Project Title: Hydrogen Production from Hydrogen Sulfide in IGCC Power Plants

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OBJECTIVE(s)

The overall objective is to produce hydrogen during the sulfur recovery process in IGCC power plants at a low enough cost so that the hydrogen revenues improve the cost effectiveness of the IGCC process.

In IGCC power plants, sulfur dioxide emissions are avoided by extracting the sulfur from the synthesis gas as hydrogen sulfide. Since hydrogen sulfide has a small free energy of formation, a small amount of energy can decompose it into hydrogen and sulfur whose sale can pay part of the production cost making IGCC more cost effective. This project aims to develop an economical technique for achieving this decomposition.

ACCOMPLISHMENTS TO DATE

The work of Task 1 of the Statement of Work is well advanced.

Task 1.1 has been completed.

The required design work for Tasks 1.2 and 1.4 has been completed and components ordered.

Task 1.1.
An electrolytic cell has been designed and fabricated for operating at 150C with gaseous hydrogen sulfide and liquid sulfur in the anode compartment and hydrogen gas in the cathode compartment. A schematic diagram of the cell is shown in Figure 1.

Tasks 1.2 and 1.4.

An apparatus for monitoring and control of the hydrogen sulfide, sulfur and hydrogen flows has been designed and the components ordered. A schematic of the system is shown in Figure 1.

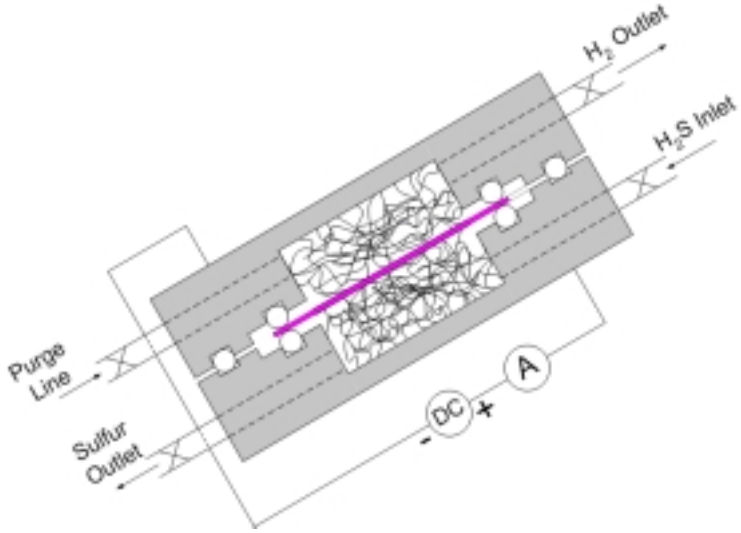

Figure 1. Schematic of Electrolytic Cell

Hydrogen sulfide is delivered to the anode compartment of the electrolytic cell via 316 stainless steel tubing and controlled by a pressure regulator on the tank and a mass flow controller in the line. The pressure is continuously monitored.

Electrons are removed in the anode compartment to yield hydrogen ions and liquid sulfur. The liquid sulfur pools at the bottom of the compartment and runs out of a drain tube there for collection. The liquid pool seals the drain tube against outflow of hydrogen sulfide from the compartment. Hydrogen ions pass through the solid electrolyte to the cathode compartment where it gains electrons to form hydrogen gas that flows out at the top.

The hydrogen produced flows into a manifold from which samples are taken for various analyses.

FUTURE WORK

In the next three month period, Tasks 1.2 and 1.4 wil be completed along with Task 1.3 which states, "Electrodes suitable for handling hydrogen sulfide and sulfur will be installed." Task 2 will then be performed as follows:

Task 2.0. Electrolysis

2.1. Decomposition of hydrogen sulfide at 150C with the apparatus prepared in Task 1.0 will be demonstrated and evaluated.

2.2. Hydrogen and sulfur produced will be analyzed.

2.3. Impermeability of the cesium hydrogen sulfate electrolyte pellets to hydrogen sulfide will be verified.

CONFERENCE PRESENTATIONS

"Hydrogen Production by Electrochemical Dissociation of Hydrogen Sulfide in Refineries,"
presented by Burton Krakow, Eric P. Weaver, George Moore, Elias K Stefanakos
University of South Florida, USA at The 231st ACS National Meeting, Atlanta, GA, March 26 -30,2006, Paper 21

"Hydrogen Production by Electrochemical Dissociation of Hydrogen Sulfide in IGCC Plants," presented by Burton Krakow, : Eric P. Weaver, George Moore, Lars Ecklund-Mitchell,
Elias K Stefanakos, Matt Smith / University of South Florida, at The Twenty-Second Annual International Pittsburgh Coal Conference, Pittsburgh, PA, USA, September 11 - 15, 2005

STUDENT SUPPORTED

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