Fiber Reinforced Composite Pipelines

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Fiber Reinforced Piping for H₂ Delivery

• **Impact:**
  • Composite pipeline technology has the potential to reduce installation costs and improve reliability for hydrogen pipelines.

• **Fiber Reinforced Piping**
  • The FRP product form consists of an inner polyethylene liner with an outer fiberglass structural layer.

• **Existing Technology:**
  • FRP is an existing commercial technology currently employed in the oil & gas industry
  • Commercial product up to 6” diameter and 2500 psig pressure rating.
  • Spoolable to ½ mile lengths.
Fatigue testing over the range of 750 psig to 3000 psig has been completed. The data provides an initial indication on the fatigue life of FRP. A preliminary design fatigue curve has been proposed based on the current test data with a design margin applied based on literature review to estimate the variability.

### Fatigue Testing

<table>
<thead>
<tr>
<th>Sample</th>
<th>Leak Rate STD CC H₂/Sec</th>
</tr>
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<tbody>
<tr>
<td>Fiber 1</td>
<td>9.8x10⁻⁵</td>
</tr>
<tr>
<td>Fiber 1L</td>
<td>1.4x10⁻⁴</td>
</tr>
</tbody>
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**Burst Testing**

Flaw tolerance tests show that for flaws up to 40% through-reinforcement and up to 2" length and 0.25" width a factor of 3X margin is maintained on rated pressure.

**Leak Testing**

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**ORNL Data**

Failure mode changes from global to local and then move back towards global as flaw depth increases.

**Fatigue Service Degradation of FRP**
FRP B31.12 Codification Effort

- **B31.12 Codification**
  - A report summarizing the FRP testing by SRNL and ORNL has been completed. The report will become the basis for ASME Codification of FRP.
  - Review comments from ASME, ORNL and the FRP Manufacturer have been incorporated.
  - The report will be updated to include the 2014 fatigue testing data and the service experience data from the FRP Manufacturer.
  - Data was provided to the B31.12 Code Committee in September 2013.
  - Next meeting with B31.12 is planned for March 2014.
Research Need- FRP Fusion Bonded Joint

• **Current Issue**
  • The current design relies on O-Ring Seals to ensure a leak tight joint. Current testing has shown that the O-Ring could be a weak link in the design.
  • Pipeline manufacturers have expressed concern about using a mechanical seal that may require maintenance.

• **Development Opportunity**
  • Develop a FRP fusion bonded joint for the HDPE layer to control leakage. An additional structural layer would be added for pressure integrity.
  • Utilize existing HDPE bonding techniques for fusion joint.
  • Develop structural layer using current pipe wrap repair technology.
  • Perform burst testing to evaluate structural integrity of joint.
Technology Demonstration – FRP Hydrogen Pipeline

- Install a 1000’ FRP pipeline operating in hydrogen service at a design pressure of 1500psi.
- The pipeline would serve as a test, surveillance and demonstration facility for FRP in fielded hydrogen service.