the Energy to Lead

Developing Performance Criteria for Composite Materials

Ernest Lever
R&D Director
Gas Technology Institute

gti

Introducing Composite Materials into Critical Gas Transmission Systems

- Composite pipelines are recognized as a potential alternative to steel in high pressure gas transmission lines
- There are currently several trial installations of different composite pipe structures in various stages of the waiver process
- Pipe sizes range from 4.5” to 16” and test pressures range from 350 psig to 1328 psig
- Evaluation methods are focused on macroscopic properties of the pipelines

Understanding Potential Gains to Public Safety

- In order to fully understand the potential gains in public safety that may be afforded by composite programs it is necessary to institute a well organized collaborative effort to:
  - Review operator requirements and expectations
  - Review existing standards
  - Review the state-of-the-art in composite pipe
  - Conduct a comprehensive gap analysis to identify the standards and data packages needed to fully define and support composite gas transmission pipeline applications in a regulated environment
  - Develop a roadmap to close the standards development and R&D gaps
  - Engage all stakeholders in a focused effort to close the gaps

Standards Development

- Standards need to include:
  - Performance standards that are not tailored to specific composite pipe structures
  - Fitness for Service Standards
  - Integrity management standards
  - Application specific standards that define how to implement specific composite pipe structures in gas transmission pipelines

Fitness for Service Gap

- Recent workshops and other information gathering activities conducted by GTI have exposed a gap in the understanding of fitness for service of composite pipe structures in the context of gas transmission pipelines
- There is insufficient focus on:
  - Understanding the effects of micro damage to the composite structure
  - Understanding the effects interchangeability of the gas supply on the composite structure
  - Understanding the primary, secondary, tertiary and higher failure modes of composite pipeline systems as a system

How to Close the Fitness For Service Gap

- **Additional Research Needs**
  - There is a need to develop the material models for composite structures that will enable proper analysis of varying degrees of damage to the structures
  - Test methods to measure and quantify the rate of defect propagation need to be developed
  - Test methods to validate the results of analyses and simulations need to be developed
  - Fitness for service guidelines need to be developed for the most promising composite pipeline structures

Benefits of Performing a Gap Analysis and Developing Material Models

- Performing a proper gap analysis will:
  - Assist the industry in developing the value proposition for composite gas transmission pipelines
  - Highlight the areas that need additional effort to ensure that public safety is enhanced
- Developing the appropriate constitutive and material models will:
  - Spur the proper development of essential fitness for service guidelines
  - Provide valuable insight on how to properly:
    - Design,
    - Operate, and
    - Inspect composite gas transmission pipelines