Gas/Liquid Membranes For Natural Gas Upgrading

Quarterly Report No. 3

Reporting Period Start Date: April 1, 2002

Reporting Period End Date: June 30, 2002

Principal Author: Howard S. Meyer, Principal Manager, Gas Processing Research

GTI Project 61147

Issued: June 2002

Contract Number: DE-FC26-01NT41227

To

Anthony M. Zammerilli

Project Manager

National Energy Technology Laboratory

P.O. Box 880

3610 Collins Ferry Road

Morgantown, WV 26507

By

GAS TECHNOLOGY INSTITUTE

1700 South Mount Prospect

Des Plaines, IL 60018-1804

DISCLAIMER

ABSTRACT

Efforts this quarter have concentrated on legal agreements, including alternative field sites. Preliminary design of the bench-scale equipment continues.

TABLE OF CONTENTS

INTRODUCTION

Gas Technology Institute (GTI) is conducting this research program whose objective is to develop gas/liquid membranes for natural gas upgrading to assist DOE in achieving their goal of developing novel methods of upgrading low quality natural gas to meet pipeline specifications.

Kværner Process Systems (KPS) and W. L. Gore & Associates (GORE) gas/liquid membrane contactors are based on expanded polytetrafluoroethylene (ePTFE) membranes acting as the contacting barrier between the contaminated gas stream and the absorbing liquid. These resilient membranes provide much greater surface area for transfer than other tower internals, with packing densities five to ten times greater, resulting in equipment 50 – 70% smaller and lower weight for the same treating service.

The scope of the research program is to (1) build and install a laboratory- and a field-scale gas/liquid membrane absorber; (2) operate the units with a low quality natural gas feed stream for sufficient time to verify the simulation model of the contactors and to project membrane life in this severe service; and (3) conducted an economic evaluation, based on the data, to quantify the impact of the technology. Chevron, one of the major producers of natural gas, has offered to host the test at a gas treating plant. KPS will use their position as a recognized leader in the construction of commercial amine plants for building the unit along with GORE providing the membranes. GTI will provide operator and data collection support during lab- and field-testing to assure proper analytical

procedures are used. Kværner and GTI will perform the final economic evaluation. GTI will provide project management and be responsible for reporting and interactions with DOE on this project.

EXECUTIVE SUMMARY

The cofunding agreement with Chevron continues under discussion, but is temporarily on hold as Chevron finalizes purchase agreements for gas supply at the Chinchaga Gas Plant in Alberta, Canada. We have begun seeking alternative hosts and sites as a backup. An information package has been prepared and is being sent to a number of producing companies with operations within North America.

A preliminary set of bench-scale equipment specifications has been prepared and is in review. Table 1 shows the design feed conditions.

A meeting was held at the low-pressure units at SINTEF, Trondheim, Norway and at Statoil's facility in Kårstø Gas Terminal to discuss the design and operation of those units. See Figures 1-5. High-pressure systems will require much larger volumes of gas and therefore a recycle system was postulated.

Table 1. Material Balance for Conventional and Membrane Separation of Acid Gases from Natural Gas

DESIGN BASIS:

20% CO_2, 1% H_2S, and 1000SCFH Natural Gas Production

Both Adsorption and desorption at 1000 psig, per proposal page 23.

"Both the absorber and desorber will be designed to operate at pipeline pressures with CO_2 and H_2S contained in the feed gas"

Incoming Natural Gas		**Amine Solution Used**	
Natural gas, SCFH	1000	40 mole% MDE Amine and 2 mole %DEAmine in Water	
Pressure, psig	1000	(same Used by Kvaerner Design)	
Temperature (assume), F	80	Amount based on the Full scale plant design 0.5 mole acid per mole Amine (per Kvaerner)	
Moisture, lbs/MMscf	7	Amine Amount,mole/hr =	1.3842649
CO_2 Content, mole%	0.78		
H_2S Content, grain/100scf	20		

Natural Gas Composition	**Mole %**	**Mole %**	**Weight %**	**Mole %**	**mole**	**Mol Wt.**
Compound		**Normalized**			**non-normalized**	
Nitrogen, N_2	1.43	1.4287343	0	0	0	28.013
Carbon Dioxide, CO_2	0.78	0.7793096	0	0	0	44.01
Hydrogen Sulfide, H_2S	0.03184874	0.0318206	0	0	0	34.08
Methane, C_1	94.3	94.216536	0	0	0	16.043
Ethane, C_2	3.07	3.0672828	0	0	0	28.054
Propane, C_3	0.321	0.3207159	0	0	0	44.097
i-Butane, i-C_4	0.039	0.0389655	0	0	0	58.124
n-Butane, n-C_4	0.051	0.0509549	0	0	0	58.124
i-Pentane, i-C_5	0.016	0.0159858	0	0	0	72.151
n-Pentane, n-C_5	0.012	0.0119894	0	0	0	72.151
Hexane +, C_{6+}	0.023	0.0229796	0	0	0	86.178
Water, H_2O	0.01473889	0.0147258	58	90.079235	3.2195393	18.015
DEAmine,	0	0	2	0.5324957	0.019032	105.086
MDEAmine	0	0	40	9.3882696	0.3355479	119.208
Total	**100.0886**	**100.0000**	**100.0000**	**100.0000**	**3.5741**	

Figure 1 SINTEF Low Pressure Pilot Unit – Lower Half

Figure 2 SINTEF Low Pressure Pilot Unit – Upper Half

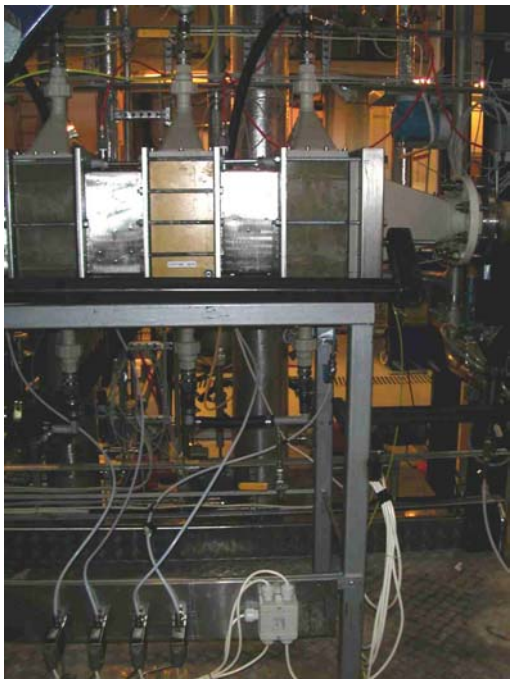

Figure 3 SINTEF Low Pressure Pilot Unit – Gas/Liquid Membrane Contactor Housing

Figure 4 SINTEF Low Pressure Pilot Unit -- Gas/Liquid Membrane Contactor Housing

Figure 5 SINTEF Low Pressure Lab Unit

EXPERIMENTAL

No experimentation was performed this quarter.

RESULTS AND DISCUSSION

No results have been achieved at this point.

CONCLUSION

No conclusions have been reached at this point.

REFERENCES

None