

AN ELECTROCHEMICALLY REGENERATIVE ENERGY SYSTEM

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The objective of this program is to assist industry in developing and demonstrating a cost-effective "Electrochemically Regenerative Hydrogen-Halogen Energy Storage System." Both hydrogen-chlorine and hydrogen-bromine systems are being considered. These are batteries with fluid reactants, and consequently can be sized independently for power and energy. Hence, they are ideal for storage applications in conjunction with intermittent primary energy sources. Work has included electrochemical studies, cell tests, and techno-economic and safety assessments.

The hydrogen-chlorine cell performance has been characterized as a function of temperature and pressure. Increasing the pressure and the temperature improves the electric to electric efficiency. In the discharge mode, performances of 0.5 A at 0.9 V have been obtained at 80 °C and a pressure of 5 atmospheres.

A detailed investigation of the transport properties of Nafion membranes in hydrogen-halogen systems has been carried out. Inefficiencies because of coulombic losses are expected to be about 1 - 3%. Transport of bromine through the membrane is less than expected because the bromine complexes to form negatively charged Br_3^- and Br_5^- ions.

A detailed heat and mass balance analysis has been carried out for both the hydrogen-chlorine and hydrogen-bromine systems. Subcontractor work included cell tests, a detailed cost and safety assessment, and a multidimensional optimization study of both the H_2/Cl_2 and H_2/Br_2 systems. The ultimate goals of the program are fabrication and testing of multi cell units, scale up to 5 kW and 20 kW units and testing of a 20 kW system in conjunction with a 250 kW h storage system.

Recent publications

- 1 P. M. Spaziant, G. C. Scioli, R. Trotta, A. Perego and J. McBreen, Hydrogen/halogen energy storage system, *Proc. DOE Chemical/Hydrogen Energy Systems Contractor Review, Washington, DC, November 27 - 30, 1978 (BNL-25212)*.
- 2 D-T. Chin, R. S. Yeo, J. McBreen and S. Srinivasan, An electrochemically regenerative hydrogen-chlorine energy storage system: a study of mass and heat balances, *J. Electrochem. Soc.*, 126 (1979) 713.
- 3 R. S. Yeo and J. McBreen, Transport properties of Nafion membranes in electrochemically regenerative hydrogen/halogen cells, submitted for publication to *J. Electrochem. Soc. (BNL-25470)*.
- 4 R. S. Yeo and D-T. Chin, A hydrogen-bromine fuel cell for energy storage applications, submitted for publication to *J. Electrochem. Soc. (BNL-26073)*.
- 5 R. S. Yeo, J. McBreen, A. C. C. Tseung, J. McElroy and S. Srinivasan, An electrochemically regenerative hydrogen-chlorine energy storage system: electrode kinetics and cell performance, submitted for publication to *J. Appl. Electrochem. (BNL-26519)*.