Mustang Sampling®

Swine Biogas - Renewable Energy

CLIENT:

Optima-KV

End use: Injected into Piedmont Natural Gas (Duke Energy) pipeline for various local uses

LOCATION:

Duplin County, North Carolina

INDUSTRY:

Renewable Energy/Biogas

PRODUCTS AND SYSTEMS:

- Mustang® Biogas Sample Conditioning System
- Mustang® Sample Conditioning System
- Certinjector™ Gas injector

Processing the waste from agricultural operations to generate Renewable Natural Gas (essentially methane) is growing in popularity but presents significant technical challenges. Optima K-V was the first such project in North Carolina, gathering waste from several hog farms and ultimately supplying Duke Energy with valuable Renewable Natural Gas for injection into their network. Mustang Sampling partnered with OptimaBio, the waste-to-energy project developer, to provide technical guidance and systems for the treatment and analysis of the "Biogas" throughout the process.

THE **SWINE CYCLE OF BIOGAS**

A pig raised as a food-source has a short and singularly focused life, with an average lifespan of about six months. During that time each pig moves from one stage to the next, gaining weight and producing waste continuously. A typical swine herd concentration numbers in the thousands to tens-of-thousands for a modern farm, with each pig producing several pounds of waste each day for six months. This waste can be processed to produce useful methane gas, the main component in natural gas, which is already a major source of energy throughout the world. The gas from the swine operation is called biogas

Methane is the simplest hydrocarbon molecule with one carbon atom and four hydrogen atoms, making it the cleanest (lowest carbon footprint) hydrocarbon fuel. In traditional natural gas production, produced gas is cleansed through an elaborate processing procedure until the mixture is suitable for transportation by pipeline to customers requiring fuel. The natural gas mixture is primarily methane and ethane with some heavier components like butane, propane, and pentane. The energy value of the natural gas is managed to be within a range suitable for burning in homes or for electricity generation. Since biogas is mainly methane, it is a logical choice to be injected into natural gas systems as a recovered, renewable fuel. In addition to its usefulness as an energy source, the capture of biogas reduces methane emissions into the atmosphere and lowers the overall greenhouse effect from unrecovered operations.

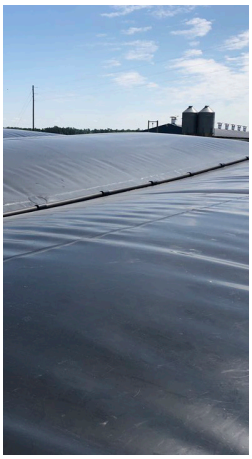
AN OVERVIEW OF THE PROCESS **FROM WASTE TO RENEWABLE ENERGY**

The process from gathering waste to producing a renewable source of methane can be broken down into the major steps of gathering, decomposition (anaerobic digestion), collection, cleaning, and injection (or alternate use as an energy source). The gathering process has not changed significantly in the past fifty years. Pigs live on slatted or grid-like flooring which allows the waste to fall through into a gathering area below. From there, the waste is transported into an anaerobic digester. The role of the anaerobic digester is to

biologically break down the glucose in the waste to create carbon dioxide, methane, and other components. The gaseous elements from the digester, or "raw" biogas, gather above the liquid and solid materials and are transported away for processing. The liquid and solids are processed as fertilizer or slurries. The term "lagoon" is used in pig operations because the waste has a high water concentration and resembles a small pond, usually covered with a thick tarp covering. Cleaning the biogas is a mainly physical process to remove water, scrubbing to remove carbon dioxide, and a sweetening process to eliminate sulfur and other unacceptable elements. From there, the gas can be injected into a pipeline for distribution with the proper mixing to an acceptable energy value or used directly to generate heat or electricity at the farm.

GAS SAMPLING & MUSTANG SAMPLING'S ROLE

Gas sampling is a generic term describing the process of extracting a small portion of gas from a process and transporting it to an analyzer(s). Biogas, like natural gas, is not a single component gas but rather a mixture of gases. Changes to the pressure or temperature of the gas sample can cause separation of the components prior to analysis, which is undesirable since only a representative sample is useful. Sampling is critical in the production of biogas because only through analysis can the process be controlled, resulting in the correct end product. Mustang Sampling provides the sampling and analysis systems that allow for a controllable, safe, and efficient process. Without the proper combination of sample control, conditioning, and analysis, the process would quickly escalate out of control. In the final step, local distribution companies also rely on proper sample conditioning and



analysis to ensure the produced gas meets local and national tariffs for pipeline gas. Methane recovery and renewable gas injection is not possible without proper sample control, conditioning, and analysis.

THE PROJECT

Optima-KV is North Carolina's first biogas injection project. The project scope includes aggregating biogas from five individual swine farms, cleaning the gas, and injecting the resultant biogas into the Piedmont Pipeline to supply Duke Energy's system for the generation of electricity. The farms involved contain nearly 60,000 pigs, which are expected to produce enough waste to ultimately power the equivalent of about 1000 households on a continuous basis. Optima-KV took the approach of aggregating the waste from multiple farms to improve the efficiency of the overall process compared to employing five different systems.

Mustang Sampling deployed multiple sampling systems and analyzers to allow for the control of Optima K-V's processes. Three basic systems were deployed to measure the raw digester gas, the cleaned gas, and finally the gas prior to entering the pipeline. Each system has unique challenges beginning with wet, acidic gas at the digester requiring hardened materials with filtration and water removal. It is critical to protect the analyzers used for each measurement at all times, including when the system is not in balance. In the final stages prior to injection, a gas chromatograph is deployed to measure each component in the gas mixture. Moisture, carbon dioxide, sulfur, hydrogen sulfide, and oxygen are also continuously monitored within the process. Assuming the energy value is suitable for the natural gas pipeline, the gas can be injected into the system.

Analytically Accurate®
TECHNOLOGY

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