



Project Summary

Demonstration of Fuel Cells to Recover Energy from Landfill Gas - Phase II. Pretreatment System Performance Measurement

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The report describes Phase II of a demonstration of the utilization of commercial phosphoric acid fuel cells to recover energy from landfill gas. This phase consisted primarily of the construction and testing of a Gas Pretreatment Unit (GPU) whose function is to remove those impurities from landfill gas which are detrimental to the fuel cell. The GPU has been successfully tested at a landfill-to-energy facility in Los Angeles (Sun Valley), California. The GPU successfully removed the sulfur and halogen compounds contained in the landfill gas to a level significantly below that specified for use with the phosphoric acid fuel cell. During a challenge test in which dichlorodifluoromethane (Refrigerant 12) was intentionally injected into the process stream during an 8-hour period, the exit concentration of Refrigerant 12 was below the limit of detection and below the specified value for the fuel cell.

This Project Summary was developed by EPA's National Risk Management Research Laboratory's Air Pollution Prevention and Control Division, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering at back).

Overview

International Fuel Cell Corporation (IFC) has completed Phase II of a U.S. Environmental Protection Agency (EPA) demonstration of the utilization of commercial phosphoric acid fuel cells to recover en-

ergy from landfill gas. This phase of the program consisted primarily of the construction and testing of a Gas Pretreatment Unit (GPU) whose function is to remove those impurities from landfill gas which are detrimental to the fuel cell.

The GPU has been successfully tested at a landfill site located in Los Angeles (Sun Valley), California. The site is operated by Pacific Energy Corporation as a landfill-to-energy facility. The GPU successfully removed the sulfur and halogen compounds contained in the landfill gas to a level significantly below that specified for use with the phosphoric acid fuel cell. During a challenge test in which dichlorodifluoromethane (Refrigerant 12) was intentionally injected into the process stream during an 8-hour period, exit concentration of Refrigerant 12 was below the limit of detection and below the specified value for the fuel cell.

The GPU was constructed by IFC at its facility in South Windsor, Connecticut. Construction of the unit was completed in February 1993. Upon completion of construction, the unit was evaluated at the South Windsor facility using nitrogen as the test gas. The unit successfully completed the 16-hour control test verifying that rated flows, pressure, and temperature were achieved. After the test, the unit was shipped to the landfill site in Los Angeles, California, where it was installed in April 1993.

The GPU system is shown schematically in Figure 1. The system consists of a number of fixed beds and condensers/heat exchangers. A functional description of the major elements of the GPU is con-

tained in Table 1. The unit has been tested on landfill gas at the site, and Table 2 compares the measured sulfur and halide contents of the gas produced by the GPU to the specification value. The data verify that the GPU reduces the sulfur and halide contents of landfill gas to a concentration lower than required by the fuel cell power plant. The data also show that li-

uids do not condense in the low temperature cooler. However, that cooler reduces the temperature of the landfill gas prior to its introduction into the carbon bed, increasing the capacity of the carbon bed for the sulfur and halogen compounds. For system simplification in the future, it may be beneficial to eliminate the low temperature cooler and accept any reduc-

tion in carbon bed capacity. Based on the favorable results of the GPU testing, the EPA directed IFC to proceed into Phase III of the program which entails characterizing the performance (i.e., emissions, efficiency, and power output) of the commercial phosphoric acid fuel cell power plant when operating on landfill gas which has been purified by the GPU.

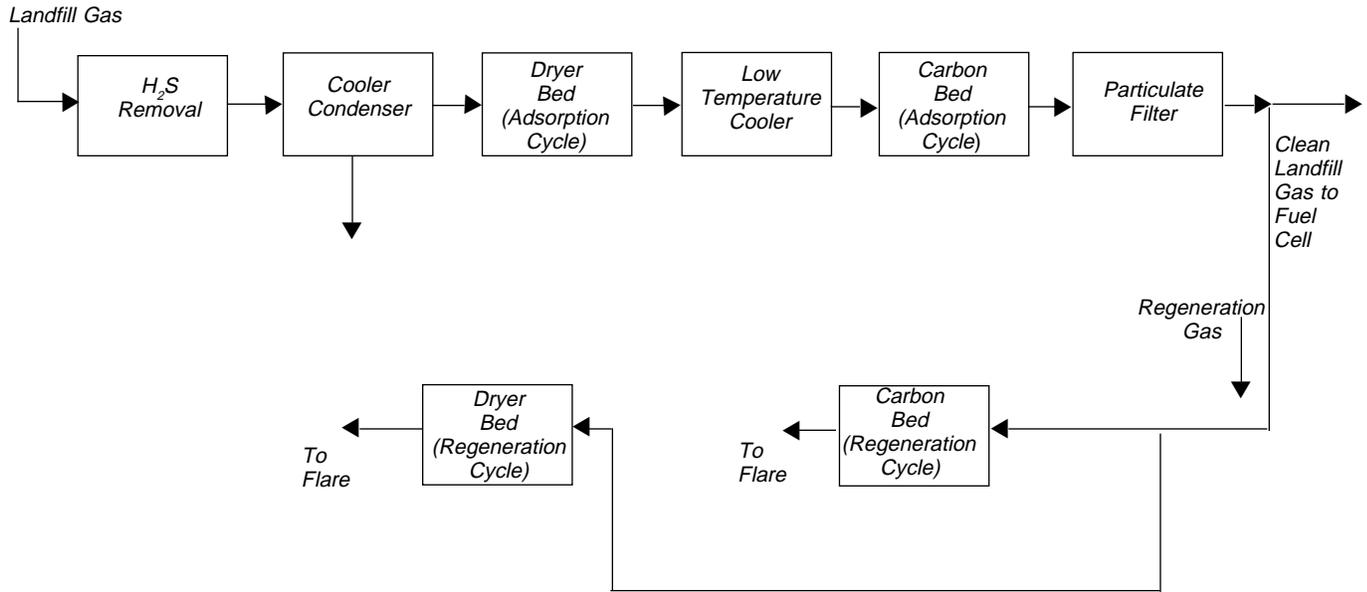


Figure 1. Landfill gas pretreatment system.

Table 1. GPU Component Functions

Component	Function	Regenerable
H ₂ S Removal Bed	Remove H ₂ S	No
Cooler/Condenser	Remove Water, Hydrocarbons	Not Applicable
Dryer Bed	Remove Water to -50°C Dew Point	Yes
Low Temperature Cooler	Cool Carbon Bed	Not Applicable
Carbon Bed	Remove Organic Sulfur and Halogen Compounds	Yes
Filter	Remove Particulates	No

Table 2. GPU Sulfur and Halide Contaminant Removal Performance vs. Specification

	GPU Exit (ppmV)	Specified Value (ppmV)
Total Sulfur (as H ₂ S) ^a	≤ 0.047	<3
Total Halides (as Chloride) ^b	≤ 0.032	<3

^a Measured by gas chromatography/flame photometric detector by EPA Methods 15, 16, and 18.

^b Measured by gas chromatography/mass spectroscopy by EPA Method TO-14.

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The complete report, entitled "Demonstration of Fuel Cells to Recover Energy from
Landfill Gas - Phase II. Pretreatment System Performance Measurement,"
(Order No. PB96-103 601; Cost: \$35.00, subject to change) will be available only
from:*

*National Technical Information Service
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