

# How laminates with EVAL™ EVOH film improve the performance of VIPs

Cynthia Teniers  
EVAL Europe nv (Belgium)



17th & 18th September 2009  
The Royal Institution of Great Britain, London

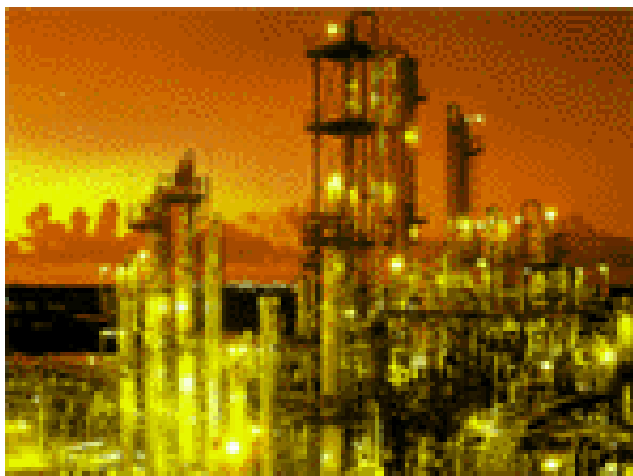
# kuraray

- Established in 1926
- 70 companies – 7000 employees
- Leader in high gas barrier technology and development
- World's leading producer of EVOH (ethylene vinyl-alcohol copolymer resins)

» EVAL ASIA-PACIFIC



» EVAL AMERICAS



» EVAL EUROPE



# Our products

## EVAL™ EVOH resins



## EVAL™ EVOH films

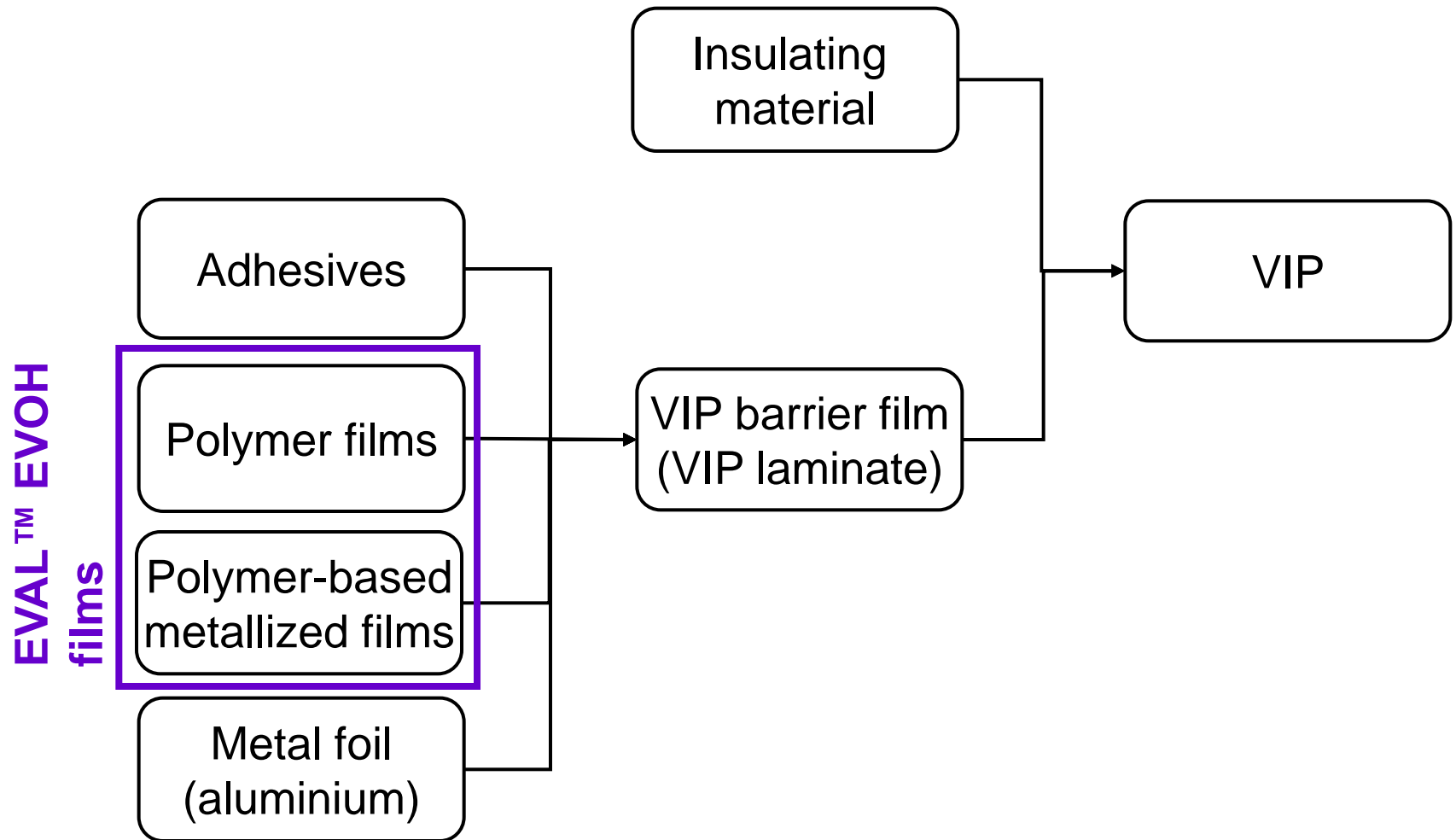
Monolayer  
EVOH films



Vacuum metallized  
EVOH films



# VIP value chain



# How laminates with EVAL™ EVOH film improve the performance of VIPs

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# Recent VIP successes in Japan

Courtesy of Panasonic - [www.panasonic.co.jp](http://www.panasonic.co.jp)

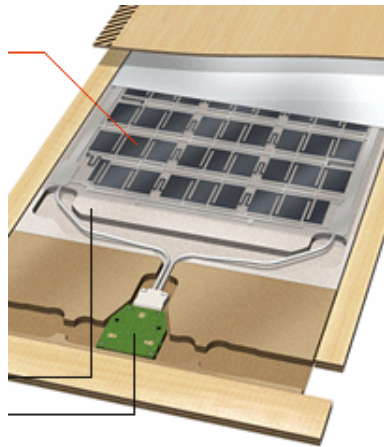


- “Eco Cute” from Panasonic CO<sub>2</sub> heat pump for hot water heater
- VIP around metal hot water tank (volume: 460 l or 370 l)
- Technical requirements
  - Temperature (60°C/100°C)
  - Moist conditons



# Recent VIP successes in Japan

Courtesy of Panasonic - [www.panasonic.co.jp](http://www.panasonic.co.jp)



- Floor heating
- VIP underneath floor heating elements
- Technical requirements
  - Temperature (40°C)
  - Long service life (20 years)

# Recent VIP successes in Japan

Courtesy of Panasonic - [www.panasonic.co.jp](http://www.panasonic.co.jp)



- Wall heating
- VIP underneath wall heating elements in a bathroom/toilet
- Technical requirements
  - Temperature (40°C)
  - Moist conditons
  - Long service life (20 years)



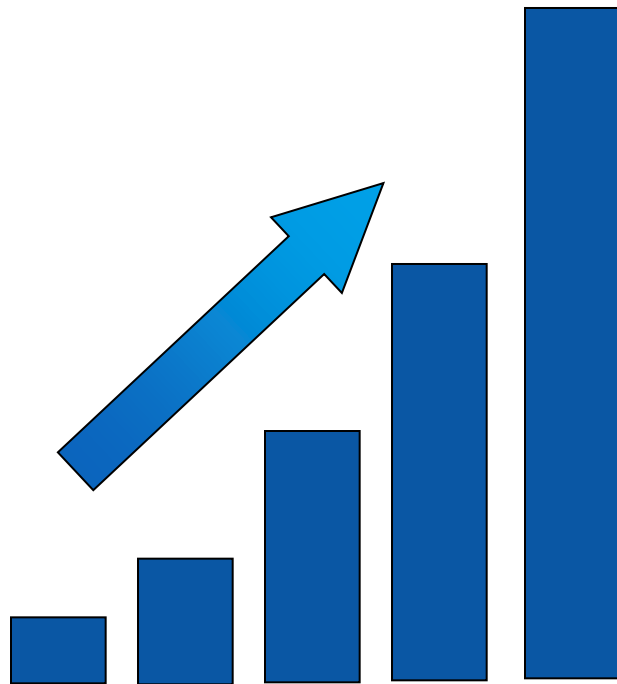
# Recent VIP successes in Japan

Courtesy of Achilles Co., Ltd - [www.achilles.jp](http://www.achilles.jp)



- Insulation boards for walls
- VIP integrated in a PUR-board to avoid damage during installation
- Technical requirements
  - Moist conditions
  - Long service life (50 years)

# VIP market needs / trends



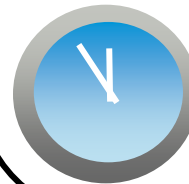
Market volumes



High temperature



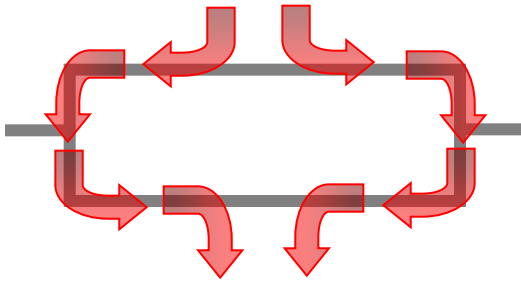
Moist conditions



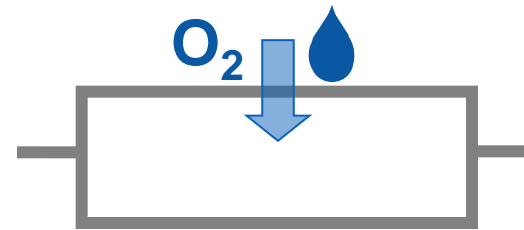
Longer service life

# Technical challenges VIP laminates

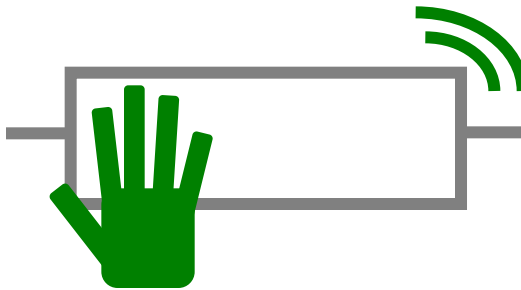
Minimal thermal conductivity



Minimal gas permeation through the skin



Resistance to manipulation



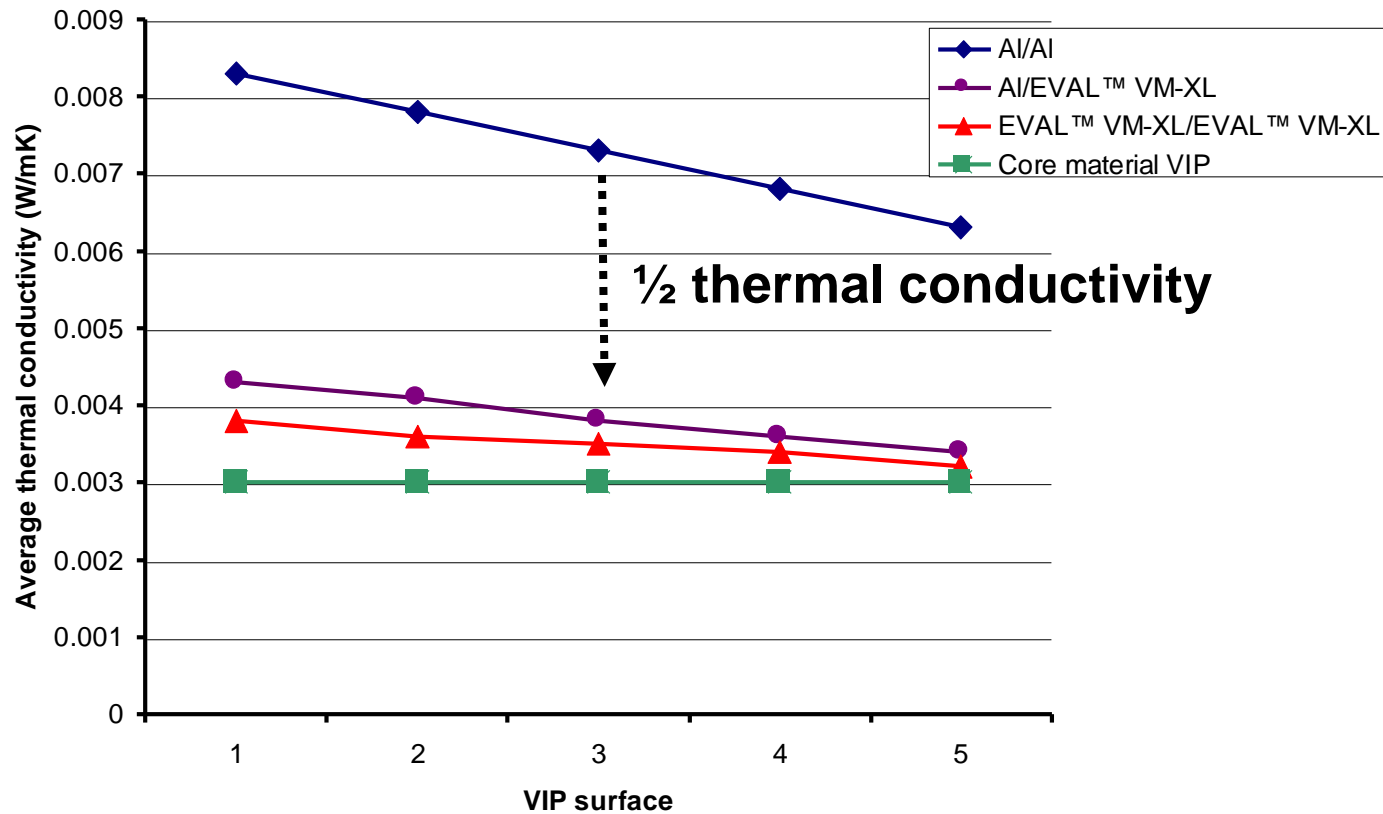
Minimal gas permeation through the seals



# How to achieve minimal thermal conductivity?

- $\lambda_{\text{total}} = \lambda_{\text{solid}} + \lambda_{\text{gas}} + \cancel{\lambda_{\text{radiation}}} + \cancel{\lambda_{\text{convection}}}$ 
  - Reduced atmospheric pressure inside the VIP
  - Almost zero- Negligible below 100°C
- Use envelopes/films with a high gas barrier
  - Use aluminium foil  
(very low  $\lambda_{\text{gas}}$  but high  $\lambda_{\text{solid}}$ )
  - Use gas barrier film - **EVAL™ EVOH film**  
(low  $\lambda_{\text{gas}}$  and low  $\lambda_{\text{solid}}$ )
- Reduce the thickness of the aluminium layer
  - Use metallized films - **EVAL™ VM-XL**  
(low  $\lambda_{\text{solid}}$  and very low  $\lambda_{\text{gas}}$ )

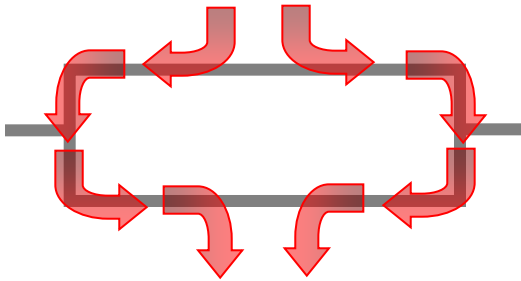
# Minimal thermal conductivity



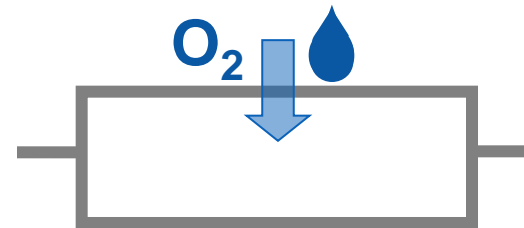
- Use an Al/EVAL™ VM-XL envelope instead of an Al/Al envelope and you will increase the insulation performance of the VIP

# Technical challenges VIP laminates

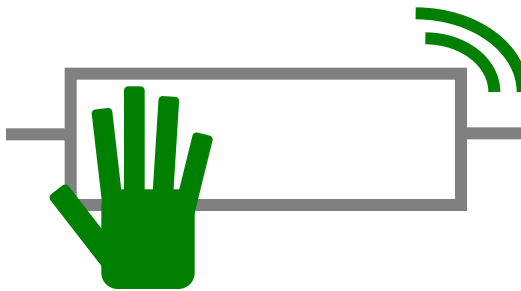
Minimal thermal conductivity



Minimal gas permeation through the skin



Resistance to manipulation



Minimal gas permeation through the seals





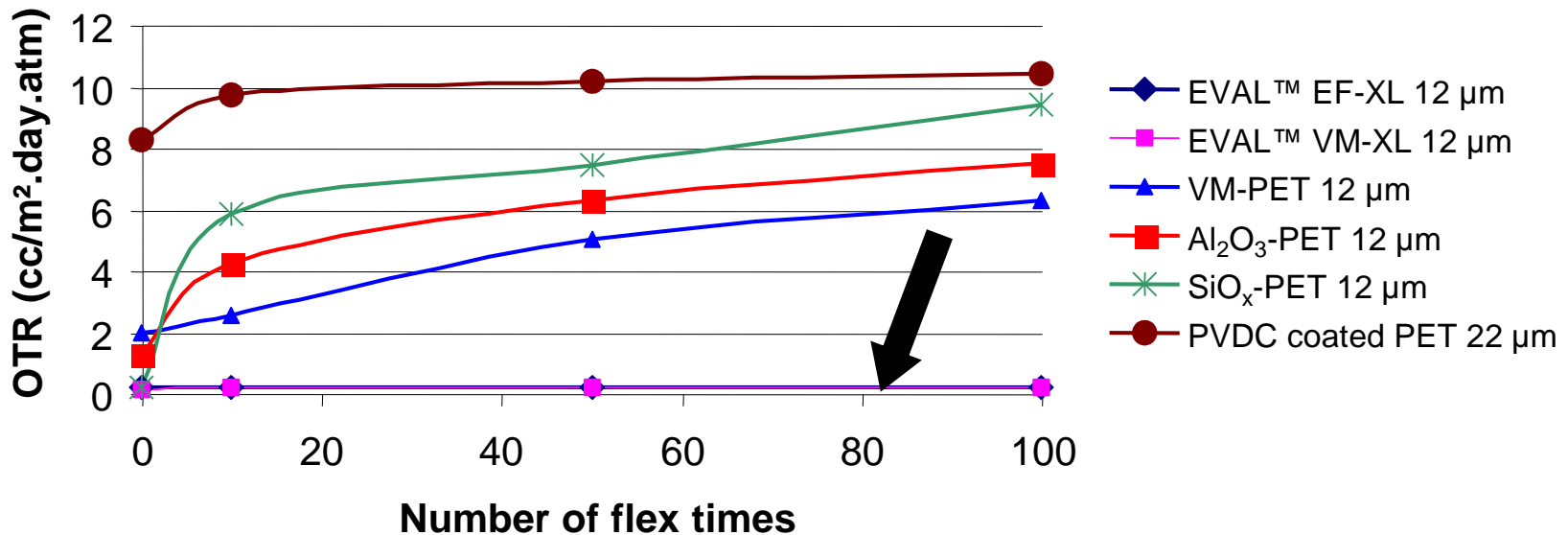
# Resistance to manipulation

## Gelbo flex test



# Resistance to manipulation

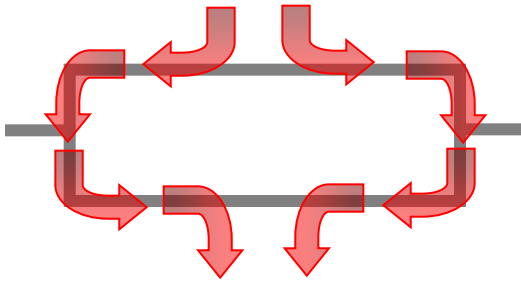
Oxygen transmission rate (20°C, 65% RH) after Gelbo flex test



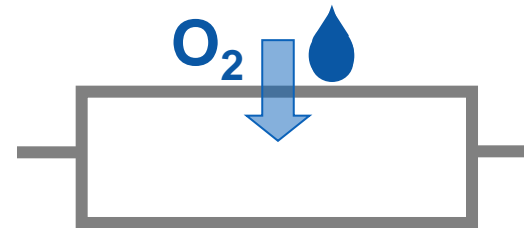
- Use EVAL™ EVOH films to ensure that the barrier of the VIP is not damaged during production, transport and installation

# Technical challenges VIP laminates

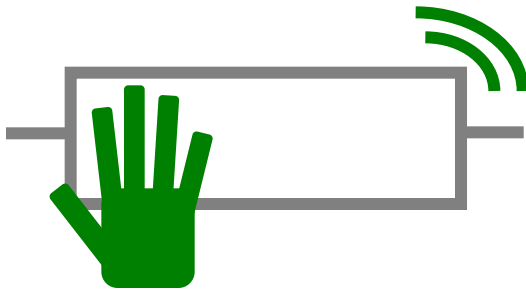
Minimal thermal conductivity



Minimal gas permeation through the skin



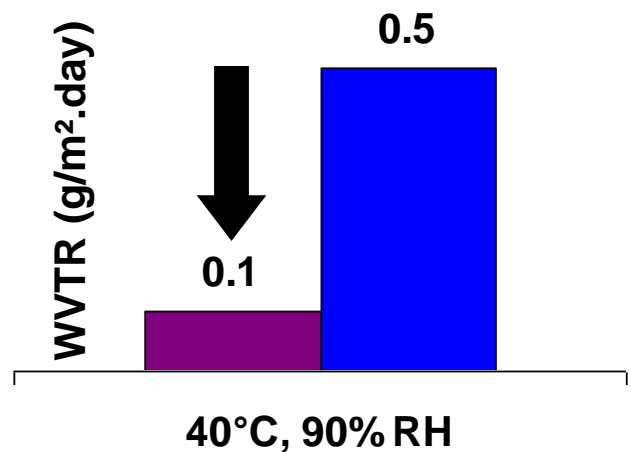
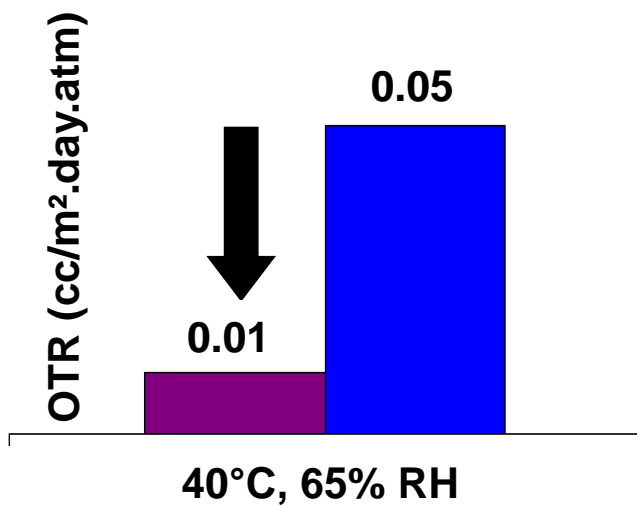
Resistance to manipulation



Minimal gas permeation through the seals



# Minimal gas permeation through the skin



■ EVAL™ TM-XL ■ EVAL™ VM-XL

## ■ EVAL™ TM-XL

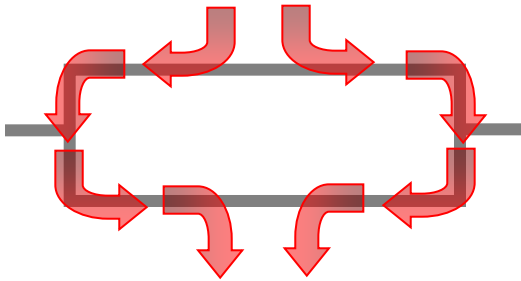
New generation of vacuum metallized EVOH film

For applications with higher operating temperatures, moist conditions and a longer service life

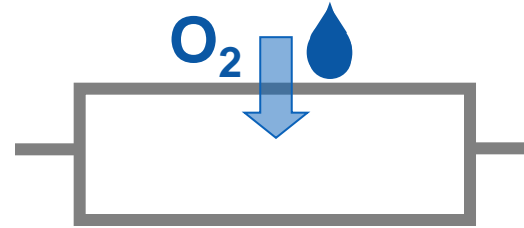
A robust film with excellent oxygen barrier and improved water vapour barrier

# Technical challenges VIP laminates

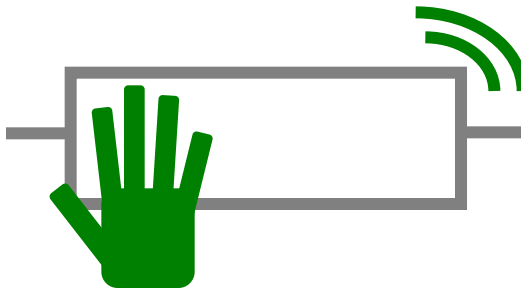
Minimal thermal conductivity



Minimal gas permeation through the skin



Resistance to manipulation



Minimal gas permeation through the seals



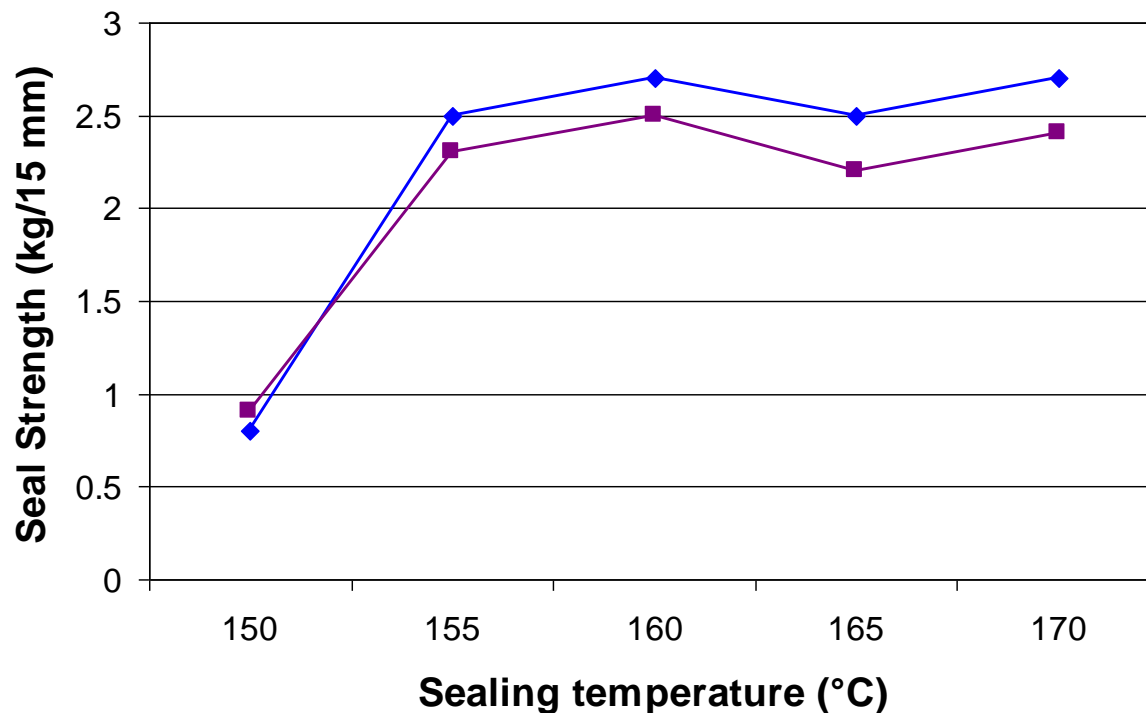
# Minimal gas permeation through seals

| Films       | Oxygen transmission rates of selected polymers<br>(cc.20 µm/m².d.atm) |   |
|-------------|---|---|
|             | 20°C, 65% RH  | 20°C, 85% RH  |
| EVAL™ EF-XL | 0.38  | 0.75  |
| EVAL™ EF-F  | 0.40  | 1.6   |
| EVAL™ EF-E  | 1.6   | 3.4   |
| cPP         | 3250  | 3250  |
| LDPE        | 10000   | 10000   |
|             | <div> <div> </div> <div> </div> <div> </div> </div>                   | <div> <div> </div> <div> </div> <div> </div> </div> |

- Use EVAL™ EVOH films to reduce the total permeation of oxygen via the seals and extend the life time of the VIPs



# Minimal gas permeation through seals



—◆— EVAL™ EF-E 30 micron —■— EVAL™ EF-E 25 micron

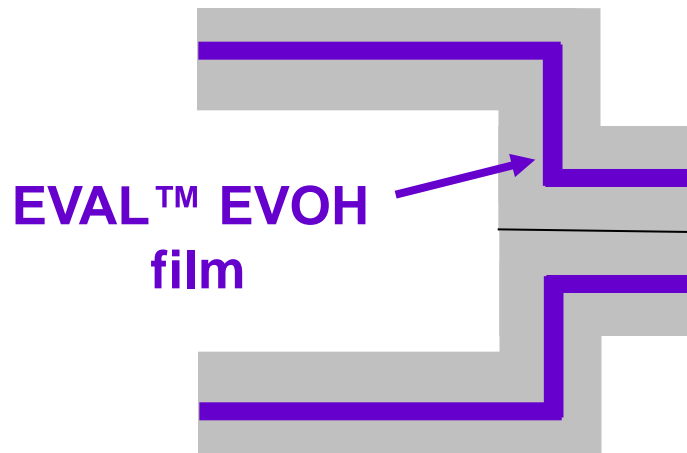
Seal conditions: force = 1 kg/cm<sup>2</sup>, dwell time = 0.5 seconds

Laminate structure: OPA//EVAL™ EF-E

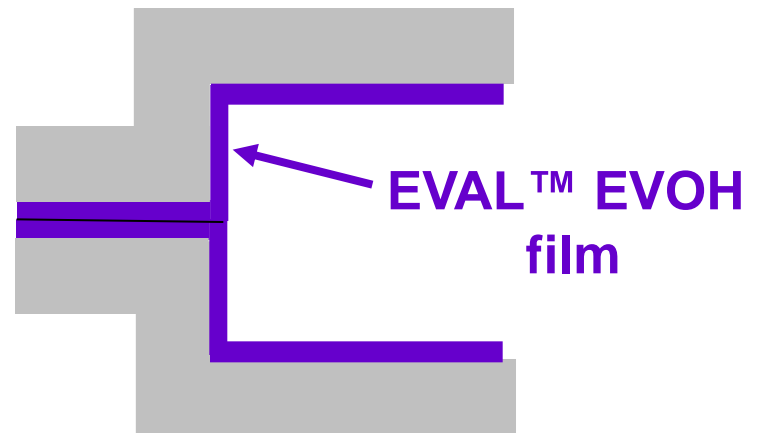
- Typical sealing temperatures for EVAL™ EVOH films

# Conclusion

- EVAL™ EVOH films can be introduced as an intermediate layer and/or sealing layer



Intermediate layer

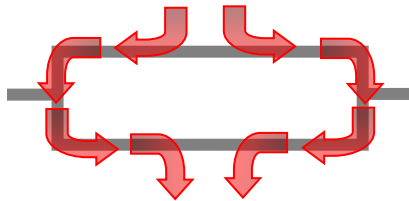


Sealing layer

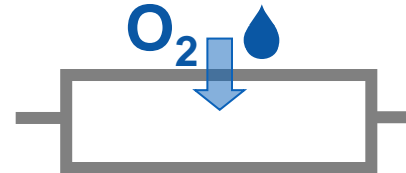
# Conclusion

- Use EVAL™ EVOH films to increase the insulation performance, service life and operating temperature of VIPs

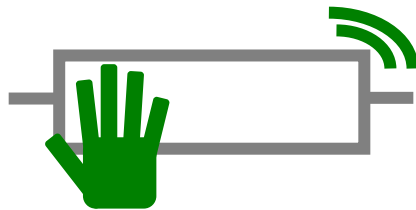
**Minimal thermal conductivity**



**Minimal gas permeation through the skin**



**Resistance to manipulation**



**Minimal gas permeation through the seals**

