QUARTERLY TECHNICAL PROGRESS REPORT

Report Title:	Field Demonstration of a Membrane Process to Separate Nitrogen from Natural Gas: Eighth Quarterly Progress Report
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Subcontractors:	None
Other Partners:	ABB Lummus Global
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Disclaimer

Abstract

The original proposal described the construction and operation of a 1 MMscfd treatment system to be operated at a Butcher Energy gas field in Ohio. The gas produced at this field contained 17% nitrogen. During pre-commissioning of the project, a series of well tests showed that the amount of gas in the field was significantly smaller than expected and that the nitrogen content of the wells was very high (25 to 30%). After evaluating the revised cost of the project, Butcher Energy decided that the plant would not be economical and withdrew from the project. Since that time, Membrane Technology and Research, Inc. (MTR) has signed a marketing and sales partnership with ABB Lummus Global. MTR will be working with the company's Randall Gas Technology group, a supplier of equipment and processing technology to the natural gas industry.

Randall's engineering group has found a new site for the project at a North Texas Exploration (NTE) gas processing plant. The plant produces about 1 MMscfd of gas containing 24% nitrogen. The membrane unit will bring this gas to 4% nitrogen for delivery to the pipeline. The membrane skid is being built by ABB. NTE has ordered the required compressor and MTR is making the membrane modules. System fabrication was completed in January 2004 and the membrane inserts were loaded. Additional pressure testing and verification will be completed prior to shipment, which is expected in early February 2004.

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Introduction

The natural gas specification for inert gases is less than 4%. On this basis, about 17% of known U.S. reserves of gas are subquality due to high nitrogen content. Some of this gas can be brought to pipeline specifications by dilution with gas of low nitrogen content; some is treated by cryogenic condensation and fractionation. Nonetheless, about 1.0 trillion scf of known reserves are currently shut in.

This project covers the first demonstration of a new membrane technology to treat this otherwise unusable gas. The objective of this project is to develop a membrane separation process to separate nitrogen from high nitrogen content natural gas. To demonstrate the process, a proof-of-concept plant is being built at a North Texas Exploration (NTE) gas field in Texas/Oklahoma.

Executive Summary

Randall's engineering group has found a new site for the project at a North Texas Exploration (NTE) gas processing plant. The plant produces about 1 MMscfd of gas containing 24% nitrogen. The membrane unit will bring this gas to 4% nitrogen for delivery to the pipeline. The membrane skid is being built by ABB. NTE has ordered the required compressor and MTR is making the membrane modules. System fabrication was completed in January 2004 and the membrane inserts were loaded. Additional pressure testing and verification will be completed prior to shipment, which is expected in early February 2004.

Experimental

No experiments were performed during this reporting period.

Results and Discussion

Under an agreement signed by North Texas Exploration (NTE), ABB, and MTR, MTR and ABB will supply NTE with a fully fabricated skid-mounted membrane unit that includes 28 eight-inch membrane inserts housed in eight pressure vessels. The process flow diagram of the proposed system is shown in Figure 1.

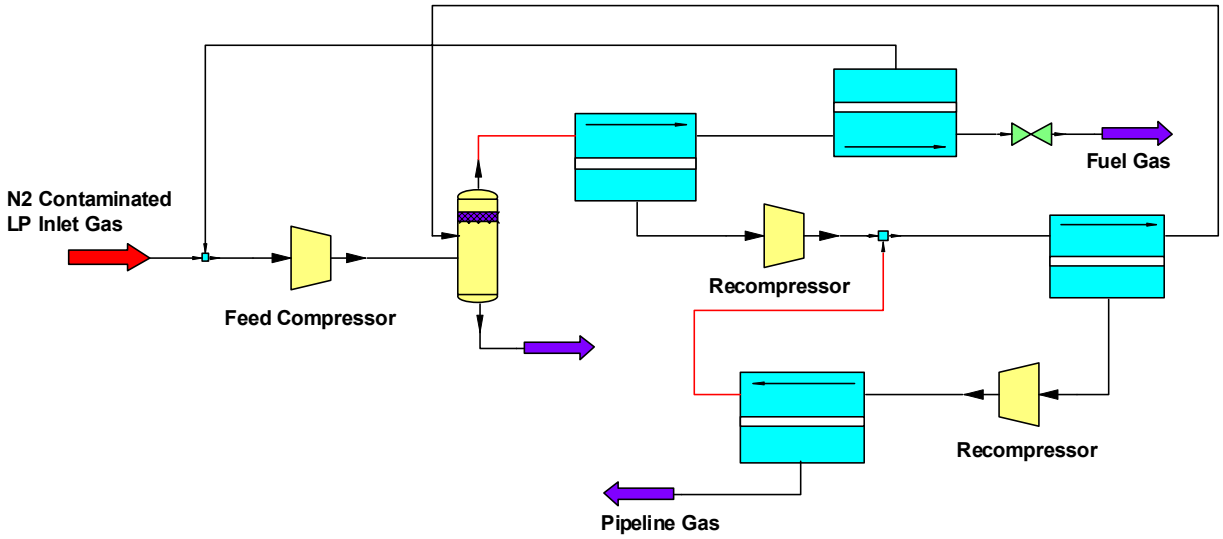

Figure 1. Process flow diagram for the NTE pilot plant system.

The low-pressure nitrogen contaminated gas will be compressed to about 800 psia, passed through a filter coalescer, and introduced into the membrane skid. The gas will pass through a set of membranes in two steps. In the first step (eight membrane inserts), partially enriched natural gas will be produced as a permeate gas. This permeate will be compressed and routed to a second stage for further purification. The non-permeate from the first step will enter the second step (eight membrane inserts) for additional recovery of methane recovery. This permeate stream will be routed to the inlet compression. The non-permeate from the second step will be routed to fuel for the compression.

The partially purified gas from the first step will be further purified in two additional stages of membrane, the first containing eight membrane inserts and the second containing four membrane inserts. The final product is pipeline-quality natural gas.

The membrane skid fabrication was completed; a photograph of this skid in the fabrication shop is shown in Figure 2. MTR manufactured 34 eight-inch membrane inserts for this project in the November 2003-December 2003 time frame. After final testing and approval, 28 of these modules were shipped to ABB. The remaining six modules passed the quality tests and may be used later in the project. Table 1 shows the manufacturing data for these modules.

Figure 2. Photograph of the membrane skid for NTE pilot test.

Table 1. NTE Module Data

Module Serial Number	Measured N_2 Flux (GPU)	Measured O_2 Flux (GPU)	Selectivity, O_2/N_2
2588	27.5	57.3	2.09
2589	25.9	56.2	2.16
2590	27.5	55.9	2.04
2591	26.4	53.6	2.03
2592	27.5	60.4	2.20
2593	27.3	58.9	2.15
2594	27.9	56.3	2.02
2606	31.4	62.8	2.00
2607	28.3	58.3	2.07
2608	29.5	59.4	2.01
2609	28.3	58.3	2.06
2610	32.7	66.3	2.03
2611	28.4	60.9	2.15
2612	29.2	61.9	2.12
2613	29.9	64.0	2.14
2614	30.0	64.3	2.14
2615	31.6	63.9	2.02
2616	30.3	63.8	2.10
2617	28.3	61.3	2.16
2623	26.5	58.2	2.19
2624	26.3	56.5	2.15
2625	26.3	55.7	2.12
2626	27.2	59.3	2.18
2627	27.9	59.3	2.13
Average	28.4	59.7	2.10
Standard Dev.	1.8	3.3	0.10

In all cases, the support membrane was polyetherimide (PEI); the selective membrane was polydimethylsiloxane (PDMS). GPU: gas permeation unit; 1 GPU = 10^{-6} $cm^3(STP)/cm^2 \cdot s \cdot cmHg$.

Conclusions

System fabrication was completed in January 2004 and the membrane inserts were loaded. Additional pressure testing and verification will be completed prior to shipment, which is expected in early February 2004.

References

None cited.