



Managing Permeation on PTFE lined Piping in Chlorine & HCl applications

Introduction to PTFE & PFA material

What is Permeation?

Negative impacts of Permeation?

What influences Permeation?

Different PTFE Grades

How can we minimize Permeation?

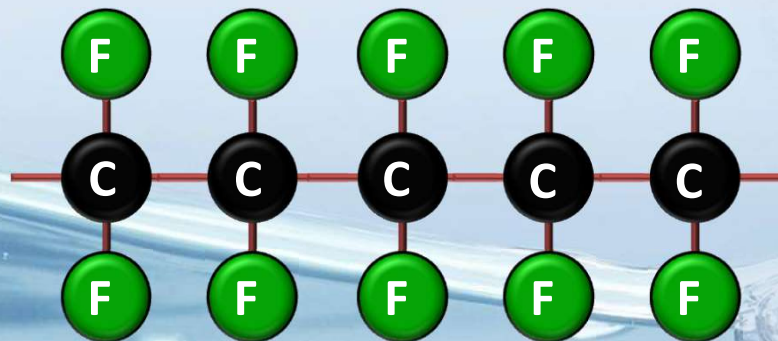
Case History

How does external insulation help to increase lifetime?

What is the ideal specification in permeable applications?

Presented by Michael Bruemmer at NACE

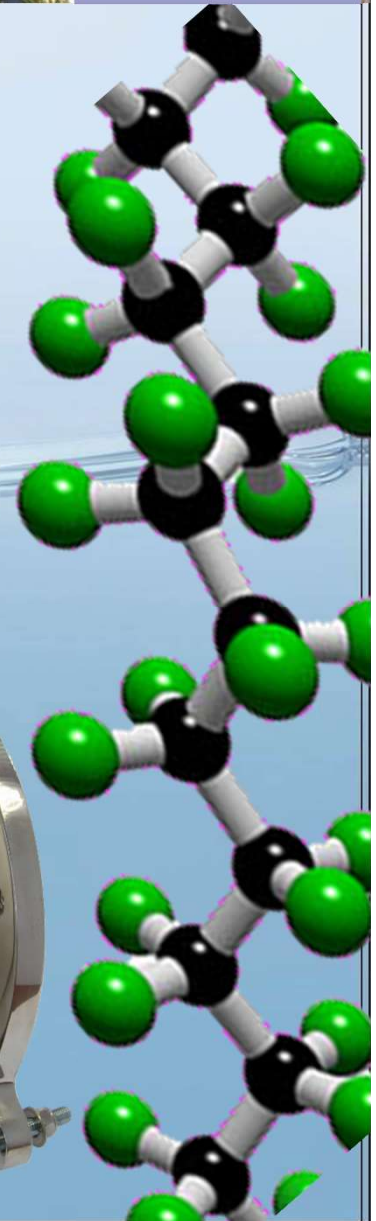
PTFE means POLYTETRAFLUOROETHYLENE



Advantages:

- + excellent universal chemical resistance
- + anti-adhesive surface
- + UV-resistance
- + wide temperature range -15°F to 392°F^*
- + etc.

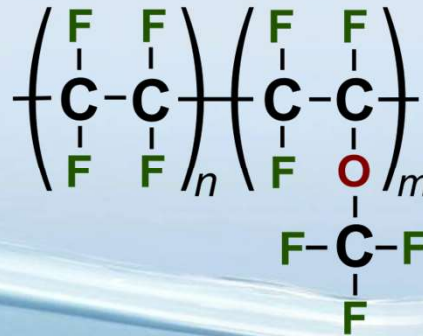
* In special applications also a wider temperature range



Intro of PTFE and PFA:



PFA means PERFLUOROALKOXY ALKANE

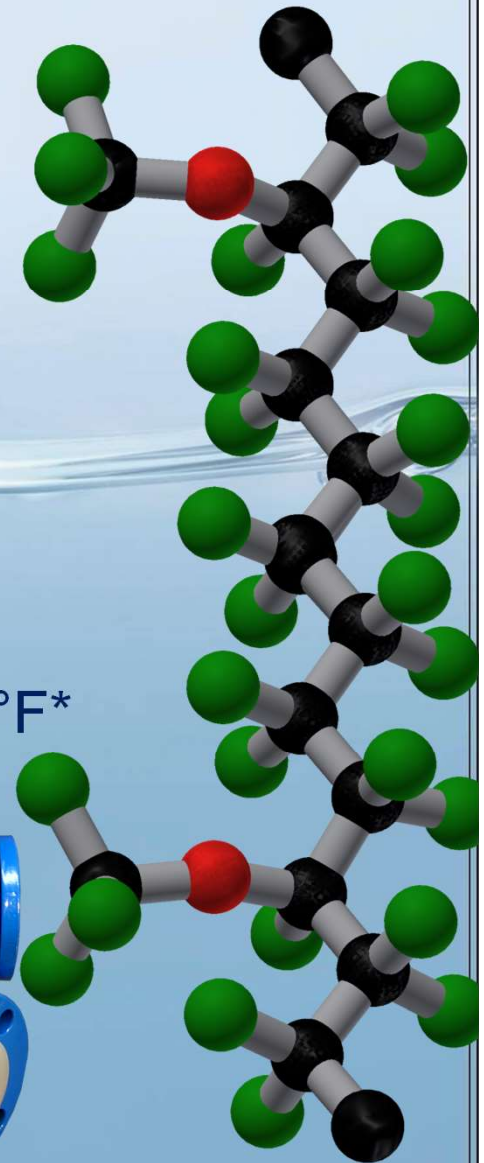


Advantages:

- + excellent chemical resistance
- + anti-adhesive surface
- + UV-resistance
- + wide temperature range -15°F to 392°F*
- + very similar to PTFE

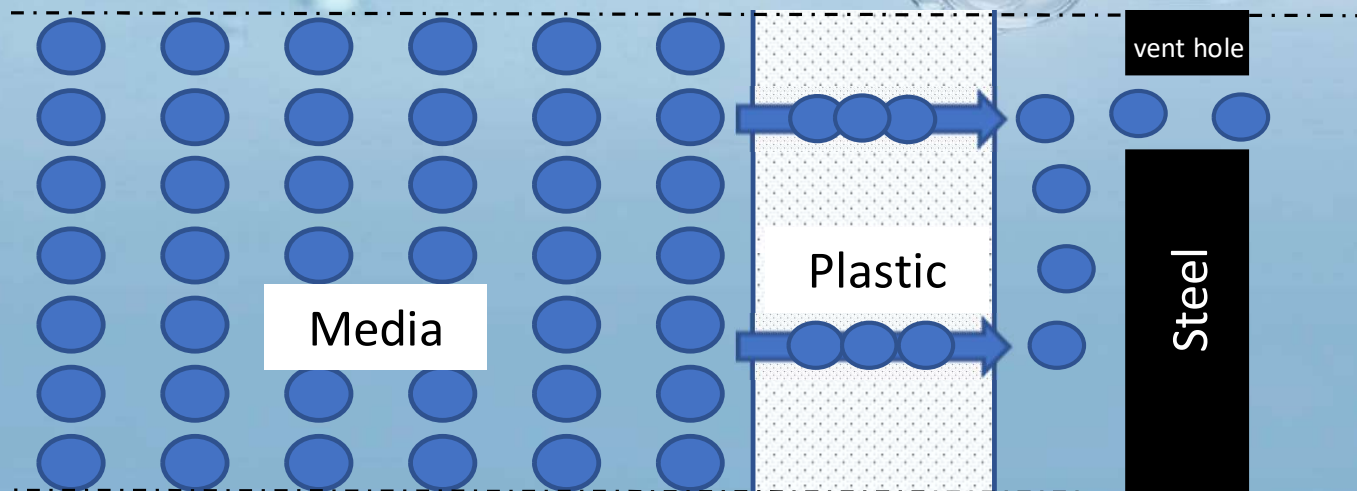
Real Thermoplastic like PVC or ABS
and can be therefore injection moulded

* In special applications
also a wider temperature range



What is Permeation?

Permeation on lined equipment describes the transport of media from one side of a liner to the other, mainly driven by the concentration gradient and to a lesser extent by the pressure differential.



Permeation

What are the negative impacts of permeation?

- ❖ Blistering of the PTFE and corrosion of the steel material
- ❖ Reduction of lifetime
- ❖ Maintenance costs and production loss
- ❖ Pollution and health problems for plant personnel
- ❖ Overall, it increases the total cost of ownership!



What influences Permeation?

- Chemical Service
- Concentration of chemicals on both sides of the lining
- Temperature
- Pressure
- Composition of the lining
- Lining thickness

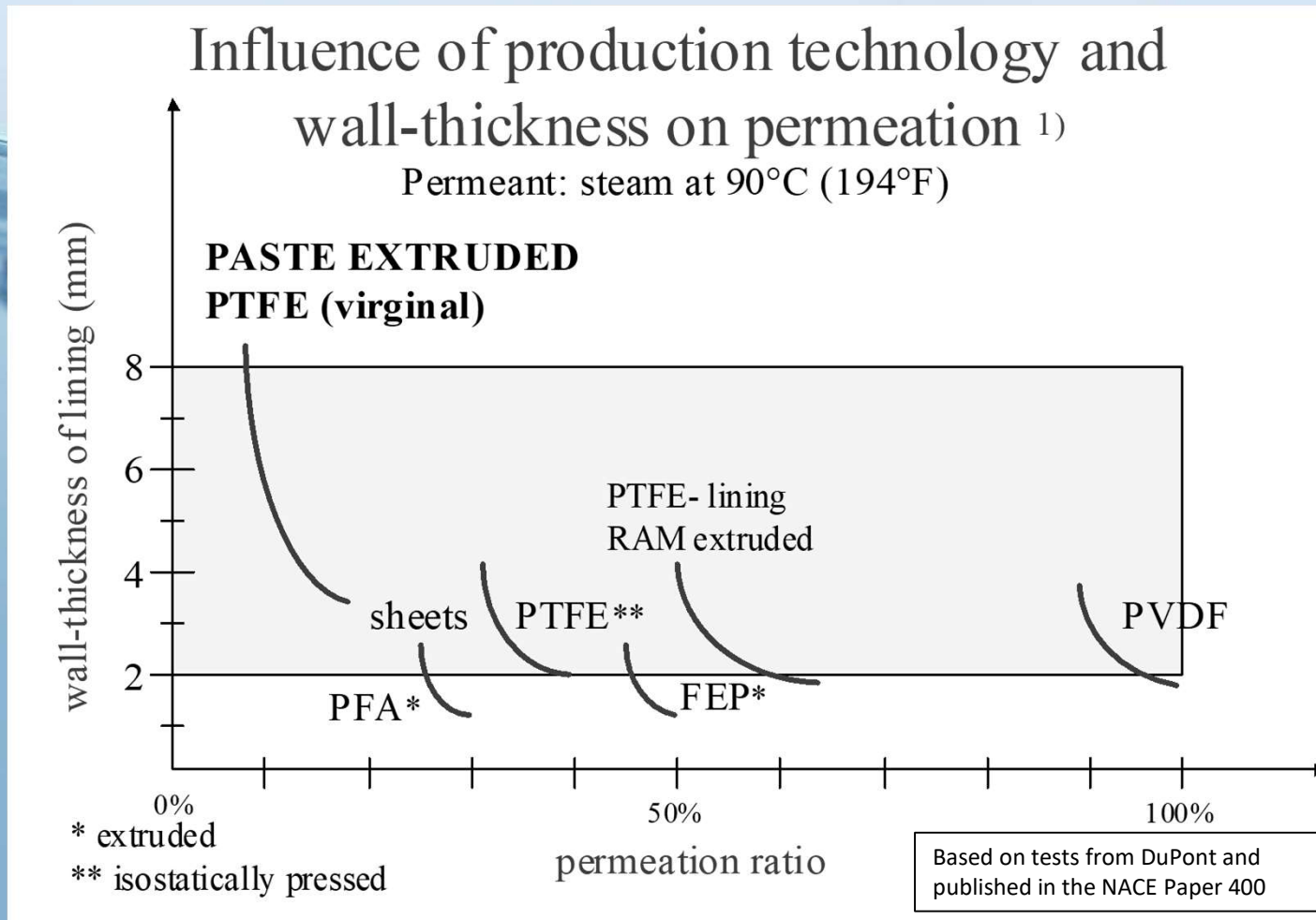
process driven

influenced by
specification

Different PTFE Grades:

- **Isostatically moulded PTFE**, using 20 μ m particles and a membrane to compress the PTFE resin. The flexibility of the membrane allows the lining of fittings & valve bodies, but also provides also a non-uniform lining thickness.
- **RAM extruded PTFE**, using 20 μ m particles, a piston compresses the PTFE resin which provides a non-homogeneous PTFE
- **Paste extruded PTFE**, using 0.2 μ m particles, continuous extrusion provides uniform lining thickness & homogeneous material allowing the lowest permeation rate

Different PTFE Grades:

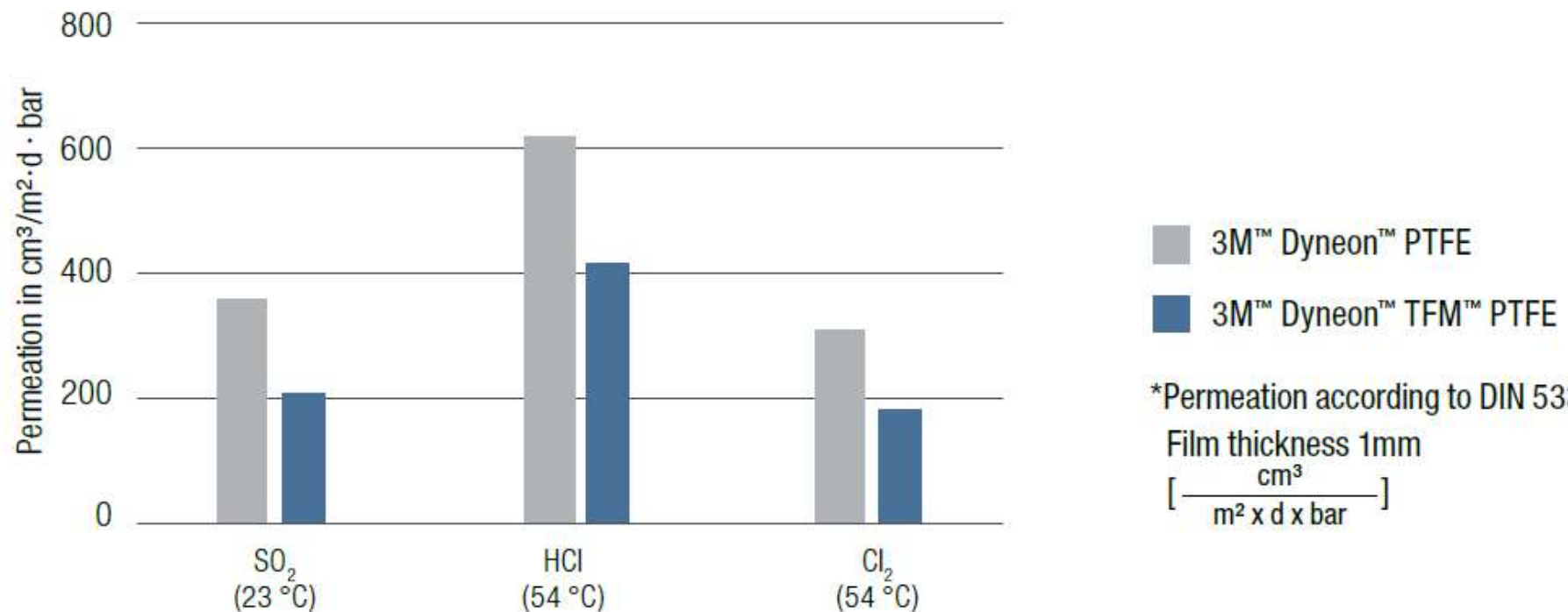


Permeation

Different PTFE Grades:

**Would anybody
like an upgrade?**

Modified(UHP) paste extruded PTFE!



*Permeation according to DIN 53380

Film thickness 1mm

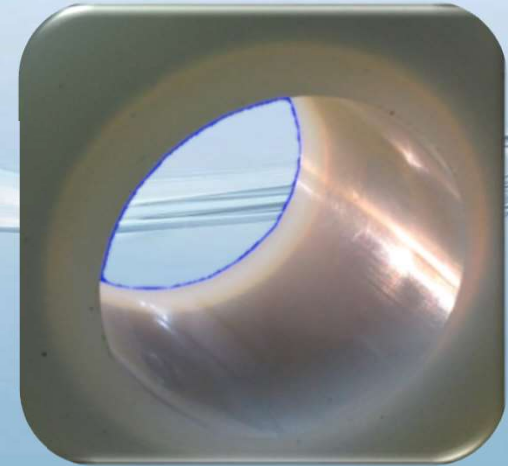
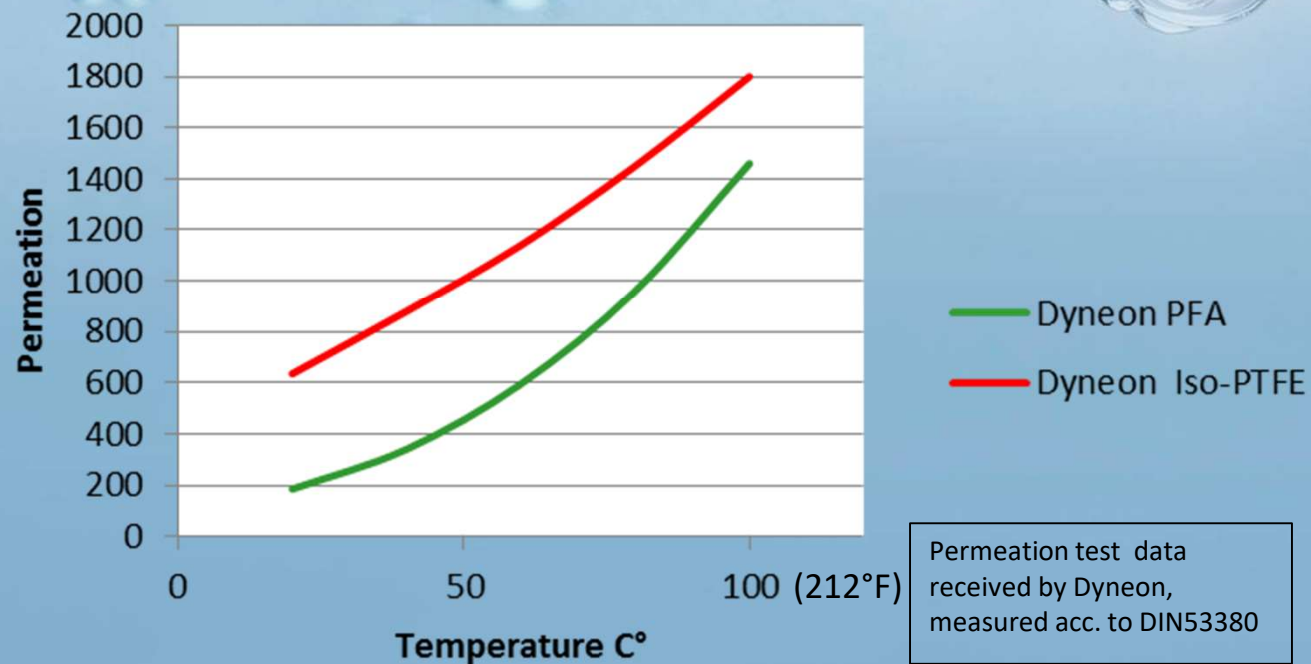
$$\left[\frac{\text{cm}^3}{\text{m}^2 \times \text{d} \times \text{bar}} \right]$$

Permeation

What does PFA offer?

- ✓ Smoothest surface = less surface to attack
- ✓ Reduction of Permeation

Permeation with HCl-Gas



How can we minimize Permeation?

- ✓ Modified, paste extruded PTFE for straight spools
- ✓ PFA lined (moulded) fittings, available up to 14"
- ✓ Highest lining thicknesses



Case History

Process: sat. HCl, MEOH, MECl, H₂O @130°C (266°F) – 3.5barg

Customer A:

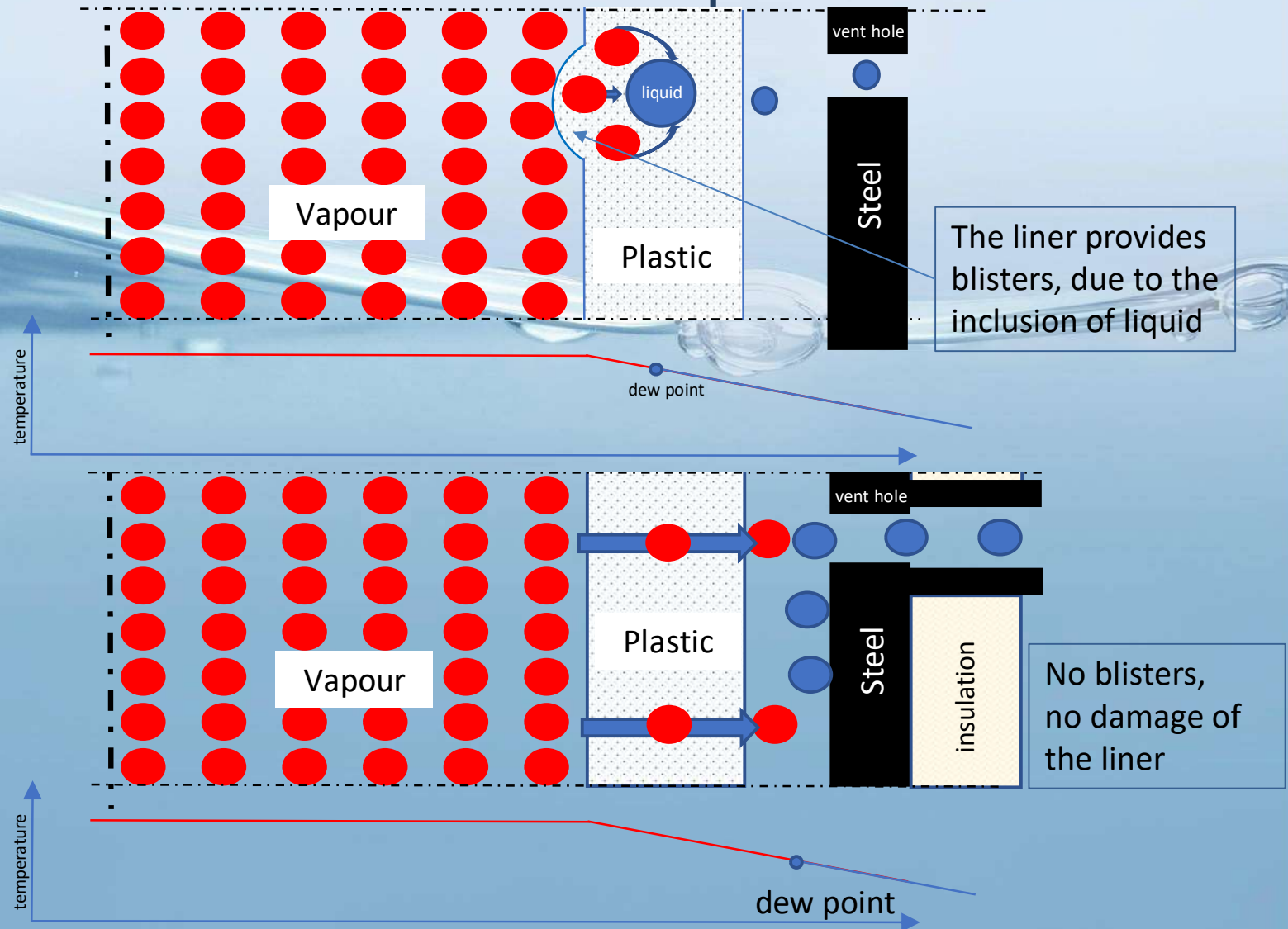
Iso-moulded PTFE lined fittings which needed to be replaced every 2 years due to heavy corrosion failure on steel housing.

Customer B:

- ✓ In the very same process this customer has been using PFA lined fittings. These have lasted more than 5 years, but will be replaced by preventive maintenance every 5 years.

External Insulation

How does external insulation help to increase lifetime?





Ideal Specification

What is the ideal specification in permeable applications?

1. Select a reliable, high quality supplier who follows the ASTM F1545 standard
2. Specify modified paste extruded PTFE & PFA material
3. Specify the thickest liner available
4. Specify vent bosses with PTFE sleeves and extensions

What are vent bosses?

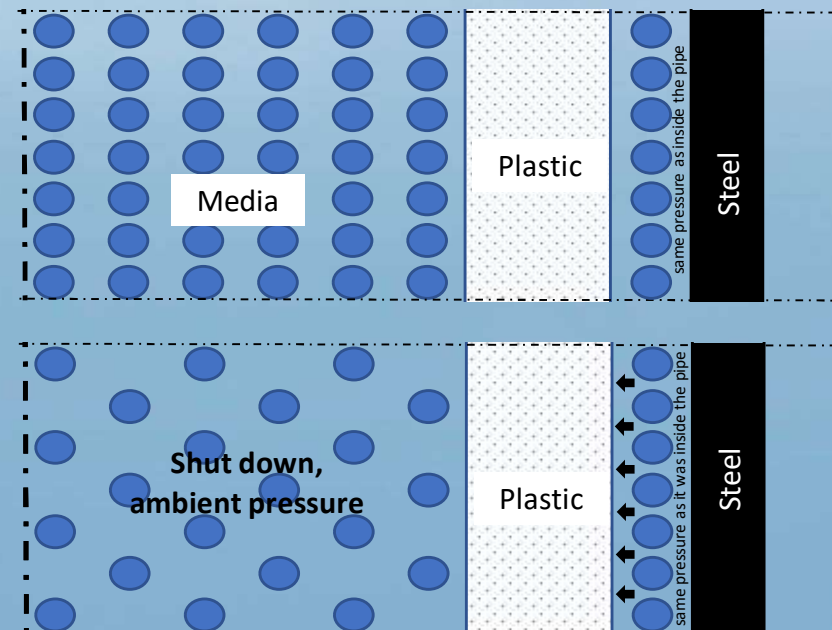
Why are the vent holes required?

1. Early failure indicator before catastrophic failure in case of liner failure
2. Escape port for permeated media

Otherwise:



Vent hole



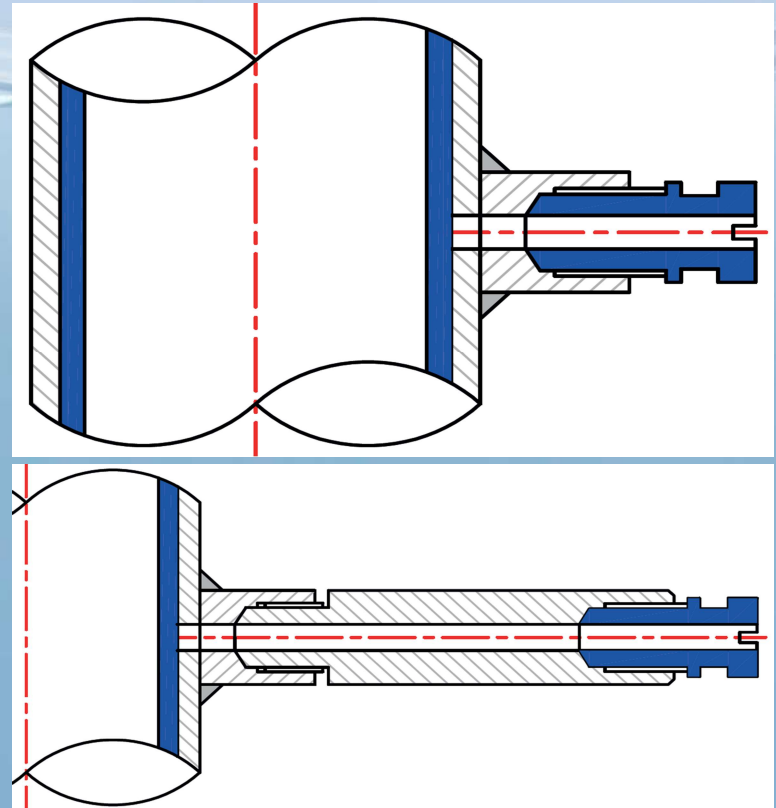
Ideal Specification

What is the ideal specification in permeable applications?

Vent hole without vent boss and extensions will provide corrosion on the steel pipes



Solution: Vent hole with vent boss, sleeve and extensions



A photograph of an industrial facility, likely a refinery or chemical plant, at night. The scene is illuminated by numerous bright lights, creating a complex network of glowing pipes, structures, and scaffolding against a dark sky. The lights are concentrated in the central and right portions of the image, with some dimmer lights visible on the left.

Ideal Specification

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5. Specify external insulation if condensable vapours could be present in the piping system

Ideal Specification

The given specification is also valid for other lined products:

i. e. paste extruded PTFE lined columns with PFA lined nozzle sections:





Questions?



Thanks for Listening