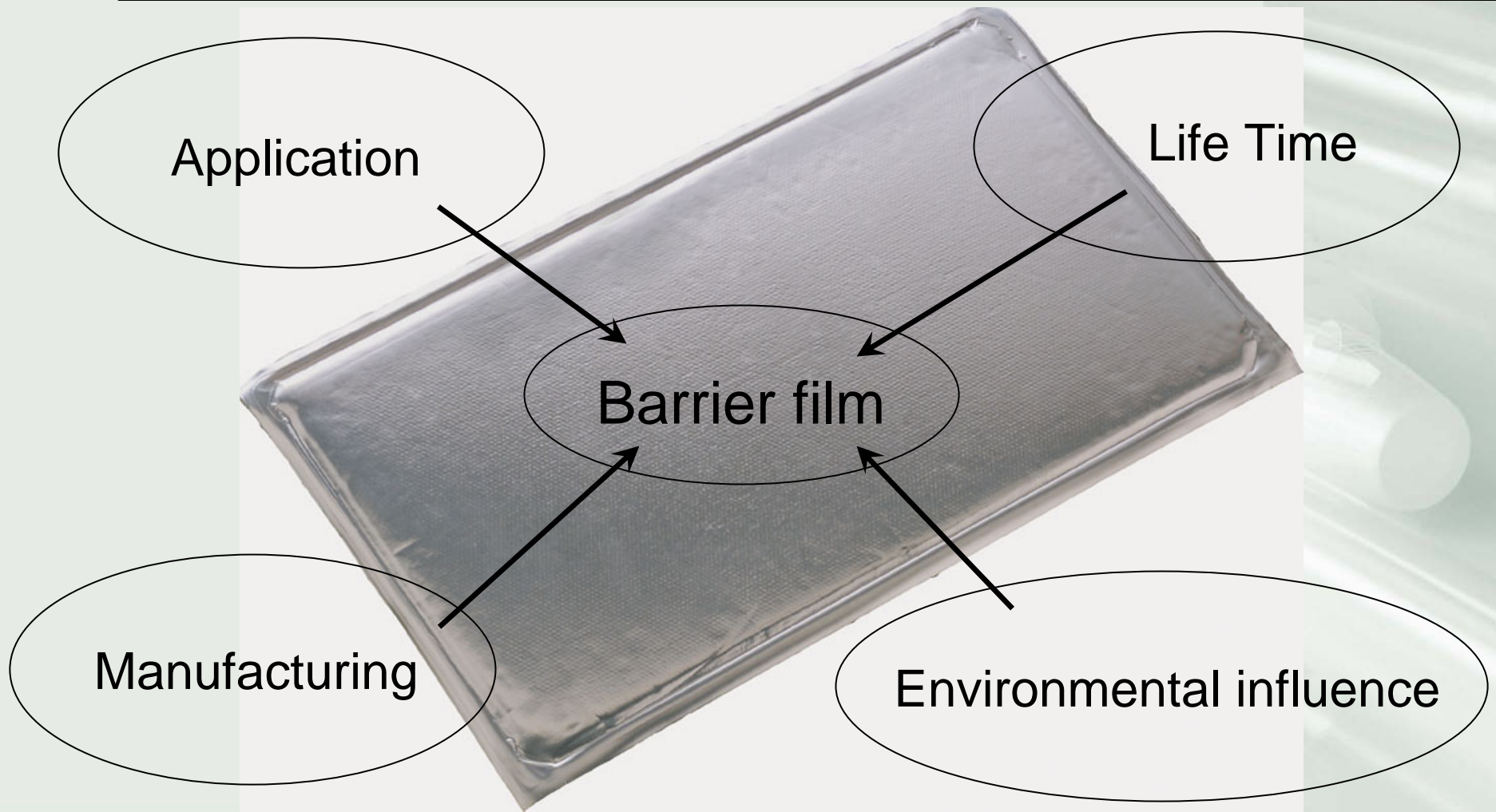
WIPAK GROUP - ORGANISATION



AGENDA

- **Introduction**
- **Requirements to a vacuum insulation panel
(VIP) / barrier film**
- **Influencing factors**
- **Summary/ Outlook**

REQUIREMENTS



REQUIREMENTS TO A BARRIER FILM

- High oxygen barrier
 $< 0,01 \text{ cm}^3/\text{m}^2 \text{ d bar}$ (23°C, 75 % r.h.)
- High water vapor barrier
 $< 0,05 \text{ g}/\text{m}^2 \text{ d}$ (38°C, 90 % r.h.)
- High mechanical strength
- Cost effectiveness
- Low thermal conductivity
- Long-life
- Compatibility with other materials (adhesive, foam, plaster,...)

VIP APPLICATION



Shipping and
transportation containers
Size: 0,3m x 0,3 m
Life time : 1 a



Domestic and industrial
refrigeration:
Size : 0,7m x 1 m
Life time : 15 a



House insulation
Size: 1,25m x 2 m
Life time: 30 a +

INFLUENCING FACTORS ON THE PERMEATION

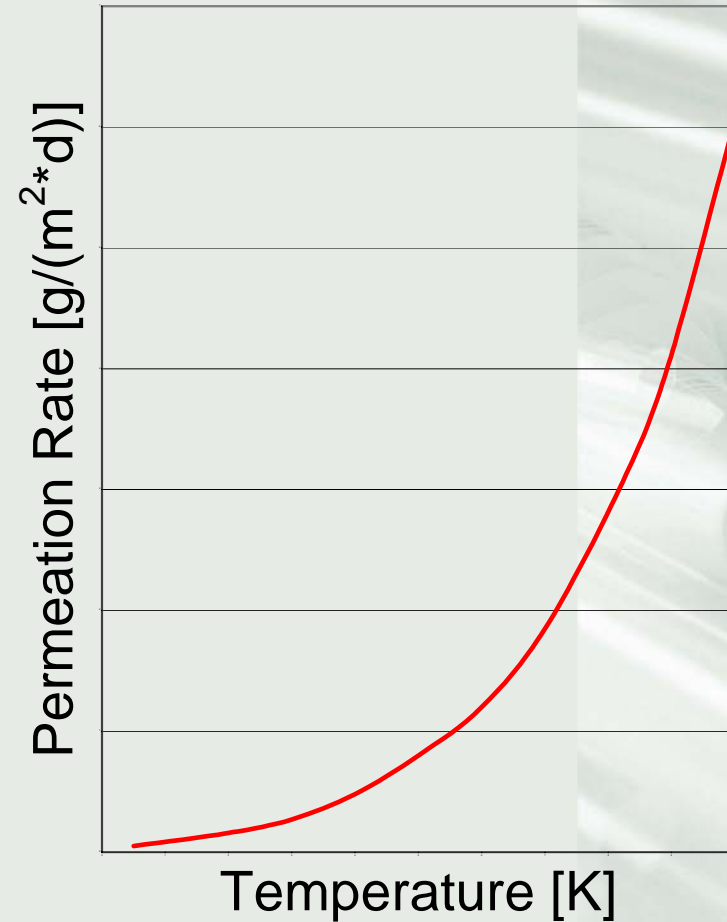
- Life time
- Temperature
- Humidity
- Structure of the laminated film
- Mechanical Stress

TEMPERATURE

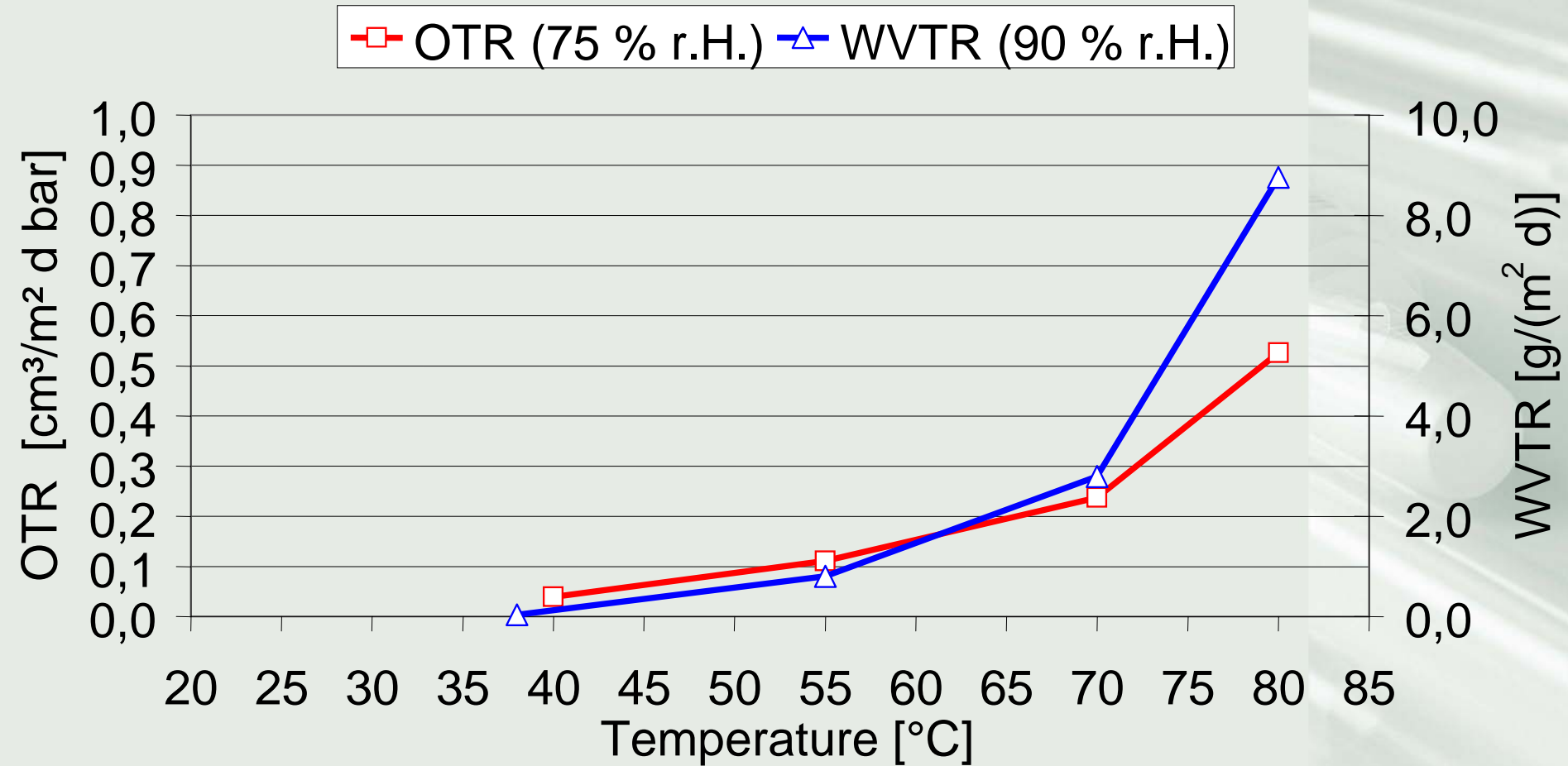
What did it mean?

Refrigerator	Building
Nearly the same temperature over year	Different temperature over one year

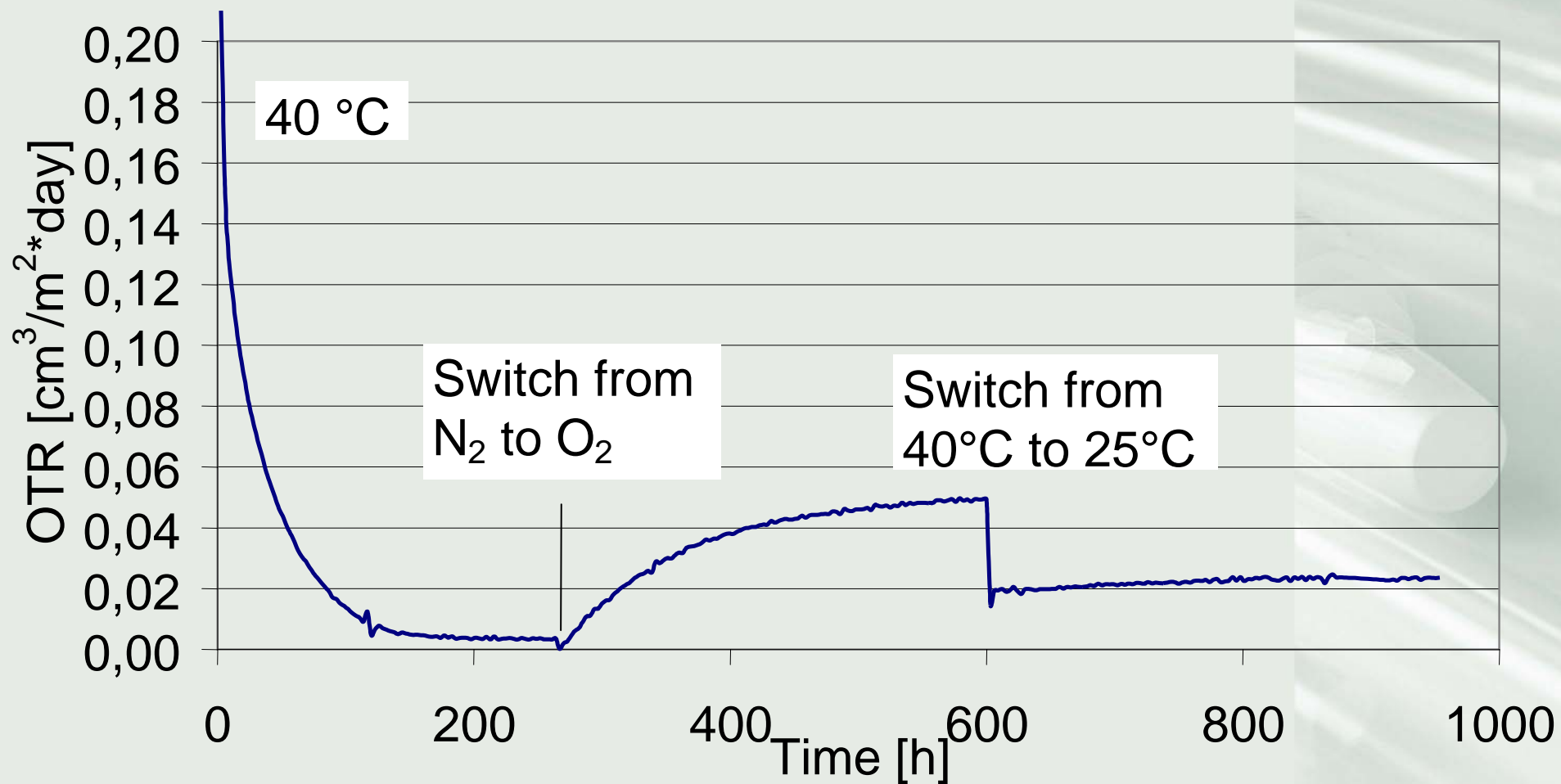
Temperature rise of 1 K increases the permeation about 5-7 %



PERMEATION VS. TEMPERATURE



MONITORING OF THE OTR OVER SEVERAL HOURS

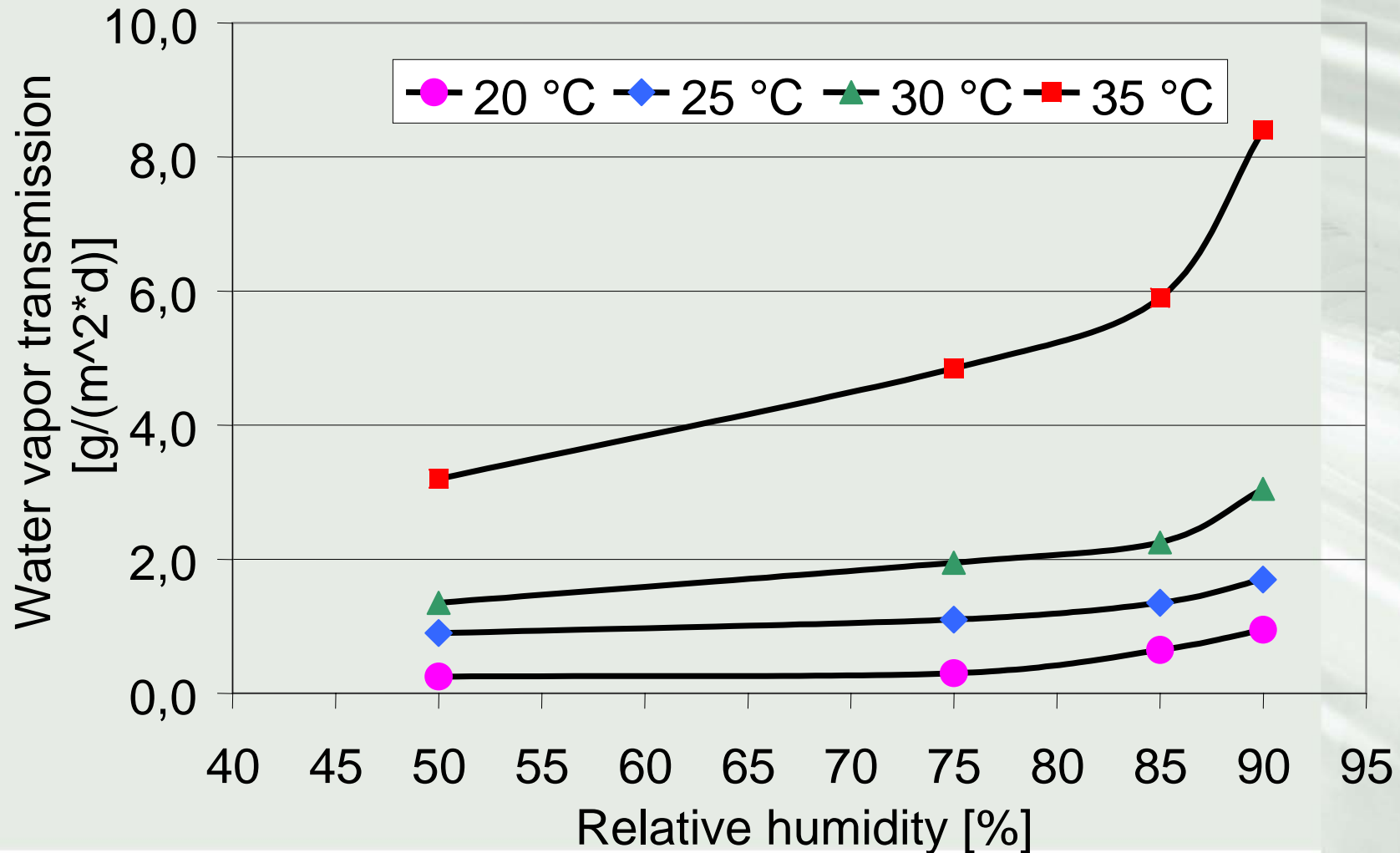


INFLUENCING FACTORS ON THE PERMEATION

- Life time
- Temperature
- Humidity
- Structure of the laminated film
- Mechanical Stress

WATER VAPOR TRANSMISSION RATE

12 μm PET, 2g/m² PVdC COATED



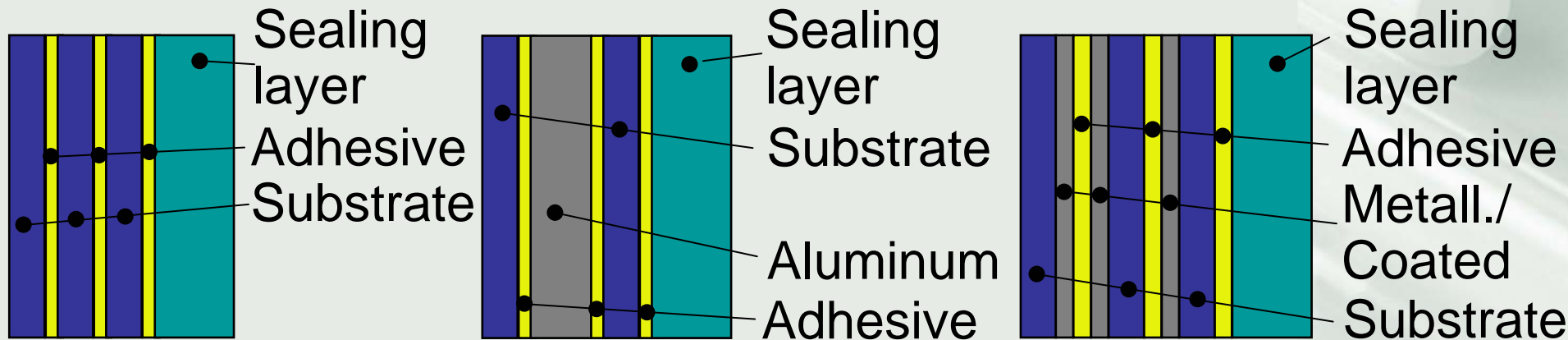
INFLUENCING FACTORS ON THE PERMEATION

- Life time
- Temperature
- Humidity
- Structure of the laminated film
- Mechanical Stress

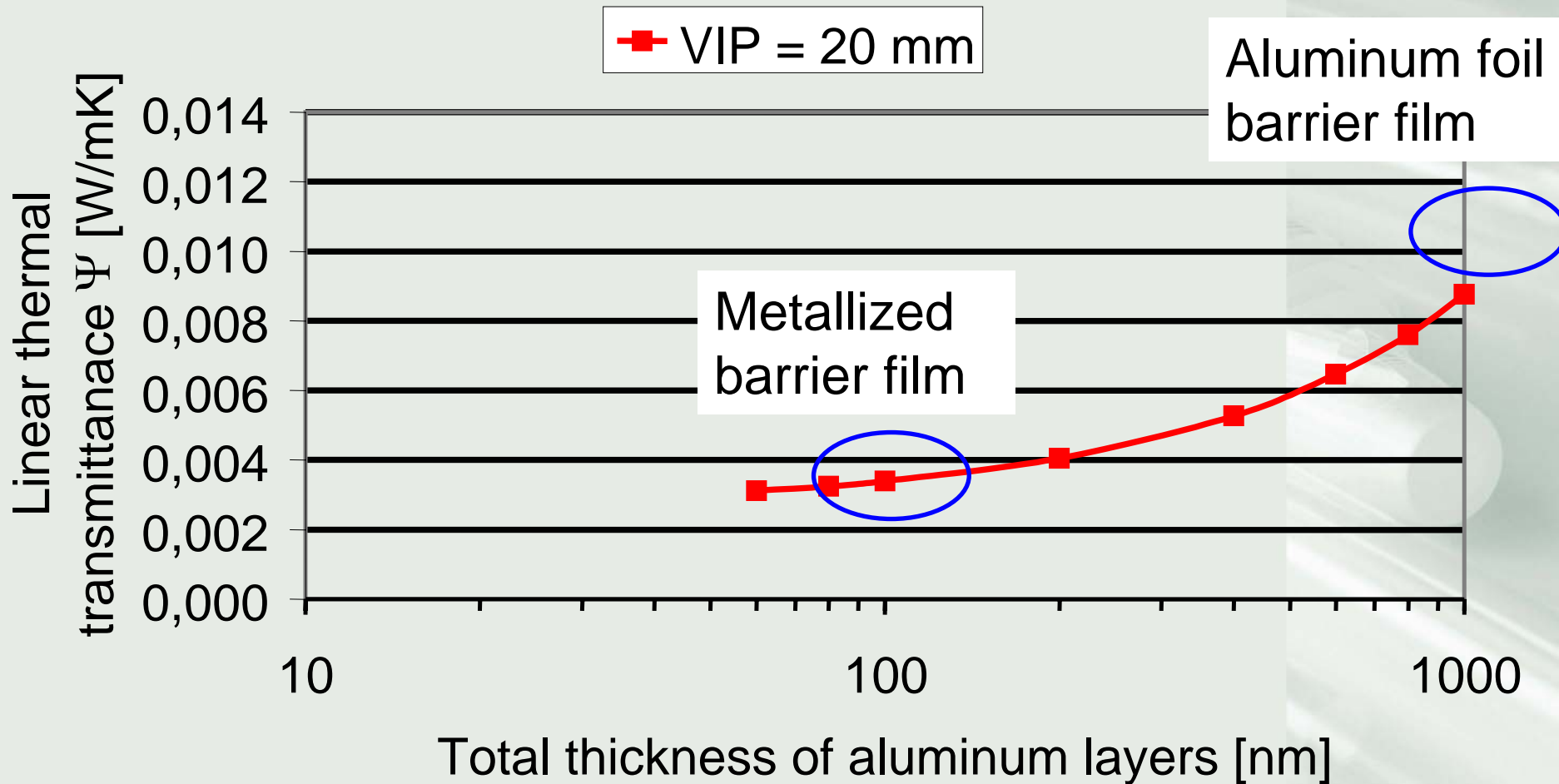
STRUCTURE OF THE FILMS

Requirements can be fulfilled by following structures

- Purely polymeric barrier films
- Aluminum foil based barrier films
- Metallised/ coated barrier films



LINEAR THERMAL TRANSMITTANCE VS. THICKNESS OF ALUMINIUM LAYERS

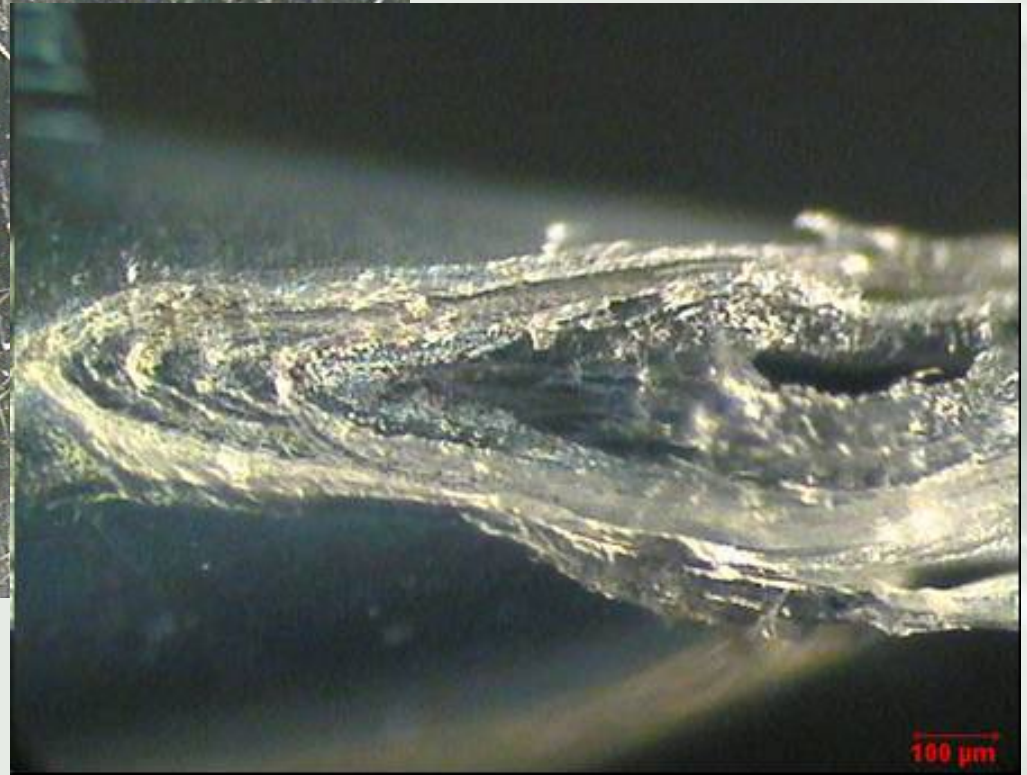
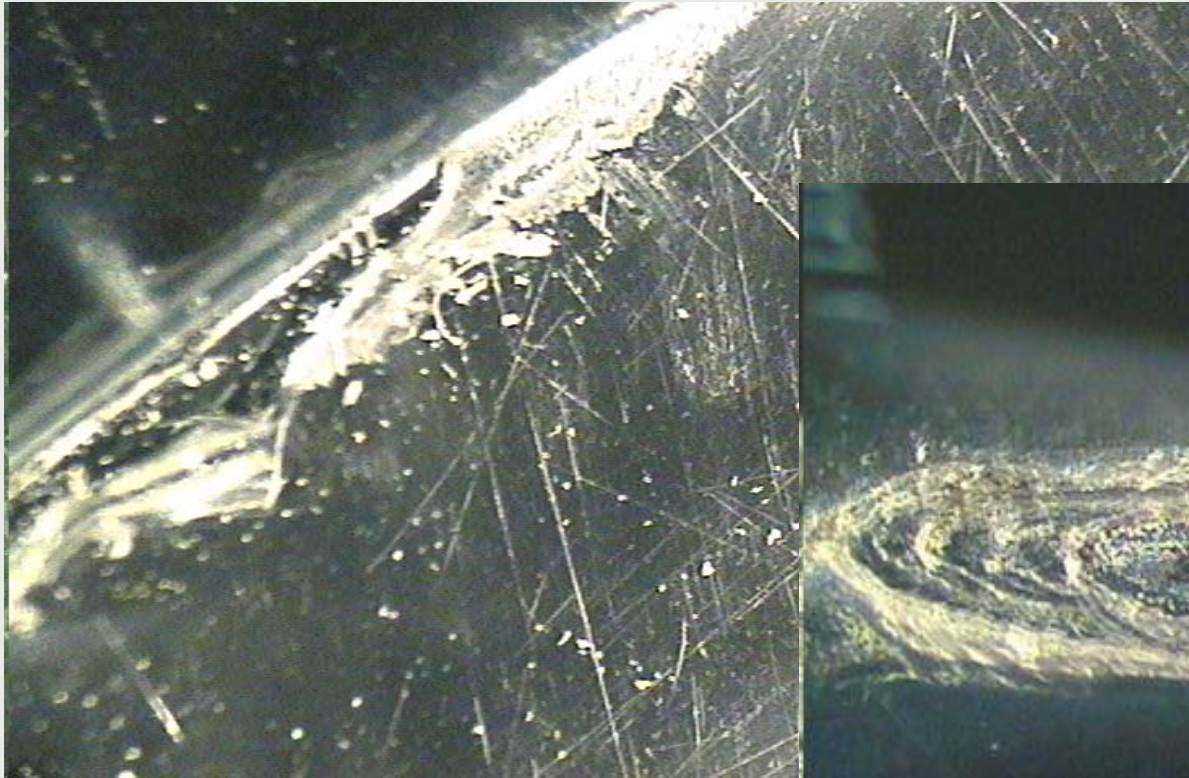


[EMPA, Switzerland]

INFLUENCING FACTORS ON THE PERMEATION

- Life time
- Temperature
- Humidity
- Structure of the laminated film
- Mechanical Stress

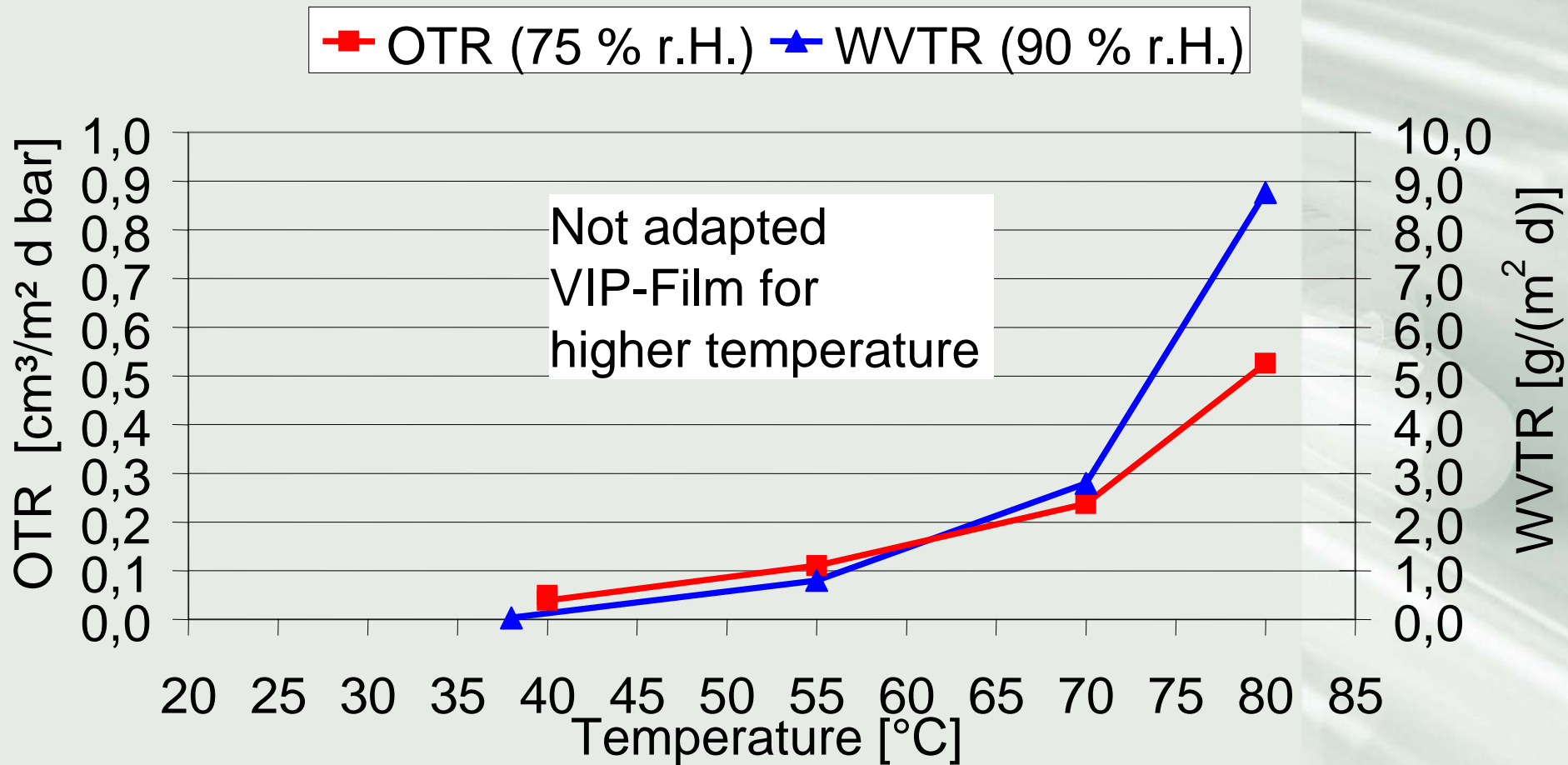
MECHANICAL STRESS



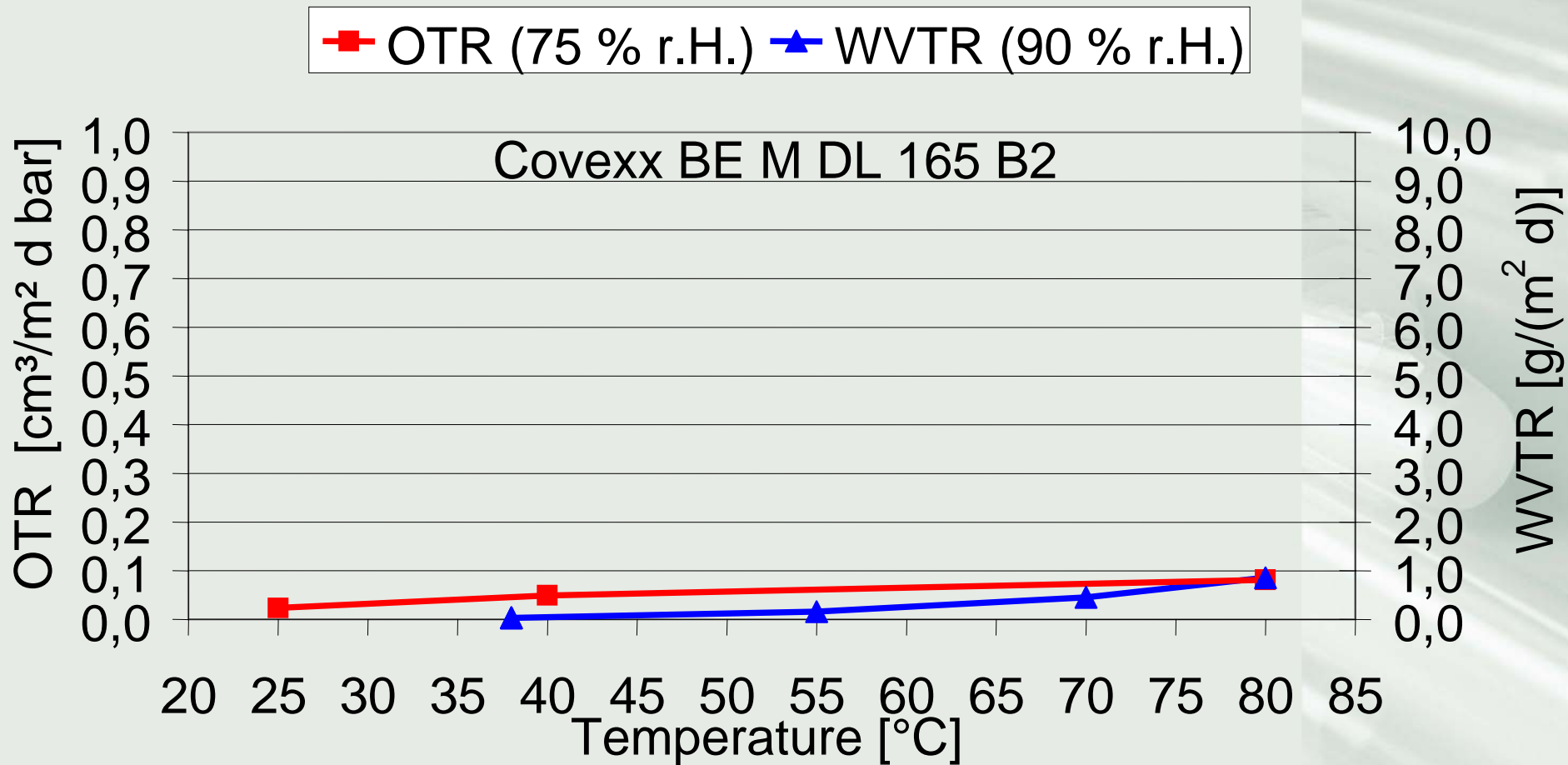
MECHANICAL STRESS

- A VIP is a sensitive product (from the lamination process to the final product)
- It is important to know how is the environment (acidic, temperature)
- How will the VIP be fixed?

THE PAST



COVEXX BE M DL 165 B2



SUMMARY/OUTLOOK

- VIPs are used in a wide range (transport boxes, refrigerator, houses)
- Wipak, has long experience in the field of VIPs, offers VIP-films for different applications (short life time, long life time, fire resistant)
- 80% of used VIP Barrier films are based on multi-layer metallized structure
- Due to a continuous development, new areas of applications have been made available
- Long-term ageing resistance > 10 years could only be estimated

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