VALVE AND PACKING DEVELOPMENT TESTING

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Agenda

1. Introduction
2. Minimum Seating Stress
3. Packing Drag and Force Transmission
4. Thermal Expansion
5. Corrosion Test
6. Fugitive Emission Test Rigs
7. Conclusions
Introduction

Low Emission Packing Design

Testing Devices: Simulate actual field conditions

Parameters that influence performance

Seating Stress

Number of Packing Rings

Stem x Packing Friction

Thermal Expansion and Contraction
Packing Minimum Seating Stress

Ni-Cr Wire Mesh Reinforced Yarn Flexible Graphite Packing (no impregnation)

Ni-Cr Wire Reinforcement Flexible Graphite Packing

Carbon and Flexible Graphite Packing with Graphite impregnation

Expanded PTFE filled with Barium Sulphate Packing

Sealing for a Safer and Greener Tomorrow
Packing Drag, Force Transmission and Thermal Expansion

1 – Stem
2 – Gland
3 – Bonnet
4 – Internally Gaged Bolt
5 – Packing
6 – Bushing
7 – Load Cell
8 – Load Cell Base
9 – Electrical Resistance
Packing Drag

Ni-Cr Wire Mesh Reinforced Yarn Flexible Graphite Packing (no impregnation)

Ni-Cr Wire Reinforcement Flexible Graphite Packing

Carbon and Flexible Graphite Packing with Graphite impregnation

Expanded PTFE filled with Barium Sulphate Packing

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Other Rigs for Testing Drag - Knife Valve Test

- Drag forces
- Sealability
Drag and Sealability Test Results

Drag and Sealability Test Results

P_H2O for STYLE C (ePTFE/Graphite)

P_H2O for STYLE A (Synthetic/PTFE)

F_DRAG for STYLE C (ePTFE/Graphite)

F_DRAG for STYLE A (Synthetic/PTFE)
### Thermal Expansion Test Results

**Ambient to 212F (100C)**

<table>
<thead>
<tr>
<th>Style</th>
<th>Yarn</th>
<th>Filler</th>
<th>Comparative e-PTFE content</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>e-PTFE</td>
<td>None</td>
<td>100% e-PTFE</td>
</tr>
<tr>
<td>B</td>
<td>e-PTFE</td>
<td>Barium Sulphate</td>
<td>B% &lt; A%</td>
</tr>
<tr>
<td>C</td>
<td>e-PTFE</td>
<td>Barium Sulphate</td>
<td>C% &lt; A% &amp; B%</td>
</tr>
<tr>
<td>D</td>
<td>e-PTFE</td>
<td>Graphite</td>
<td>D% &lt; A%, B% &amp; C%</td>
</tr>
</tbody>
</table>
Thermal Expansion Test Results
Ambient to 212F (100C)

PTFE Packing Extrusion due to Thermal Expansion
Thermal Gravimetric Analysis - TGA

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Material Degradation and API 607 Simulation

<table>
<thead>
<tr>
<th>Packing</th>
<th>External Leakeage After burn and cooldown (5min)</th>
<th>Validation API 607 Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Style E</td>
<td>0.0 mL/min</td>
<td>CERTIFIED</td>
</tr>
<tr>
<td>Style F</td>
<td>0.0 mL/min</td>
<td>CERTIFIED</td>
</tr>
<tr>
<td>Style H</td>
<td>0.2 mL/min</td>
<td>CERTIFIED</td>
</tr>
</tbody>
</table>

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Galvanic Cell Corrosion Test

![Graph showing electrical potential difference over time for different inhibitors.]

**Graph Details:**
- **Y-axis:** Electrical Potential Difference (Volts)
- **X-axis:** Time (Hours)
- **Legend:**
  - Inhibitor 2
  - Inhibitor 3
  - Inhibitor 1
  - Inhibitor 4
  - No Inhibitor
Low Emission Valves Test Rigs

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R&D Results

API Standard 622 2nd Ed. Simulation (4th CL300) Test Report

Static Leakage Chart
Reading

Static Leakage Chart
Maximum Reading

Leakage (PPm)

Leakage (PPM)

Cycle Number

Cycle Number
Conclusions

Minimum Seating Stress
  Leak free installation and start-up
  Increase plant safety and reduce costs

Stem Torque or Drag determination
  Design of actuation devices

Thermal Expansion and Contraction Effects
  Develop lower thermal expansion packings
  Installation procedures

Fire Safe

Corrosion Inhibitors

Protection of Equipment

API 622, API624 (valve), ISO 15848, VDI2440, others

Consolidation - Development of Low Emission Packings
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Thank you!