FLEXPIPE®

Carbon (CO_2) Capture and Transportation Using Spoolable Composite Linepipe

EASY-TO-INSTALL SPOOLABLE COMPOSITE LINEPIPE

THE FLEXPIPE ADVANTAGE

Flexpipe's high-quality composite linepipe products are extremely corrosion-resistant, and designed for a quick and efficient installation. Flexpipe and Flexcord are lightweight products that can be installed faster than steel using a smaller installation crew with less land disturbance. Both products are laboratory tested and field proven to be successful in CO_2 service.

- 100% CO_2
- Gas and super critical phases
- Up to 2250 psi and 180° F
- Established product performance
- 650,000' installation base
- 12+ years in CO_2 service

CASE STUDY

In 2010, a privately held, Houston based, oil and gas company sought a reliable pipeline system to handle high concentrations of CO_2. The CO_2 was to be used in very high concentrations in a tertiary recovery system. Flexpipe was selected as the linepipe material of choice due to its ability to handle gas and liquids containing up to 100% CO_2 by volume.

The pilot project consisting of 12,500' was installed in 2 days and the engineers were impressed with the speed and ease of the installation. After the successful pilot, the company selected Flexpipe for second phase of the program, consisting of an additional 40,000' of FP301. By 2012, over 220,000' had been successfully installed into the company's gathering system, operating at 300 psi and up to 95% CO_2.

In 2013, the property was acquired by a large US energy production and transportation company who also saw the value in Flexpipe Spoolable Products. The new owner built upon the previous success, and more CO_2 projects were developed while Flexpipe continued to be an active partner. Between 2013 and 2020, an additional 180,000' of pipe was added to the oil gathering systems (400,000' total).

In addition to expanding the gathering systems, the CO_2 distribution system was also expanded using Flexcord. The injection system transports 90-100% CO_2 from a central facility to various injection wells located throughout the field and operates at pressures up to 1500 psi. To date, 100,000' of Flexpipe and Flexcord have been installed into the high-pressure injection systems.

Figure 1. High CO2 Gathering Lines During Construction

STRONG TRACK RECORD IN CO_2 PROJECTS

Flexpipe Spoolable Products have been used successfully in CO_2 applications for over 12 years across Canada and the USA. To date, there has been 10+ end users who have installed over 650,000' of Flexpipe and Flexcord into applications with over 90% CO_2 concentration. Most projects to date have been a part of Enhanced Oil Recovery (EOR) systems, either transferring emulsion with high CO_2 gas concentration, or used to transport high pressure CO_2 from central facilities to injection wells.

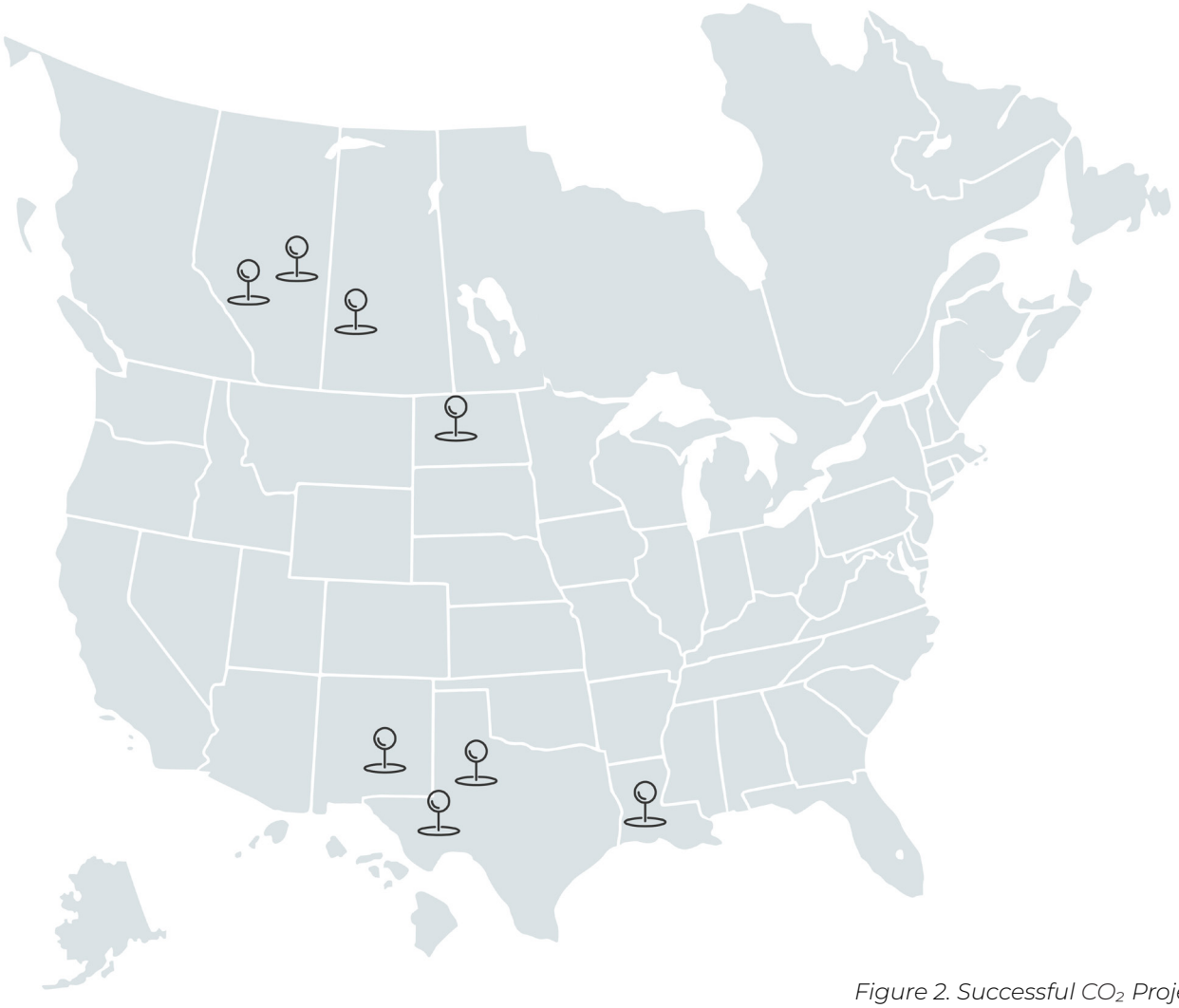


Figure 2. Successful CO_2 Projects

PIPE COMPATIBILITY

The materials used in Flexpipe Spoolable Products have been widely used in the oil and gas industry for many years. The liner and jacket are manufactured using bimodal pressure-pipe-grade high density polyethylene (HDPE) thermoplastic resin. The reinforcement materials are either continuous glass fiber rovings for FlexPipe and FlexPipe HT or high strength steel cords for Flexcord.

Flexpipe Spoolable Products have a self-venting design which allows permeated gases to vent at the fittings. This prevents or reduces the pressure from building up within the annulus (the space between the liner and jacket that contains the reinforcement layer), thereby lowering the risk of liner collapse during line depressurization.

Flexpipe and Flexcord have demonstrated performance to be able to withstand pipe level rapid decompression from maximum operating pressure and temperature. The Testing consisted of saturating the samples with 100% CO_2 at maximum operating conditions before decompressing the samples at over 100 psi/minute. No cover blow off, liner collapse, blistering or disbondment was detected.

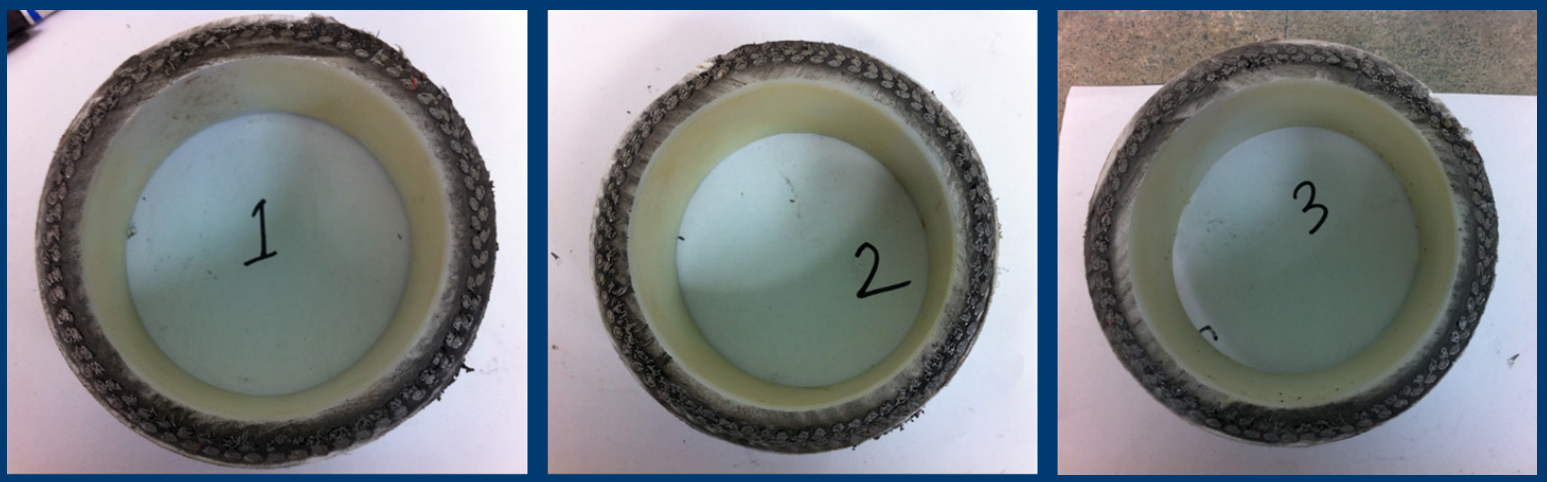


Figure 3. Flexcord cross sections after a successful rapid gas decompression test

LINER

The liner used in Flexpipe and Flexcord is a bimodal high-density polyethylene designated as PE4710 by PPI TR-3 in accordance with ASTM D3350. The PE4710 material has good resistance to slow crack growth as well as excellent impact and abrasion resistance. The liner material has demonstrated excellent performance in rapid gas decompression (RGD) testing in accordance with API 17J and API 15S testing and is very well suited for high pressure CO_2 service. The testing consisted of saturating the liner at the maximum pressure and temperature ratings for 24 hours before decompressing at over 1000 psi per minute. After 20 cycles, the samples were analyzed and found no evidence of blistering or changes in material density.

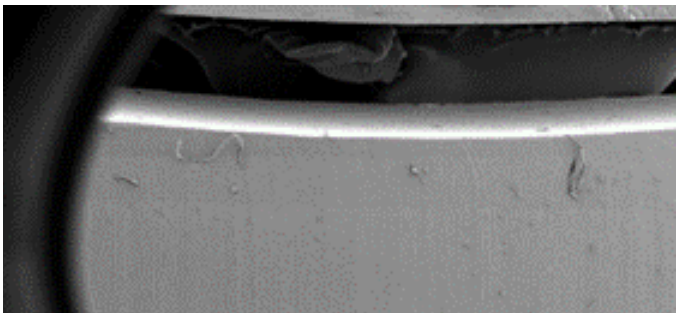


Figure 4. Before RGD Testing

Figure 5. After 20 Decompression Cycles

FITTINGS

Flexpipe and Flexcord fittings are corrosion resistant and available in either coated carbon steel or duplex stainless steel. The fittings are designed and tested in accordance with NACE MR0175, CSA Z662 and API 15s. Carbon steel fittings are supplied with a high-phosphorus electroless nickel coating (ENC) and this coating is typically an effective barrier against corrosion and abrasion in most oilfield applications. For highly corrosive applications, Duplex stainless steel mandrels can be specified in place of coated carbon steel.

O-RINGS

For applications above 10% CO_2 and 750 psi Flexpipe supplies specific FKM O-rings that are rated for RGD in accordance with NORSOK M-710 at 2200 psi and 212°F.

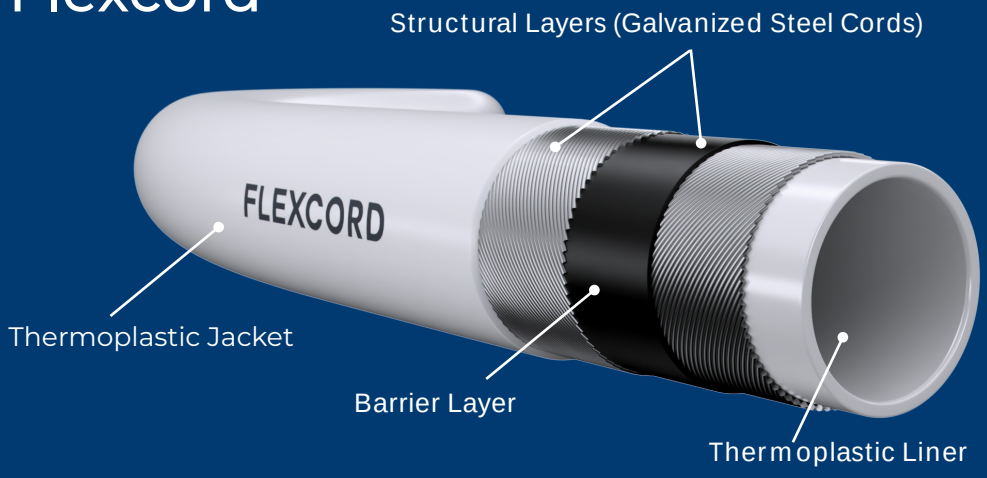
Figure 6. Flexpipe RGD Test Assembly

REINFORCEMENTS

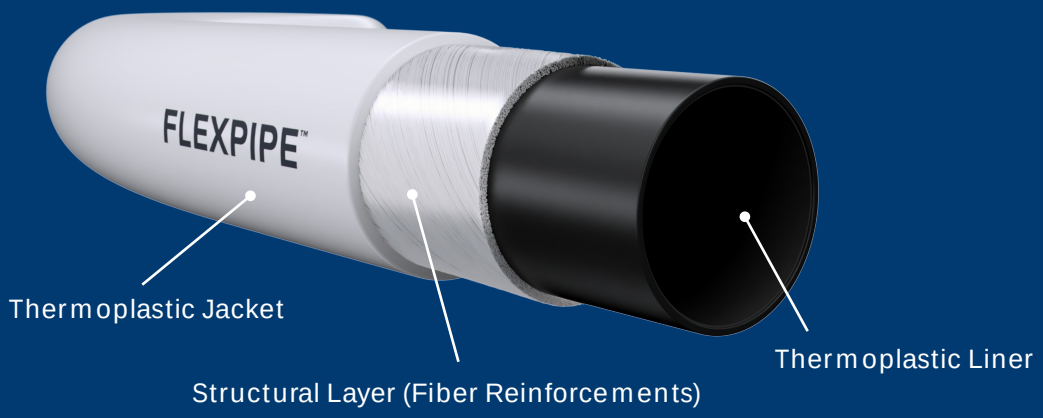
Flexpipe & Flexpipe HT: The helically wrapped, dry fiberglass reinforcement in Flexpipe is designed to handle a wide variety of CO_2 applications with operating pressures of 750 or 1,500 psi at either 140°F or 180°F. Flexpipe's proprietary construction technology ensures the final product is lightweight, well-balanced and can handle the rigors of oil & gas gathering systems.

Flexcord: Designed for demanding applications up to 2250 psi and 140°F, the helically wrapped galvanized steel cords are optimized to achieve excellent weight, flexibility and pressure containing capabilities. Flexcord can handle nearly any CO_2 application and is especially capable in high pressure, cyclic services.

Flexcord



Flexpipe



WORKING FOR YOU

We are a global materials science company specializing in products, services and solutions for the water, energy, infrastructure and transportation markets. We continually pursue sustainable solutions that protect the environment, conserve resources and extend asset life.

flexpipesystems.com

FLEXPIPE®