Internal linings
Selection variables and their link to design standards

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Represents Hempel:
- ISO TC 67 WG 11
- ISO TC 67 WG 11 TG3 : ISO 18796-2
- JIP 33 SL 35 External stakeholder group
- IOGP Coating sub-committee

Linings History
- 1989 – 1993 Vinyl Ester development
- 1994 – 2000 High Temperature Epoxy Novolac development (Belzona)
- 2000 – 2004 High Temperature Epoxy field support and sales (Current)
- 2008 – 2010 Ceilcote integration and linings offer development (AkzoNobel)
- 2019 Linings standard development (ISO 18796-2)
<table>
<thead>
<tr>
<th></th>
<th>Storage tanks</th>
<th>Process tanks</th>
<th>Pressure vessels</th>
<th>Containment areas</th>
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</thead>
<tbody>
<tr>
<td><strong>Range of compositions</strong></td>
<td>Limited</td>
<td>Wide</td>
<td>V. Limited</td>
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<td><strong>Temperature range</strong></td>
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<td>Wide (Substrate)</td>
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Institute of Corrosion – Linings Event
London, January 2020

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Question 1

Which of the following variables would you suggest is the most important to consider when specifying an internal lining?

A. Fluid composition
B. Temperature
C. Pressure & gas composition
D. Complicating factors (e.g. abrasion, potential for impact damage, resistance to cleaning, impact)
Question 2

Which of the following variables would you consider first when specifying an internal lining?

A. Fluid composition
B. Temperature
C. Pressure & gas composition
D. Complicating factors
   (e.g. abrasion, potential for impact damage, resistance to cleaning, impact)
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Compare and contrast.......storage tank lining is easy (well relatively!)

Typical storage terminal lined opportunity > 75,000 m²

Typical process train lined opportunity < 10,000 m²
Fluid composition

- Passive Aqueous / hydrocarbon (permeation)
- Reactive e.g. Strong H⁺ (chemical attack)
- Ad hoc compositions
- Cleaning compositions (de-scalers)
Temperature

• Which one?
• Most thermoset properties change with temperature
• Importance of softening (glass transition) point
  • Tg versus heat distortion
• Presence of temperature gradient (cold-wall)
  • Thermo-osmosis
Glass transition

- Hard
- Impermeable
- Tough / Brittle
- Soft
- More permeable
- Plastic

OT  Normal Operating temperature
MOT  Maximum operating temperature
DT  Design temperature
Glass transition

- Hard
- Impermeable
- Tough / Brittle

- Soft
- More permeable
- Plastic

OT  Normal Operating temperature
MOT Maximum operating temperature
DT  Design temperature

* Measurement is quite important
Pressure - Which of the following variables has the most effect on coating performance?

A  Gas composition & parcel pressure
B  Total pressure
C  Decompression rate
D  All of the above or it depends?
1. Liquid solids content
2. Abrasion
3. Impact resistance
4. Di-electric strength
5. Adhesion
6. Cathodic disbondment resistance
7. Substrate compatibility
8. Design………. and many more
Role of design

• Improved equipment design will aid coating success
• Bad design
  - Remains a major challenge
  - Lack of access
  - Inability to holiday test
  - Potential for mechanical damage
    - In service
    - During assembly
Guidance is increasingly available (but needs accelerating)

- **ISO 16961** – “Petroleum, petrochemical and natural gas industries-Internal protective coating and lining of steel storage tanks”


- **ISO DIS 18796** - “Part 2 - Internal lining of process pressure vessel – guideline on selection of coating and lining systems”

Other standards from other bodies are also available e.g. NACE, API etc.
NORSOK M-501 Edition 6

- Quite prescriptive in terms of systems, but,
- No pre-qualification guidance

ISO DIS 18796 - 2

- Will combine evaluation of pre-qualification data
- And appropriate test methods
Guidance is given for the following:

- Key factors influencing coating and lining selection
- Principle test methods to be used as supporting evidence of performance when selecting suitable coatings and linings
- Typical coating and lining types and their suitability for certain environments
- Generic composition of test liquids which can be used as references when evaluating supporting evidence for coatings and linings
- Ensuring that supporting evidence used in evaluating coatings and linings is relevant to the potential end use
Summary

• Selection of linings needs to go beyond just “chemical” resistance

• Pressure vessels represent a particularly complex environment

• Better guidance is becoming available but in some cases “Vanilla”
  • Need to establish more robust pre-qualification framework
  • Create a process for pre-qualification not just a list of tests

• Designers have a very important role to play in successful internal lining
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