Managing Permeation on PTFE lined Piping in Chlorine & HCl applications

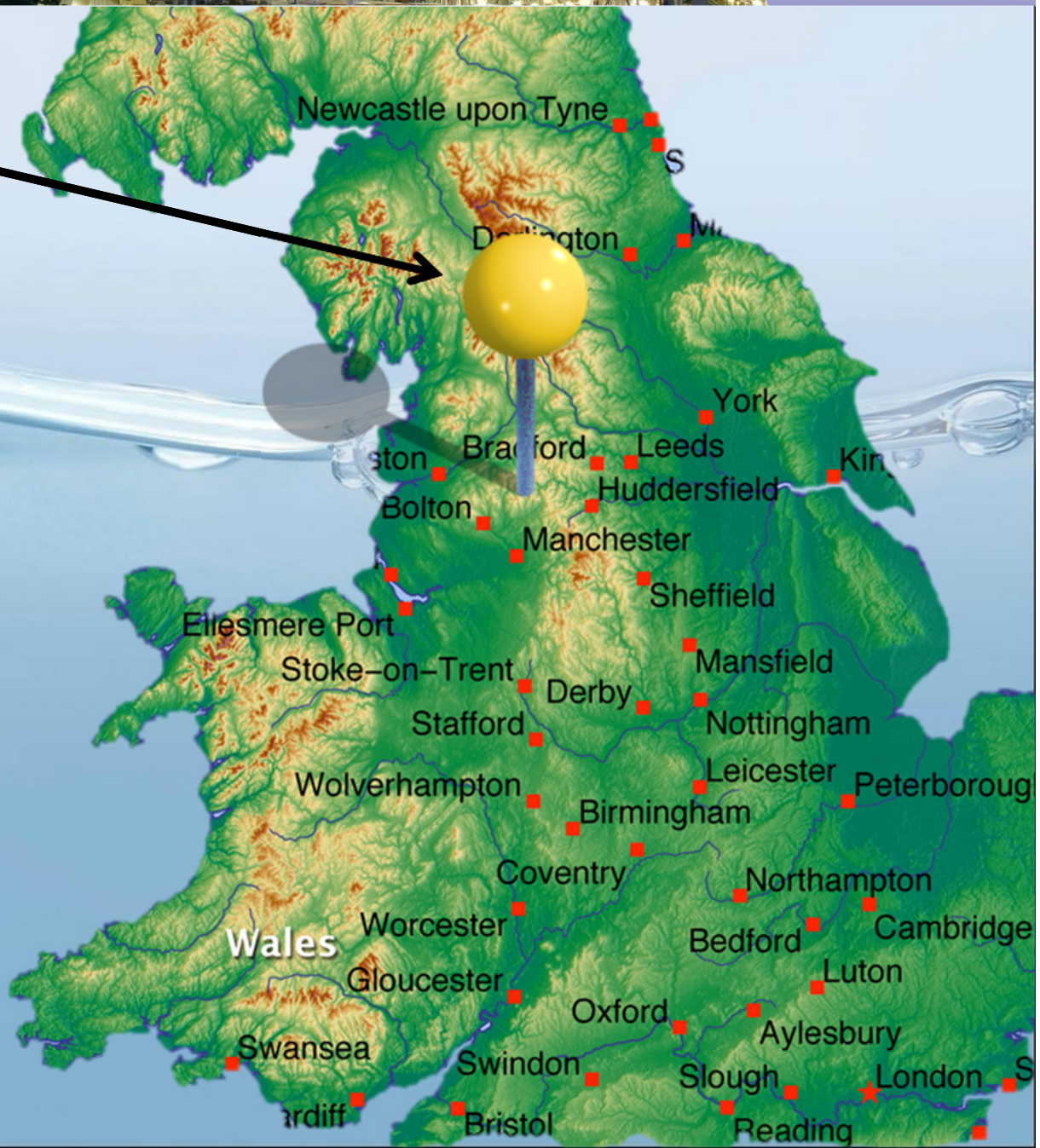
by Michael Bruemmer 24.01.23
Sales & Marketing Director at crp the corrosion expert

COMPANY Introduction

- Founded 1983
- Iso 9001 – 2015 certified
- 76 employees
- Capacity: 245 PFA fittings & 280m/900ft of spools per day, on bellows we are selling roughly 2000 bellows per year
- The manufacturing site is 9,770m^2 or 98,000ft^2
- Product stock in Memphis, Houston, Singapore, Shanghai

Company Location

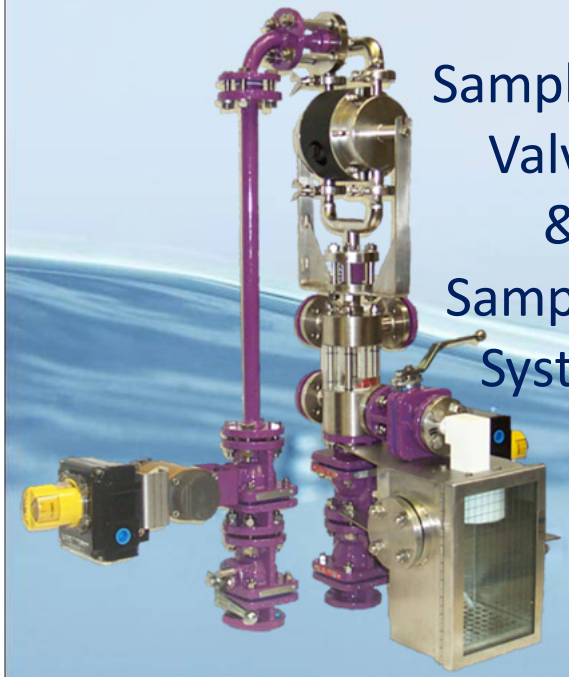
Todmorden Road
Littleborough
OL15 9EG, UK



Distributors & Reps

near at our customers, around the world

Product Overview

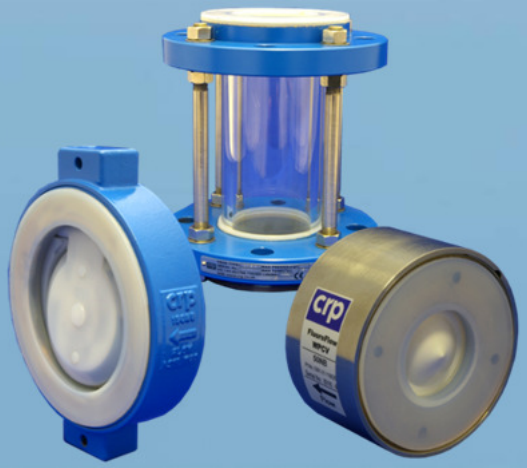


Sampling – Valves & Sampling – Systems

PTFE lined dip pipes up to 6“/DN150

PTFE/PFA lined pipes & fittings up to 20“/DN500

PFA lined check valves & sight glasses



PTFE bellows up to 42“/DN1050

ePTFE – gaskets

Corrosion Resistant Safety Shields

PTFE & PFA lined columns to DN500

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?

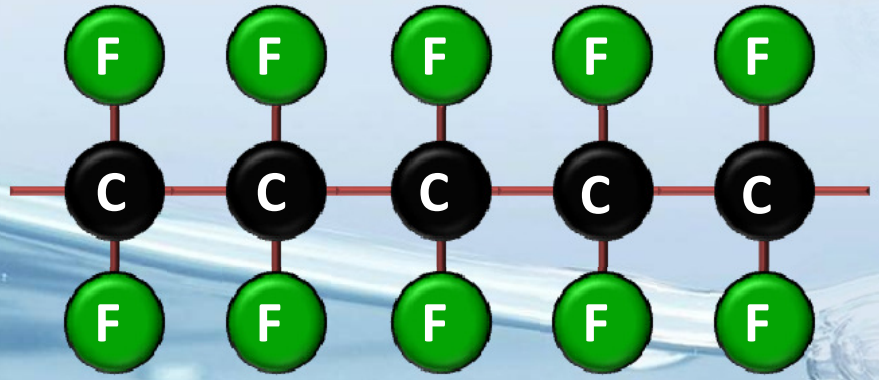
What is the ideal specification in permeable applications?

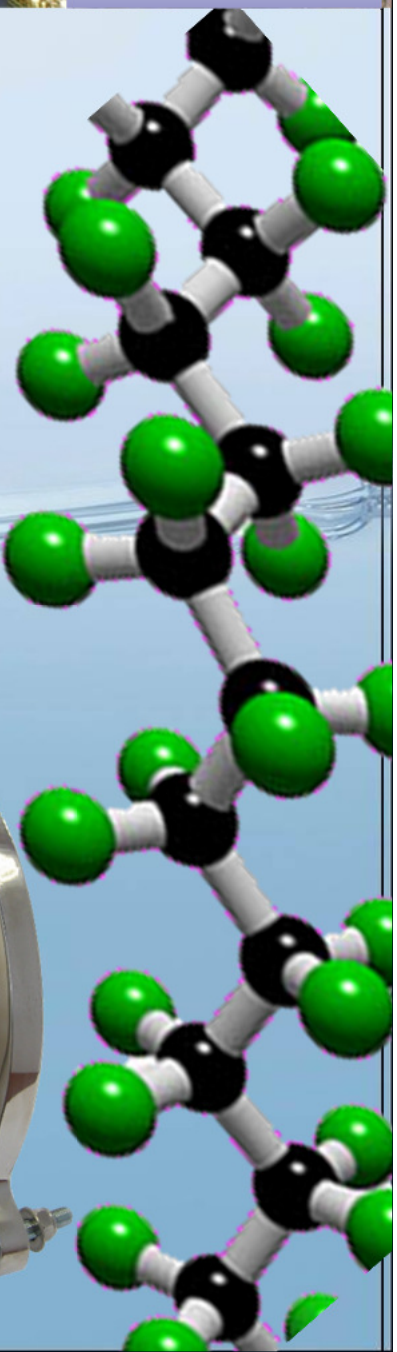
Presented by Michael Bruemmer at NACE

CORROSION 2018 Conference & Expo

Intro of PTFE and PFA:

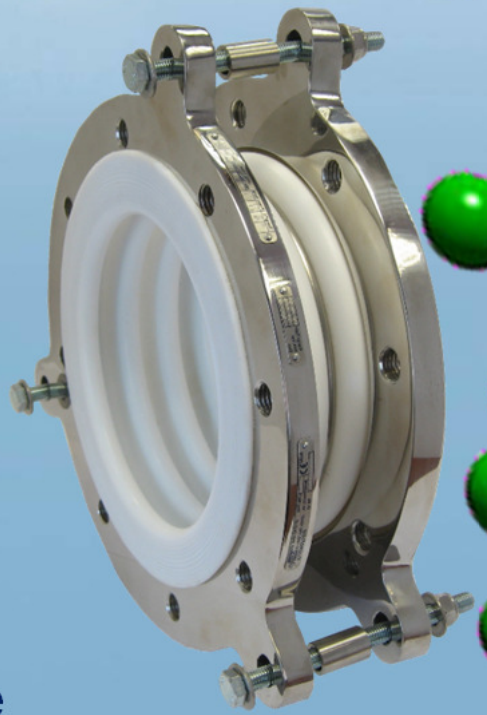
PTFE means POLYTETRAFLUOROETHYLENE





Advantages:

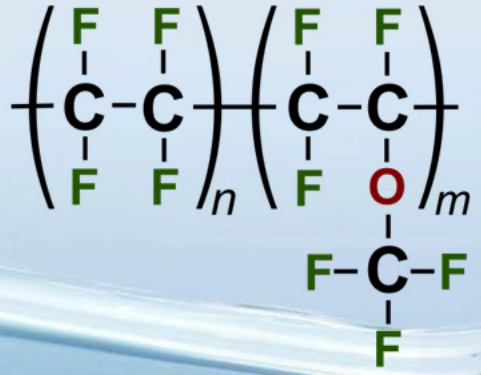
+ excellent universal chemical resistance
+ anti-adhesive surface
+ UV-resistance
+ wide temperature range
  -100°C to 200°C / -212°F to 395°F*
+ etc.

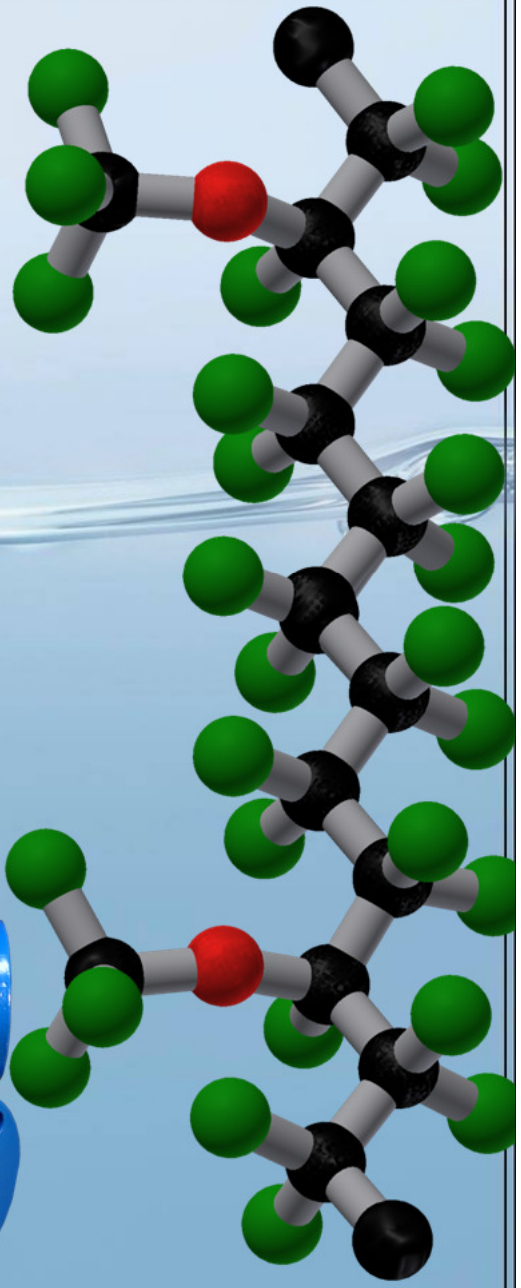


* In special applications also a wider temperature range

Intro of PTFE and PFA:

PFA means PERFLUOROALKOXY ALKANE



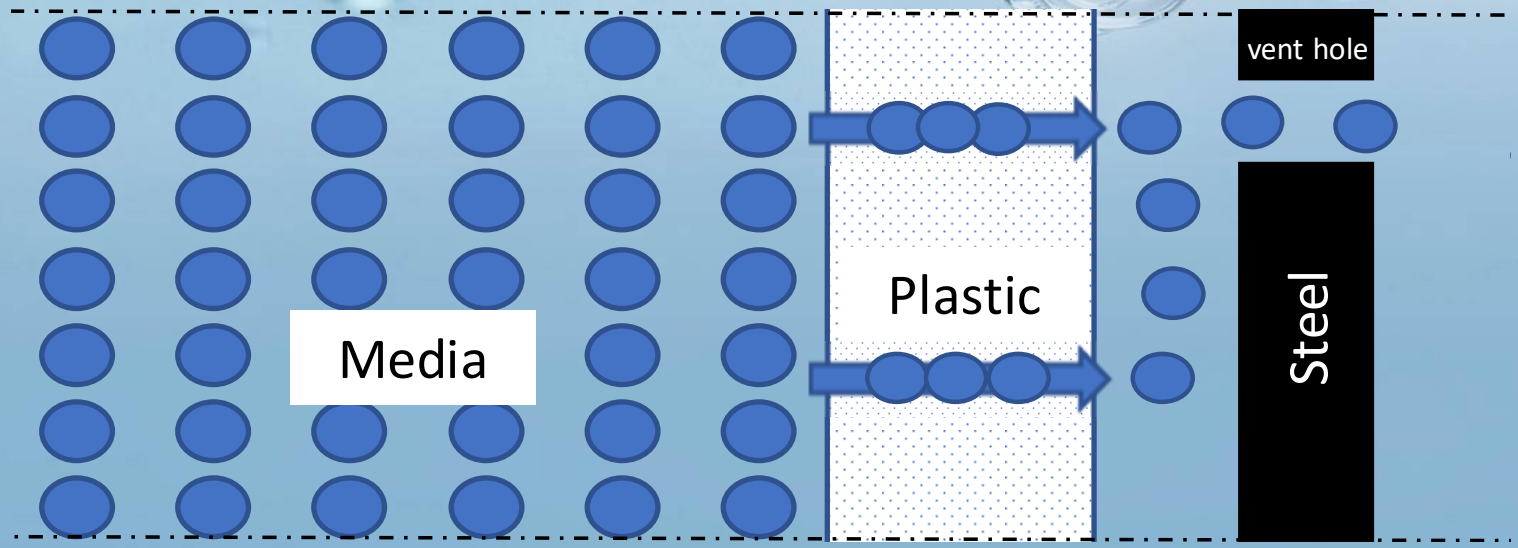


Advantages:
- + excellent chemical resistance
- + anti-adhesive surface
- + UV-resistance
- + wide temperature range as PTFE
- + very similar to PTFE

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

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!

Permeation

What influences Permeation?

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

process driven

- Liner density

acc. to Stand. i.e. ASME F1545

- Composition of the lining
- Lining thickness

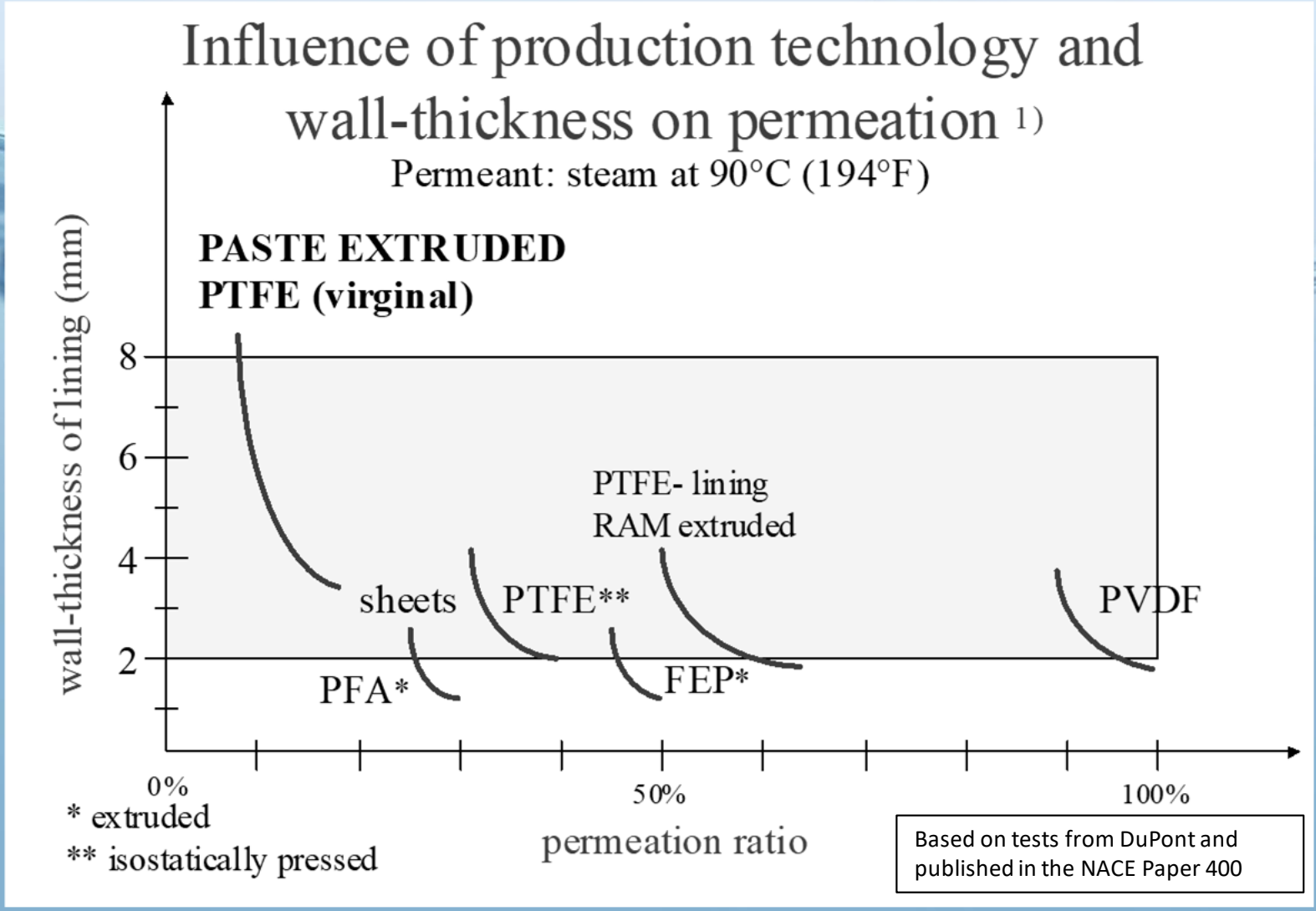
influenced by specification

Different PTFE Grades:

- **Isostatically moulded PTFE**, using 20µm 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 non-uniform lining thickness.

- **RAM extruded PTFE**, using 20µm particles, a piston compresses the PTFE resin which provides a non-homogeneous PTFE
- **Paste extruded PTFE**, using 0.2µm particles, continuous extrusion provides uniform lining thickness & homogeneous material allowing the lowest permeation rate

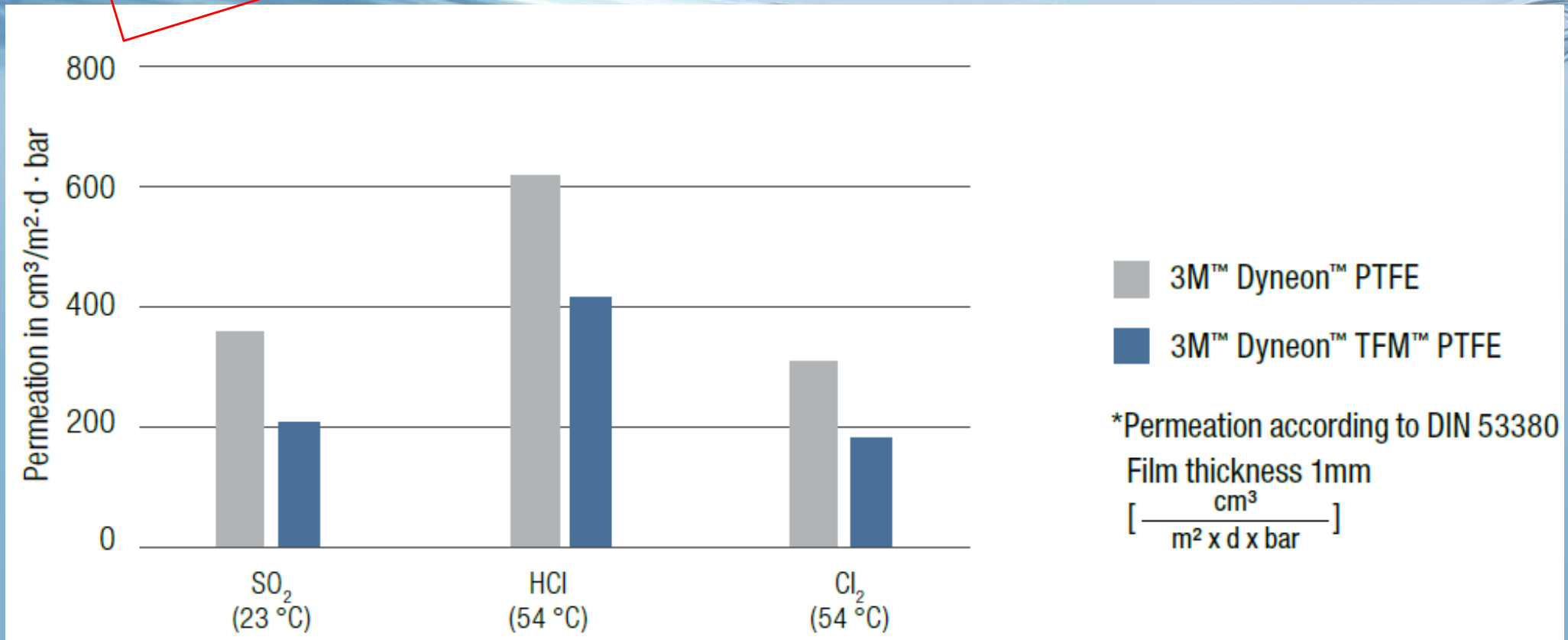
Different PTFE Grades:



Different PTFE Grades:

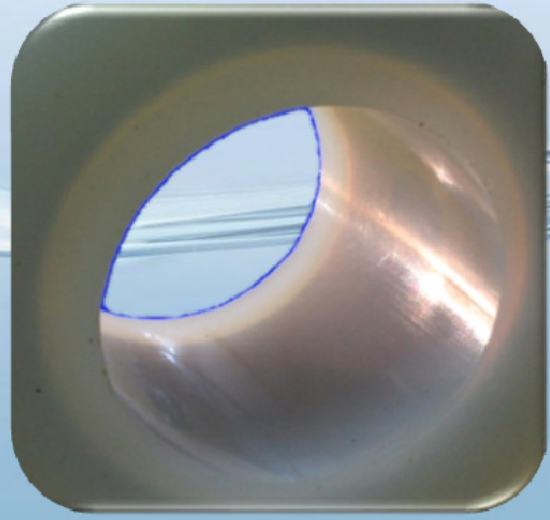
Would anybody like an upgrade?

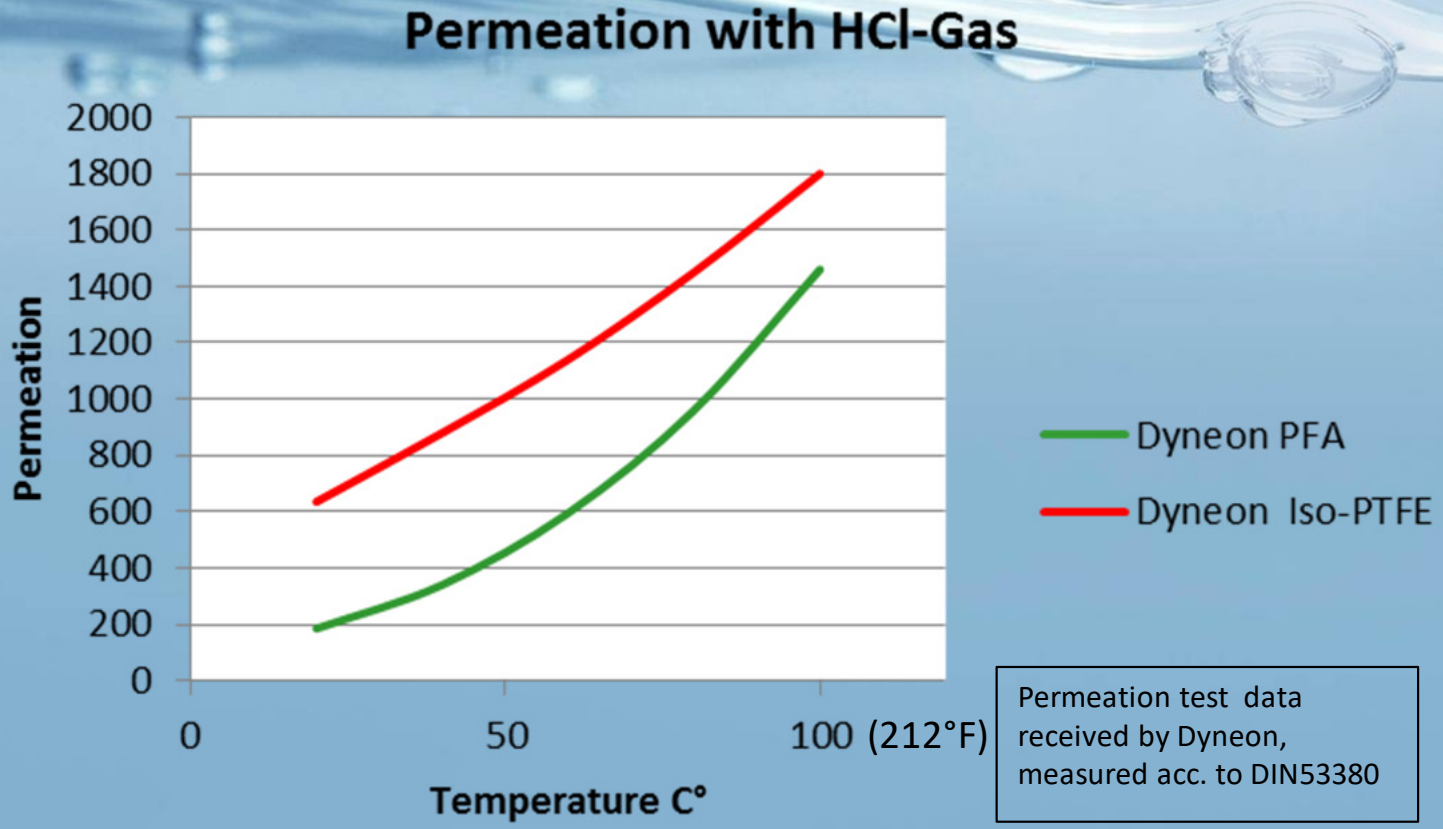
Modified(UHP) paste extruded PTFE!



What does PFA offer?

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





Permeation test data received by Dyneon, measured acc. to DIN53380

How can we minimize Permeation?

- ✓ Paste extruded PTFE for straight spools
- ✓ If available, modified paste extruded PTFE for 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:

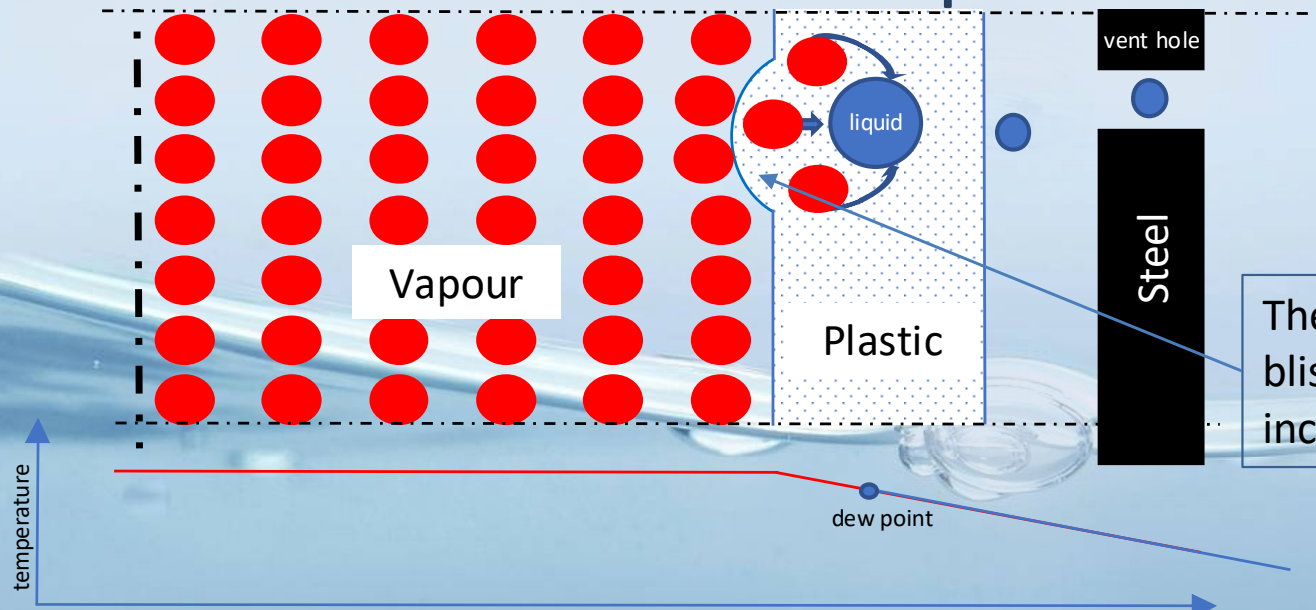
Iso-moulded PTFE lined fittings which needed to be replaced every 2 years due to heavy corrosion failure on steel housing.

Customer B:

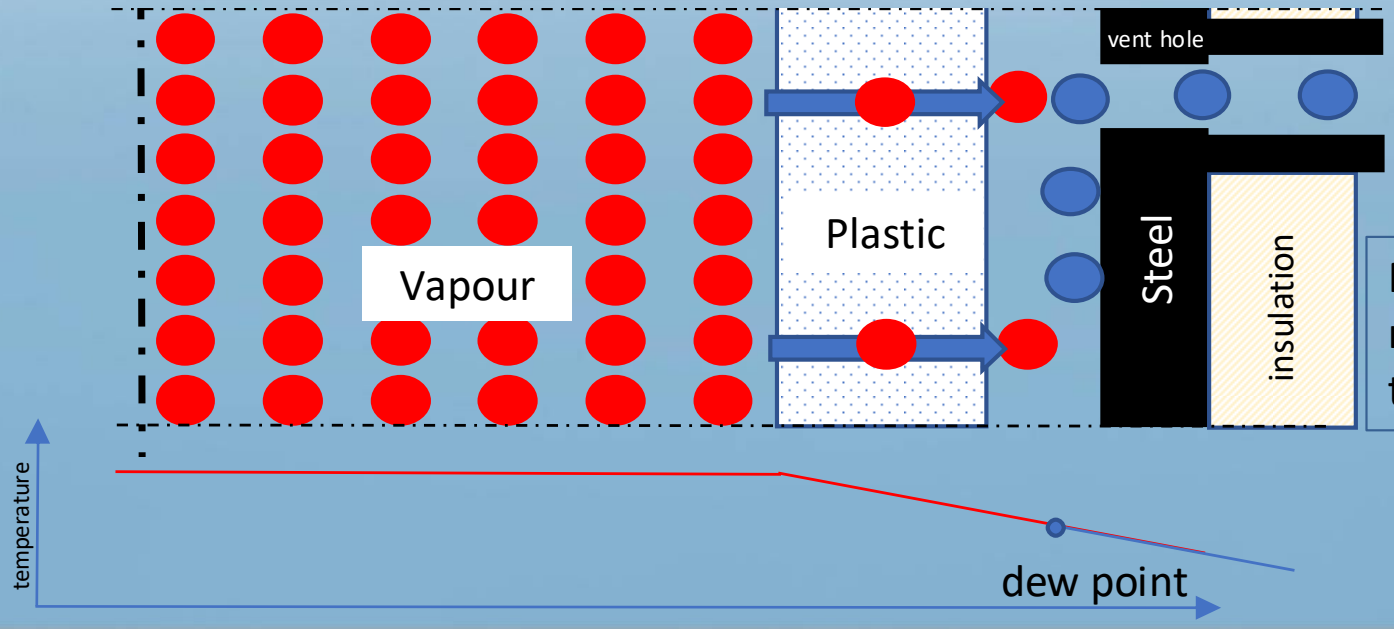
- ✓ In the very same process this customer has been using PFA lined fittings. These have lasted more than 5 years, but will be replaced by preventive maintenance every 5 years.

External Insulation

How does external insulation help to increase lifetime?



The liner provides blisters, due to the inclusion of liquid



No blisters, no damage of the liner

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

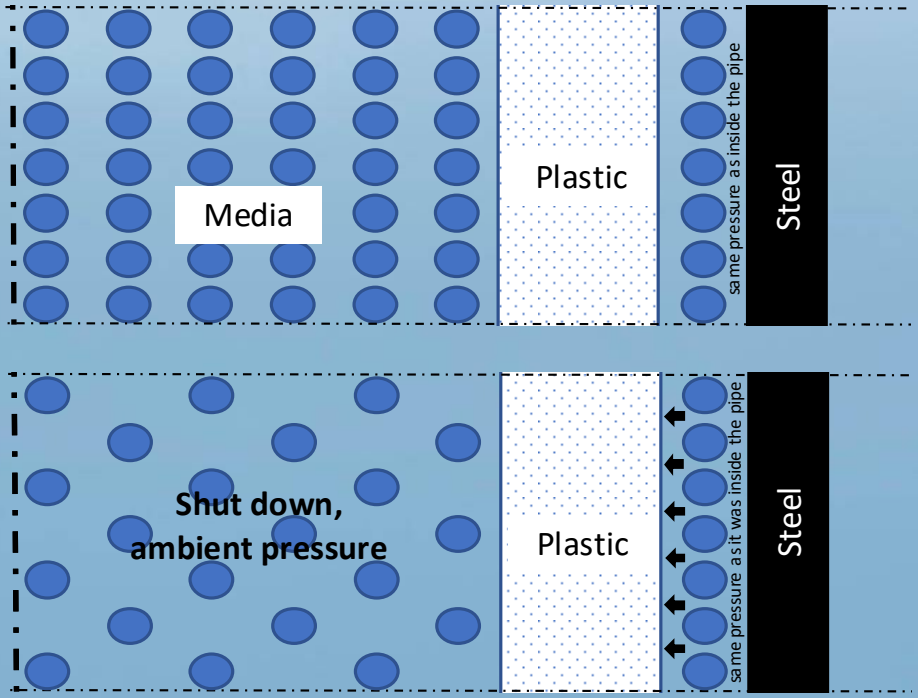
What are vent bosses?

Ideal Specification

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:

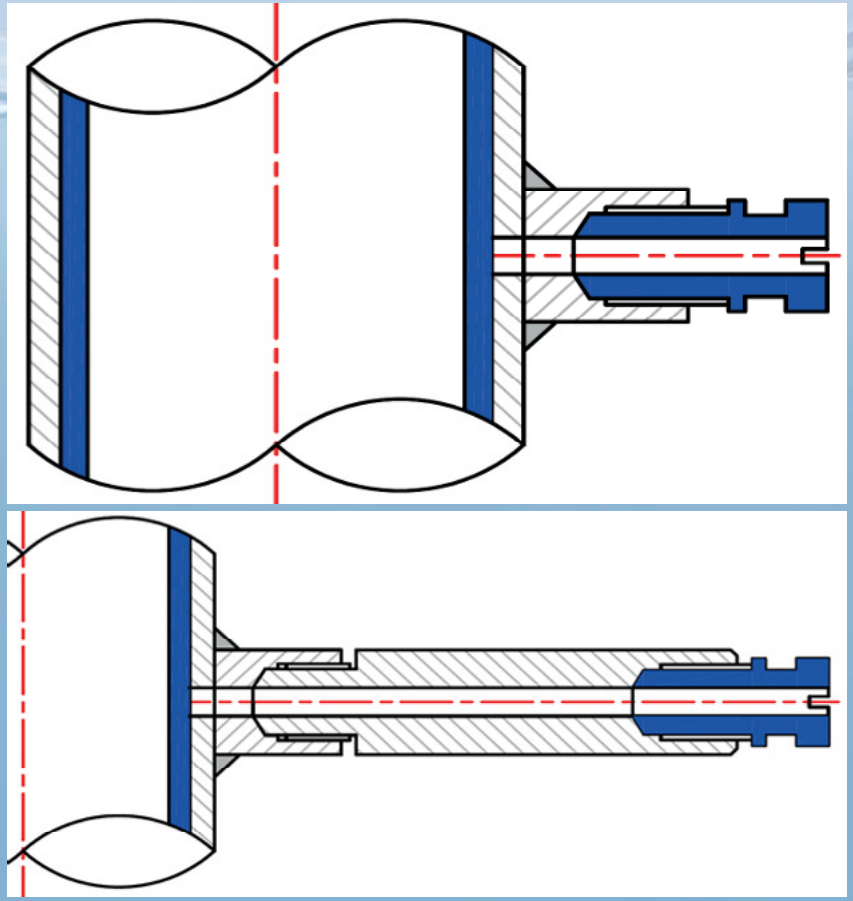


Ideal Specification

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



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1. Select a reliable, high quality supplier who follows the ASTM F1545 standard
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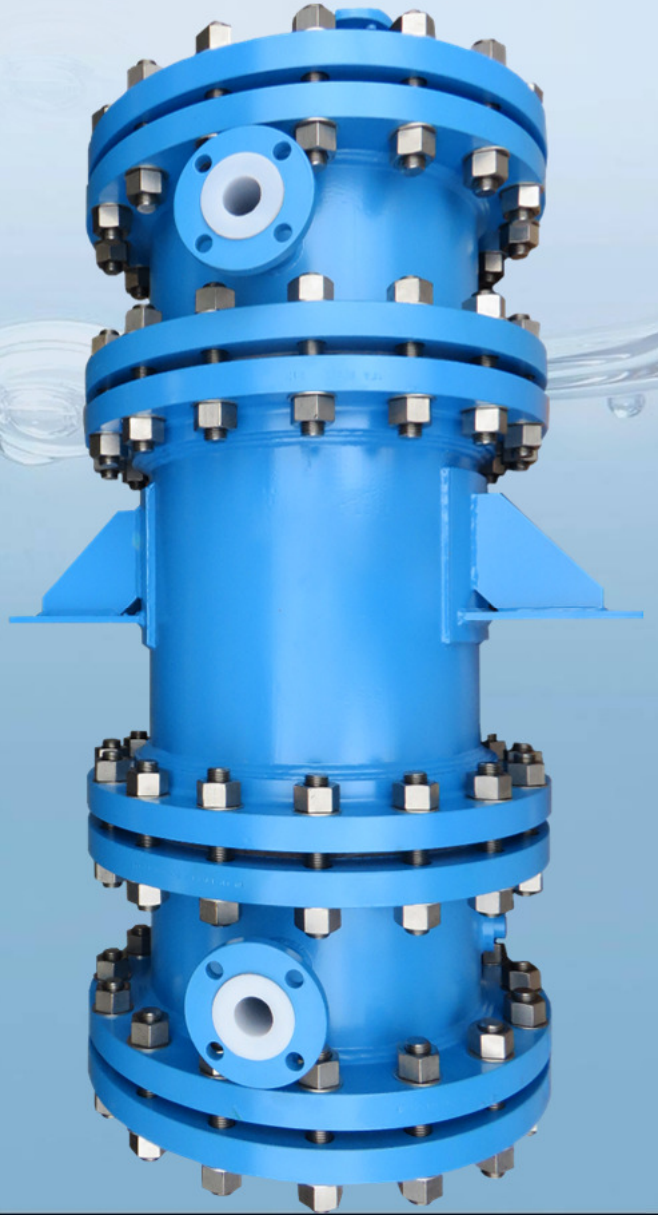
4. Specify vent bosses with PTFE sleeves and extensions
5. Specify external insulation if condensable vapours could be present in the piping system

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?