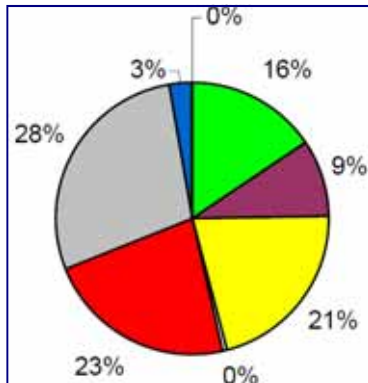




THERMOFLEX®

Wet Sour Gas line (8% H₂S and 9% CO₂) Wintershall Germany

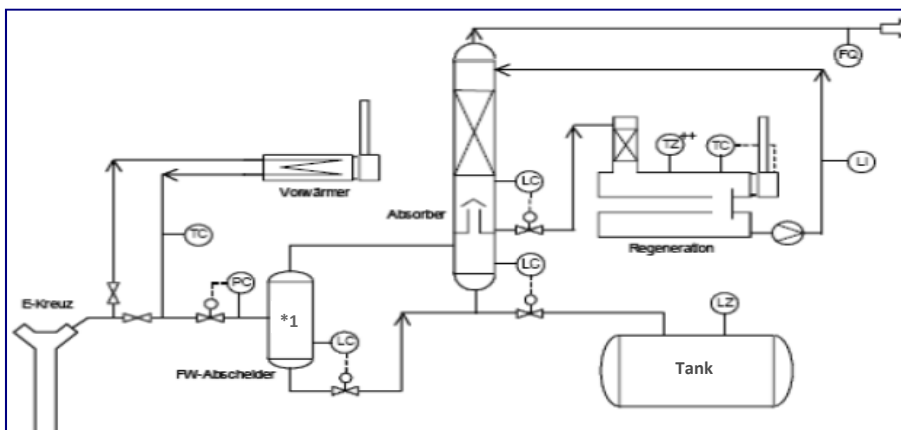
Gas production cost



Background

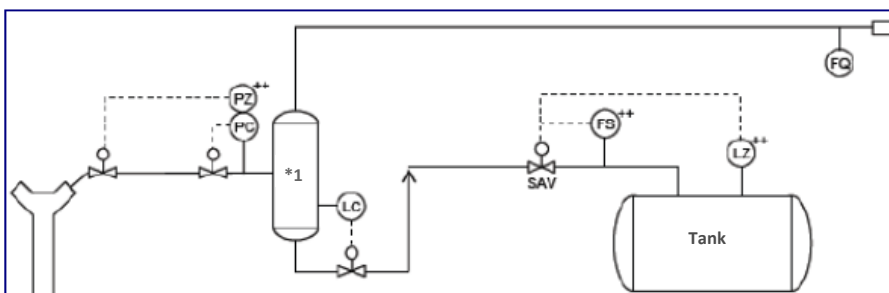
The gas well, subject of this case description and located in NW Germany, produces up to 8% H₂S and nearly 9% CO₂. Transporting wet sour gas has always been forbidden to minimize corrosion and public hazards. The well pads are consequently equipped with complex dehydration units that are expensive in operation. Well site dehydration represents approx. 23% of the total gas production cost.

Carrying the wet sour gas to a centralized processing unit would substantially reduce the production cost. However, it would require pipelines made of expensive steel or bimetal compositions and corrosion protection measures.



Well site dehydration system includes :

- Glycol tower
- Glycol regeneration



*1 : Free water knock out (gas / water separator)

Well equipment where only the free water is separated and the wet sour gas is centrally dried .



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Wintershall Germany**

Thermoflex® PPS lined Reinforced Thermoplastic Pipe (RTP)

A non-metallic solution by means of a multi-layer fiber reinforced thermoplastic pipe was chosen to transport wet sour gas from a gas well to the dehydration unit of a 287m far neighbor well.

In Dec. 2010, Wintershall commissioned a Thermoflex 3" RTP pipe, inserted in a 5" steel pipe, to directly channel wet sour gas from well Z1a to the dehydration unit of well Z6a.

The installation and testing was supervised by Bergamt (Mining Authorities) and TUV North .



A 5" - 287m, carbon steel pipe is being installed between well Z1a and Z6a. The pipe, made of a steel grade suitable for dry sour gas transport, is hydro-tested at 150bar in accordance with local requirements.

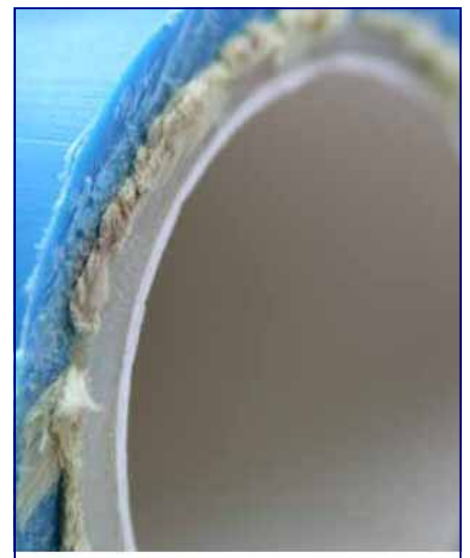
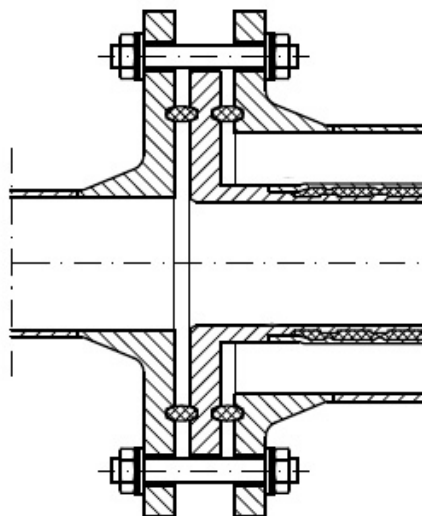




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Wintershall Germany**

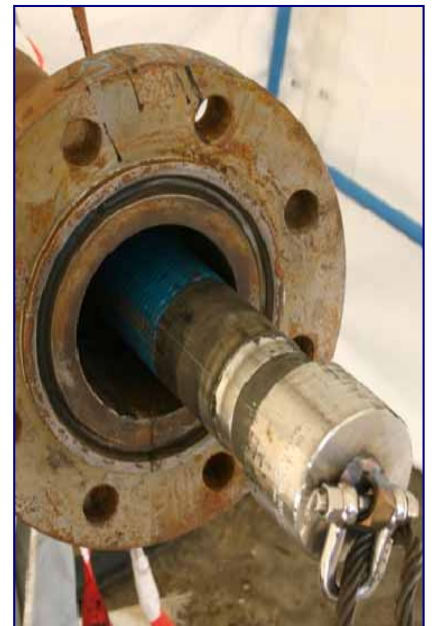
A Thermoflex® 3" O.D. / 2,53" I.D. pipe, with rated pressure 1.500psi was selected for the project. The pipe is composed of a PPS inner liner (polyphenylene sulfide - Fortron®) of 0,050" thickness, a longitudinal and radial Aramid fiber braid and a Nylon outer jacket. The pipe's long term design strength safety factor is 2,2. The pipe showed, witnessed by Bureau Veritas, burst tests results of 350bar. The two, swage type end-fittings are specially designed, double sided, 600lbs RTJ flange type couplings; the flange-insert is made of stainless steel grade 1.4571 and the ferule in Duplex 2205 stainless steel. Both the internal part of the insert as well as the flange surfaces were coated with Fortron®. The 300m 3" pipe spool, manufactured at Polyflow's plant in Oaks, PA-USA , was transported on a 10ft diameter disposable reel.





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The Thermoflex® 3" pipe was pulled in the 5" steel pipe using a steel cable attached to a pulling cap screwed on a disposable threaded coupling. The 300m line was pulled through in approx. 20min using a winch. The pulling force was recorded and never exceeded 700kg; a force by far lower than the pipe's max. allowable pulling force. A modified traffic cone was used as pipe centralizer and to protect the 3" pipe from being damaged by the steel pipe's sharp edges.



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The double sided, RTJ flange fittings are swaged onto each pipe end using the special hand pump operated swaging machine. The fitting's Duplex 2205 ferule is crushed with a force exceeding 100.000 lbs onto the fitting's insert, locking and holding the pipe's braid.



The Thermoflex® pipe's expansion (a few %) during pressure testing needs to be constrained at each line end. Hydrostatic test was performed in steps of 20bar till 100bar, followed by a min. 24h pressure hold test at 60bar. To further check the fittings tightness a 2h, 100% He test at 66bar was performed.

The annular space between steel pipe and Thermoflex® pipe is pressurized at 1 to 3bar with Nitrogen and connected to a leak detection system. Annular pressure and temperature are permanently checked. Nitrogen samples are regularly taken to Wintershall's lab for H₂S , CO₂ , CH₄ , H₂O trace analysis.

The wet sour gas pipe line was put into service on Dec. 18th. 2010, at an operating pressure of 40 to 45bar and an operating temperature of approx. 30°C.