United States
Environmental Protection
Agency

Municipal Environmental Research
Laboratory
Cincinnati OH 45268

Research and Development

EPA-600/S2-84-039 Mar. 1984

EPA

Project Summary

Sale of Surplus Digester and Landfill Gas to Public Utilities

Cynthia A. Cairns and Albert B. Pincince

Gas produced by anaerobic digestion of wastewater can be upgraded and sold to public utilities. Upgrading the gas involves treatment to remove carbon dioxide and hydrogen sulfide, dehydration, and compression.

Upgrading digester gas is technically feasible and less expensive than current prices for natural gas. Several wastewater plants have investigated the use of digester gas, but no programs have been instituted, primarily because other gas-use alternatives (involving on-site uses) are considered more economical.

Gas generated in solid waste landfills is similar to digester gas. Several programs to use landfill gas have been implemented and more are planned. Because landfill gas cannot usually be used on-site and because larger quantities are typically produced, landfill gas has a greater potential for future development by public utilities than digester gas.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Methane gas is generated as a byproduct of (1) anaerobic digestion of wastewater sludge and (2) solid waste landfills. With proper recovery and treatment, the gas can be upgraded and sold to public utilities.

Anaerobic digestion is widely used in wastewater treatment plants to stabilize sludge. Sludge is maintained at about 90 °F for 10 to 30 days in the absence of free oxygen. The organic matter decomposes, and the pathogen content is reduced. Decompositibn primarily produces methane, carbon dioxide, and water. The energy in the gas is greater than the energy required to heat and mix the sludge in the digester, and the surplus gas is available for other uses.

Many wastewater plants flare the surplus gas. With today's energy costs, however, utilizing the gas has become economically beneficial, particularly for plants producing large volumes. The gas can be sold to utilities and added to their natural gas distribution systems. This involves upgrading the gas and conveying it to a distribution pipeline.

Solid waste, which decomposes in landfills, produces a gas similar to digester gas, and several programs have already taken advantage of landfill gas. These programs involve steps to recover and upgrade the gas before it can be sold.

This study examines the sale of surplus digester and landfill gas to public utilities. It was conducted by contacting individuals involved in gas-use programs and by reviewing applicable literature. The report examines gas quality and quantity requirements, costs, risks, and regulatory constraints. It reviews gas purification processes and competing uses of digester gas, and it summarizes the current staus of gas-use programs.

Digester Gas and Public Utilities

Several factors influence a public utility's decision to purchas surplus digester gas: the quality of the gas, the available quantities, economics, the utility's perception of project risk, and regulatory constraints.

Before gas can be injected into a natural gas distribution system, it must be upgraded to pipeline standards and it must be pressurized. General requirements for purifying digester gas include removing carbon dioxide to increase heating value, removing hydrogen sulfide to meet air quality standards and to eliminate corrosion, and dehydration to eliminate corrosion and the formation of condensate that could restrict pipeline flows. Although the requirements vary significantly from one utility to another, "purified" gas should have less than 3 percent carbon dioxide, less than 2.7 ppm of hydrogen sulfide, a minimum heating value of 36,300 kJ/std cu m (975 Btu/scf), and less than 0.1 mg/L (7 lb/10^6 cu ft) of water. Hydrogen sulfide and water are the most critical contaminants. High concentrations of either can cause severe corrosion problems.

Most public utility distribution systems can accept whatever quantities of digester gas are available. No minimum natural gas quantity is required to satisfy the demand, in that the ratio of digester gas to natural gas in the distribution system would be small.

The economics of gas treatment vary from one plant to another. Factors to be considered include the characteristics and quantities of surplus digester gas, variations in production, quality standards required for pipeline injection, and costs of treating, compressing, and transporting the gas. The price the utility will pay is another important factor. But the price can vary greatly, depending on the availability and cost of conventional energy resources and on the utility's assessment of the viability of the plan. The potential revenue must also be compared with the revenue generated from selling the gas to a private user off-site, or the energy savings from using the gas on-site, to determine if selling to a utility is economical.

One of the most significant factors influencing a utility's decision to purchase digester gas is the perceived risk associated with using the energy resource. Although the purification and sale of digester gas for use in a natural gas distribution system appears to be technically an economically viable, utilities have been unwilling to commit themselves, primarily because of the financial risk for relatively small quantities of gas.

Existing regulatory policies can seriously constrain the sale of digester gas because of price control, limited government funding, lengthy permit processing, and air pollution requirements associated with gas processing facilities. Moreover, no specific regulatory policy governs the sale of digester gas to a local utility. And numerous federal, state, and local regulations overlap or conflict in many cases.

Digester Gas Treatment

Before digester gas can be injected into a utility's distribution system, it must be upgraded to pipeline standards. Purification usually involves removing carbon dioxide, hydrogen sulfide, and moisture from the gas. Gas purification processes are often referred to as scrubbing or sweetening processes. "Sour" gas, containing impurities such as hydrogen sulfide and carbon dioxide, is converted to "sweet" gas, free of contaminants.

Several commercial gas purification processes have been proven technologically in the petroleum and energy industries. And many processes can be readily adapted. The quantity of gas required to make treatment with these processes economical is, however, typically greater than the amount of gas available. Selecting appropriate processes for a facility depends on many factors, including the degree of purification reqired, the need to recover impurities, the quantity of gas, the presence of trace contaminants, the plant's location, and available financing.

Competing Uses for Digester Gas

At wastewater treatment plants, digester gas is usually used for fuel to keep the digester at its required temperature. Untreated digester gas is typically fed to boilers for combustion, generating steam or hot water. The steam or hot water then heats the raw sludge by pumping the sludge through heat exchangers or by steam injection. Depending on ambient air temperatures, one-third to one-half of the digester gas produced is required to heat the digester. The rest is available for other uses.

Surplus gas can be flared, used to satisfy other energy needs within the plant, or sold to off-site users, such as public utilities or nearby industries. Alternatives implemented at plants will depend on local power costs, energy requirements of the plant, quantities and characteristics of the surplus gas, proximity of off-site users, and existing facilities. If the quantity of surplus gas is small or if the projected energy saving does not justify operating costs, the surplus gas is flared.

In-plant uses include space heating and cooling, driving internal combustion engines, generating power, incinerating sludge, and process heating. Off-site uses include selling the gas to private industries, upgrading for use as vehicle fuel, producing and selling excess steam or hot water, selling electricity produced by on-site cogeneration, and chemical conversion.

Digester Gas Utilization Programs

Most of the current interest in digester gas use by public utilities has been centered in California. The California State Legislature adopted utility regulations that make off-site use of digester gas easier to implement. Moreover, because several wastewater treatment plants serve large population centers and because the warm climate reduces in-plant energy demands, larger quantities of digester gas are available for sale.

In-plant gas utilization programs are being conducted in Chicago, IL; Denver, CO; East Bay Municipal Utility District, CA; Fresno, CA; Livermore, CA; New York, NY; Philadelphia, PA; Sacramento Regional County Sanitation District, CA; and San Diego, CA. Off-site gas utilization programs are being conducted in Los Angeles, CA; County Sanitation Districts of Los Angeles, CA; New York, NY; Sanitation Districts of Orange County, CA; and Washington, D.C.

Using Landfill Gas

Methane gas generated in sanitary landfills is similar to digester gas. As with digester gas, interest in using landfill gas as an alternative energy source has increased.

As municipal waste in landfills decomposes, methane is produced. In the past, methane generation and migration in landfills have created potential explosive hazards. Several large landfills have had to install gas collection systems to prevent migration of gas to adjacent property where explosive mixtures could form. The collected gas can either be vented to the atmosphere or incinerated. With today's energy prices, it has become economically beneficial for some larger landfills to recover, process, and use the gas.

Landfill gas can be used in various ways: upgrading and then injecting the gas into a natural gas pipeline; partially

upgrading and selling to a nearby industry; generating power; producing steam; and conversion to liquified natural gas or methanol.

Conclusions

Digester Gas

- Selling upgraded surplus digester gas to a public utility for injection into a natural gas pipeline is both feasible and economical. No programs have been implemented in the United States, however, mainly because other gas-use alternatives have been considered more viable.

- Wastewater treatment plants usually choose on-site use of digester gas for the following reasons: (1) most of the energy made available by digester gas can be used in-plant; (2) it is relatively easy to implement in-plant programs of gas use; (3) the technology for in-plant gas use is proven; (4) in-plant gas use requires minimal gas treatment; (5) public utilities, which represent the off-site markets for digester gas, tend to believe that using digester gas will force them to accept disproportionate risks in terms of reliability, quality, and institutional factors, whereas the use will only offset a tiny fraction of their natural gas needs; and (6) complex and vague regulatory policies concerning off-site sale of digester gas at every level of government can delay implementation.

- Alternatives to selling surplus digester gas to utilities include: (1) in-plant use, which is widely practiced; (2) conversion of gas to vehicle fuel and sale; and (3) upgrading and sale to a private user.

Landfill Gas

- Gas generated at solid waste landfills is similar to digester gas, and it is generated in large quantities.

- Several programs of recovering and using landfill gas have been implemented or are in the planning stages.

- When compared with digester gas, landfill gas has greater potential for public utility development because larger quantities are produced, thus making the economics more favorable, and because no competing on-site uses exist.

The full report was submitted in fulfillment of Contract No. 68-03-2803 by Camp, Dresser and McKee, Inc., under sponsorship of the U.S. Environmental Protection Agency.

Cynthia A. Cairns and Albert B. Pincince are with Camp Dresser and McKee, Inc., Boston, MA 02108.
***R. V. Villiers** is the EPA Project Officer (see below).*
The complete report, entitled "Sale of Surplus Digester and Landfill Gas to Public Utilities," (Order No. PB 84-155 555; Cost: $10.00, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Municipal Environmental Research Laboratory
U.S. Environmental Protection Agency
Cincinnati, OH 45268

☆ U.S. GOVERNMENT PRINTING OFFICE: 1984 — 759-015/7607

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

BULK RATE
POSTAGE & FEES PAID
EPA
PERMIT No. G-35

Official Business
Penalty for Private Use $300