Fiberspar LinePipe™
The Leader In Spoolable Pipeline Systems

Composite Piping Systems, Development, Application, and Evaluation

July 17th, 2012
History of Fiberspar and Spoolable LinePipe

• Fiberspar was founded in 1986
• Market leader in high tech sporting goods from advanced composite materials
• Commenced spoolable pipe joint development with Conoco in 1992
• Developed composite coiled tubing with Halliburton
• Sold sporting good division in 1999 to focus on O&G industry
• First installation 2500 psi injection line in 1999 still in trouble free operation
• Total installed base over 50 million ft (15,000 Km)
Spoolable GRE LinePipe

- Spoolable GRE is a unique form of GRE pipe which is made in lengths of more than 3 miles in a continuous process and can be spooled for transport.

- The pipe can be installed quickly and safely by unspooling at location.

- The basic design consists of:
  - Thermoplastic pressure barrier
  - Helically wound glass fiber
  - Epoxy matrix
  - External wear layer

- Sizes – up to 6 ½” Nom OD
- Pressure Ratings – up to 2,500 psi
Spoolable GRE LinePipe Eliminates Corrosion and Increases Safety

- No risk of failure from corrosion
- Integrity monitoring and chemical treatment programs reduced
- Rapid installation, minimum people and equipment at location, and minimal time spent in the ditch all significantly reduce safety risks during pipeline construction
- Smaller footprint
- Less ground disturbance
- Can also be used very effectively to remediate corroded steel pipelines at low cost without any ground disturbance
- Spoolable GRE is manufactured in a controlled factory environment, tested, and deployed on location rapidly and with low labor and low cost equipment
Fiberspar LinePipe Can be Used for All Oilfield Applications

Applications

- Gas or oil gathering
- Water disposal
- Gas injection
- Water injection
- CO₂ injection

Installation Methods

- Conventional trench
- Surface Lay
- Rehabilitation
Spoolable GRE Manufacturing

- Production for 2” to 8” ID
- Continuous lengths up to 36,000 ft (depending on size)
- Full statistical process control, in-line marking, serialization
- Full traceability of raw materials

Since the product is shipped as a complete, tested pipeline, Spoolable GRE eliminates many of the quality and safety risks associated with fabrication on location.
Quality Control Testing

• Pipe Conditioning

• Lead and Tail QC Samples
  • Burst Test
  • Compression Test
  • DSC Scan
  • Ring Crush Test
  • Over 14 years of Data

• Random Test Samples

• Hydro test of entire manufacturing run to 1.5x MAOP
Qualification and Approvals

- LinePipe Design Meets or Exceeds all recognized specifications and standards for lined GRE pipe:
  - API 15HR
  - API 15S
  - ASTM D2992
  - ASTM D2517
  - Shell DEP 31.40.10.20-Gen
  - CSA Z662
  - Pemex Spoolable Pipe Specification NRF 185

- CSA (Canadian Standards Association) Audited
- Shell Qualification Tests conducted by Shell Laboratories in the Netherlands to meet Shell DEP 31.40.10.20-Gen (2005)
- QMS Certified to API Q1/ISO 9001:2008
Field Operations and Installation

- Fast Installation using specialized equipment
- Hydraulic powered spooling equipment includes
  - Carousels – for larger reels to 16ft diameter
  - A frames for reels to 12 ft diameter
- Trained technicians supervises the installation of all Fiberspar LinePipe
- Training Program for Spoolable GRE Installations
Alberta Energy & Utility Board

- AEUB and Fiberspar jointly operated a program to analyze pipe samples after a two-year installation period
- Samples were removed from various locations and applications
- Samples were extensively tested and full reports submitted to the AUEB
- Testing over 40 samples, all were found to show no degradation in service in this extensive evaluation of a new pipeline technology.
- Spoolable GRE accepted by AUEB as a routine application in Oil and Gas service to 1440 psi 2003
Proven Track Record

- Over 50 million feet installed throughout the world
- FS LP 2.5” 2,500 (E) in water injection service since 1999
- FS LP 3.5” 750 (E) in oil emulsion service since 2000
- All samples were visually inspected and tested for physical and mechanical properties
- Sample performed as new compared to original quality control records from date of manufacture
Fiberspar Spoolable GRE in DOT Regulated Applications

- Columbia Gas Waiver approved March 2005 (Docket No. RSPA-04-18757)
- 4200 ft 4” pipe installed in 2005 as a gas transmission line
- Operation at 750 psig for over 7 years with no problems
- Samples at 1, 2.5, and 5 years removed by Columbia Gas and tested by Jana Labs showed no signs of degradation

- Anchor Point Special Permit approved in October 2010
- 33,200’ of 4 ½” pipe installed in January 2011 as dual gas transmission lines
- Operating at 1,328 psig for over 1 year
Fiberspar Petition to Modify Part 192

- Submitted in May 2008 and assigned Docket #PHMSA-2010-003
- Revise Part 192.121 to allow the use of thermoset pipe up to its hydrostatic design basis (HDB) as listed by ASTM D 2517
- Revise Part 192 appendix B to reference latest version of ASTM D2517

192.121 Design of plastic pipe.

- $S =$ For plastic thermoplastic pipe (thermoplastic and thermoset), the HDB determined in accordance with the listed specification...
- For reinforced thermosetting plastic pipe, 11,000 psig (75,842 kPa).

Appendix B

- ASTM D \textbf{2517-00-2517-06} – Standard Specification for Reinforced Epoxy Resin for Gas Pressure Pipe and Fittings
Next Steps & Path Forward