### QUARTERLY PROGRESS REPORT

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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, a large multinational corporation with significant worldwide engineering and construction activities. MTR will be working with ABB’s Randall Gas Technology group, a supplier of equipment and processing technology to the natural gas industry. Randall’s engineering group found a new site for the project at a North Texas Exploration (NTE) gas processing plant.

The NTE 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 was built by ABB. NTE ordered the required compressor and MTR made the membrane modules. The membrane skid was completed by year-end 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 sub-quality due to high nitrogen content. Some of this gas can be brought to pipeline specifications by dilution with low-nitrogen-content gas; 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 was built at a North Texas Exploration (NTE) gas field in the Texas/Oklahoma Panhandle.

Additional test sites are also being explored (see below).

Experimental Installation

During its first quarter of operation, the NTE installation was stopped and the system was removed from the site due to constant gas production issues of the client. The unit will be moved to Houston for storage until an appropriate new location is identified. We are currently working with our partners ABB Lummus Global in identifying such potential clients and sites into which this unit can be redeployed.

Results and Discussion

The NTE membrane test unit has been stopped and is slated for removal from the site. The client has not been able to supply the volume of gas required to operate the unit and has been having constant well production problems. Fortunately, MTR has identified other commercial clients that have provided both sales and field test results; see the following sections for additional details.

Additional Field Sites

Our second commercial installation at Twin Bottoms, KY has been operational since November 2004. The system has consistently performed at or better than guarantee and has demonstrated unequivocally that the \( \text{N}_2/\text{CH}_4 \) membrane separation process works and is commercially viable. Due to the very flexible design of this unit, the client has been able to dial in the nitrogen content of the produced gas and has thereby maximized the total production and revenues generated. The membrane unit has been online virtually 100% of the time since it was started up.
Other Commercialization News

MTR and ABB are pursuing the commercialization of this product within the natural gas industry. In December 2004, we received a large order worth US$850,000 for a membrane skid from a company in Kansas; the order was for a membrane system to reduce nitrogen content in 4 MMscfd of gas from 40% to about 17%. This system incorporates eighteen 12-inch membrane modules, which represents one of the largest membrane skids sold by MTR. Additionally, the membrane unit will incorporate 12-inch diameter membrane modules, the first in MTR history to do so. The membrane system was fabricated in Houston, TX and will be ready for delivery to the client at the end of May 2005. A picture of this system in the fabrication shop is attached (Figure 1).

MTR also visited the Omaha Public Power District (OPPD) commercial facility in Omaha, Nebraska, where one of our other N₂/CH₄ systems has been operating for about 2 ½ years. The client confirmed that the membrane system has operated continuously without any disruption during the entire period and there has been virtually no change in performance over that time. This OPPD unit is delivering fuel with a lower nitrogen content to a fuel cell.

Based on the success of this OPPD unit, another customer in the same geographical area -- First National Bank of Omaha -- is also requesting a firm proposal for a set of membrane units to remove nitrogen from the fuel gas for four fuel cells at their facility. We expect to complete negotiations on this project by Q3 2005.

Conclusions

MTR has successfully tested the N₂/CH₄ separation process in a commercial unit and demonstrated its performance at one site in Kentucky. The successful demonstration has resulted in the sale of a commercial unit which was installed and started successful operation in December 2004. The demonstration unit at the NTE facility in North Texas stopped operation in Q1 2005 due to a lack of gas production. We expect to relocate the unit to another site before Q3 2005. The MTR/ABB team sold a new large nitrogen removal plant to a client in Kansas; it can process 4 MMscfd of gas. This order worth US$850,000 represents a very significant advance in the commercialization of this product line for MTR.

References
None cited.
Figure 1. Membrane skid developed to remove nitrogen from 4 MMscfd of natural gas.