CERAMIC MEMBRANE ENABLING TECHNOLOGY
FOR IMPROVED IGCC EFFICIENCY

QUARTERLY TECHNICAL PROGRESS REPORT

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ABSTRACT:

This quarterly technical progress report will summarize work accomplished for Phase 2 Program during the quarter October to December 2003. In task 1 OTM development has led to improved strength and composite design for lower temperatures. In task 2, the yield of a large batch of OTM elements improved. In task 3, operational improvements in the lab-scale pilot reactor have reduced turn-around time and increased product purity. In task 7, IGCC economics were updated to reflect state-of-the-art OTM and cryogenic air separation processes.

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A. Executive Summary

The objectives of the second year of phase 2 of the program are to construct and operate an engineering pilot reactor for OTM oxygen. Work to support this objective is being undertaken in the following areas in this quarter:

- Element reliability
- Element fabrication
- Systems technology
- Power recovery
- IGCC process analysis and economics

The major accomplishments this quarter were

- **Long term life and process cycle tests have been completed**

B. Experimental Methods

B.1. OTM Element Reliability Experimental Methods

Characterization of OTM and substrate materials has been undertaken using many different experimental procedures. These include permeation, crystallographic, thermomechanical, thermochemical and electrochemical measurements. Standard equipment such as XRD, SEM, dilatometry and TGA/DSC were used. In addition oxygen permeation testers were used to measure the oxygen flux of OTM elements. The permeation test facility was described in the DOE IGCC first annual report ¹.

B.2. Element Manufacturing Experimental Methods

Various fabrication routes have been developed to prepare composite OTM samples. The fabrication routes used are proprietary information and included in the Appendix.

B.3. Systems Technology Experimental Methods

Details of the O-1 pilot reactor operation and advanced reactor design are proprietary information and included in the Appendix.

B.4. Process Analysis and Economics Experimental Methods

HYSIS simulations are used to model various process options.

C. Results and Discussion

C.1. OTM Element Reliability Results and Discussion

OTM life and process cycle tests have been completed. Improvements to the OTM material continue to be made.

C.2. Element Manufacturing Results and Discussion

Production of high quality, robust composite elements of PS01d has been scaled up at Praxair's manufacturing facility. The batch size OTM element production was increased.

C.3. Systems Technology Results and Discussion

O-1 reactor testing has continued. Operational improvements continue to decrease turnaround time and stabilize oxygen flux and purity.

C.4. Process Analysis and Economics Results and Discussion

IGCC economics were updated to reflect state-of-the-art OTM and cryogenic air separation processes. Methods to operational costs have been identified.

D. Conclusion

Progress has been made in all tasks toward achieving the DOE-IGCC program objectives. In task 1, more robust OTM elements have been tested in life and process cycle tests. In task 2, manufacture of robust composite PS01d elements has been scaled up with improvement in yields. In task 3, the operation of the O-1 reactor has been improved, and the advanced reactor design was finalized. In task 7, alternate OTM-IGCC processes were developed and process economics were evaluated.

E. References

- [1] Prasad, Ravi, "Ceramic Membrane Enabling Technology for Improved IGCC Efficiency" 1st Annual Technical Progress Report for US DOE Award No DE-FC26-99FT40437, October 2000.