Selling Titanium to the Industrial Market
Industrial Market

• WHY?

• Expansion Worldwide
  – Growth 2018 – 6.3%; 2019 – 6.8%
  2020 to 2022 – average 7.0%

• Proven chemical technologies

• Additional corrosive environments

• New processes – recycling
Concerns Raised

- Availability
- High Cost
- Limited Alloys
- Code Qualification
- Design Criteria
- Fab Quality
- Corrosion Data
- Competitive Materials
Availability

- Not “un-obtainium” anymore
- Not an “exotic” Metal
- Worldwide Supply Base
  - Quick, on-time material delivery
- Stocking Distributors in Industry
- Knowledgeable Fabricators
Cost

• **Ti Stable Cost (2009-18)** vs Other CRAs
  - Nickel, SS and CuNi Alloys
    • Ni, Cr, Mo, Cu volatility

• **Ti Initial Cost** – Very Competitive

• **Life Cycle Costing**
  • Effective against non-metallic MOCs & Lower Nickel alloys
Cost

• Initial Cost Competitive with CRAs
  – Use Ti density, design allowables to develop:

  Cost per Square Meter vs Nickel Alloys
  – Ti Grade 2
    – 1/2 of C276 cost
    – 2/3 of 625 cost
Comparative Costs

Schedule 40 Pipe Cost Ratios

<table>
<thead>
<tr>
<th>Material</th>
<th>2&quot; Diameter Cost Ratio</th>
<th>6&quot; Diameter Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>316 Stainless Steel</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Alloy 20</td>
<td>2.20</td>
<td>1.33</td>
</tr>
<tr>
<td>Ni-Cu Alloy 400</td>
<td>1.75</td>
<td>1.72</td>
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<tr>
<td>Titanium</td>
<td>2.04</td>
<td>2.67</td>
</tr>
<tr>
<td>Ni Alloy C276</td>
<td>3.87</td>
<td>3.99</td>
</tr>
</tbody>
</table>
Life Cycle Costs

• **Titanium Effectiveness**
  – Longer Life with low or no maintenance

• **Analysis must include:**
  – Downtime, production loss, all maintenance costs, removal of defective equipment, etc.
  – Capital vs Maintenance Budget
  – Company ROI must be realistic
Alloys

• **Titanium Alloys**
  - Grades 2 & 2H, 7 & 7H (Pd), 9 (3-2.5), 1 & 11 (for clad), 12 (Ni-Mo), etc.

• **Compete against SS & Nickel Alloys**
  - Duplex SS (2205-2507), 904L, Alloy 20, 6MoAlloys, 625, C2000, C22, C276, etc.
Code Qualifications

• Titanium Alloys
  – Approved by ASME to 600°F
  – ASME Div 1 (17 alloys) and Div 2 (6 alloys) approved
  – Approved by other Codes & Specifications
    • PED, CRN, API, AWS, ASTM
Design Criteria

• Design for Titanium Properties
  – density, strength, corrosion resistance

• Design for Effective Use
  – Only where needed for corrosion
    • Flanges, supports, etc.
  – Titanium Clad to lower cost (>1” thick)
Quality of Fabrication

• Experienced Titanium Fabricators
• Educate Market in Inspection & Quality Control Requirements
• Titanium Field Welding – Available & Reliable
Corrosion Data

• Titanium Historical data available
  – Key applications well documented
  – Ensure Data availability to end users

• Nickel Producers continue to develop and publish New Field and Lab. results
  – NACE Publications mostly pro-Nickel
Competitive Alloys

• Nickel, Copper & Stainless Steel
  – Companies & Alloy Development
  – Salespersons & Technical Staff

• Other Issues Nickel industry uses against Ti:
  • “Hydriding”
  • “Fluorides”
Non-Metallic Materials

- Variety of Materials
  - Dual Laminate, FRP, Linings and Coatings
- Large Sales Force
- Compete on lower cost
- Questionable life plus maintenance
Summary - Market

• Industrial Market
  – Expanding between 6 -7 % annually
  – Combination of Historical and New Uses

Titanium should get a reasonable share of this increasing market
Summary - Issues

• Competitive MOCs are numerous
• Ni Producer support is High
• Competitive Sales Force is Large
• Titanium is still misunderstood
  • By Chemical Industry Engineers and Engineering Companies
Summary

- Titanium Industry
  - Focus is an Issue
  - Need Aggressive Posture in Titanium
    - Cooperation between Producers and Fabricators is essential

ITA can be the Place for this Focus.
Thank You

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