



Gulf Coast Environmental
Systems

CASE STUDY

THERMAL OXIDIZER

LANDFILL - BIOGAS | NOVEMBER 2018

LANDFILL

Employees: 138

Industry: Landfill/Waste Management

Project Type: Biogas

Project Goal: Building a biogas facility to develop pipeline quality natural gas

Equipment Type: Carbon Adsorber and Thermal Oxidizer

EXECUTIVE SUMMARY:

Gulf Coast Environmental Systems was tasked with finding a pollution control solution that could handle two combined PSA reject gas vent streams.

CLIENT OVERVIEW:

This client is an environmental firm specializing in the operation and management of landfill and waste hauling. This location handles up to 4,000-tons of diverse municipal waste, daily, and services a very large area in the southwest corner of the state. They work closely with federal, state, and local regulatory agencies to ensure they exceed all landfill emission regulations, and are a shining example of the value landfill gases hold in today's market.

PROJECT OVERVIEW:

In this case, Pressure Swing Adsorption (PSA) systems are cleaning biogas from a landfill. Potentially dangerous gases like methane (CH₄), carbon dioxide (CO₂), sulfides, and ammonia, are created by the decomposition and evaporation of organic compounds as well as chemical reactions between waste components.



PROJECT OVERVIEW CONTINUED:

These gases and other hydrocarbons are often considered greenhouse gases and play a huge role in global warming.

According to the EPA, in the United States landfills are the third most prevalent source of methane and other greenhouse gases. Another risk when dealing with methane is the flammability of the gas which is incredibly high. When condensed into a small space, methane is considered an explosive, and should be handled with extreme caution. The fact that a minimal amount of oxygen is present in this particular stream of waste gas eliminates risk of the process concentration becoming combustible that could lead to flashback. However, poorly designed or maintained landfills run the risk of higher levels of oxygen entrainment leading to elevated danger and uncontrolled greenhouse gas emissions.

The goal of this project was to convert the landfill gases into a source of income for the client. This client wanted to build a biogas facility at the landfill that would ultimately be able to produce pipeline quality renewable natural gas.



SOLUTION:

There are a couple of steps to abating landfill gases. The first step that must be taken is the removal of H₂S. H₂S, or hydrogen sulfide, is a very corrosive compound, which can be destructive to common machinery. The best way to abate hydrogen sulfide is by using a carbon absorber, or a dry scrubber (sometimes in the form of an iron sponge system). In this case, a 2,150 SCFM Active Vertical Vessel Carbon Adsorber with integrated Side (Standby) Adsorber was used. Adsorption is a filtration method used to remove certain chemicals and volatile organic compounds (VOCs) from waste gas. The gas flows through an activated carbon bed that traps the VOC particulates on its surface. Various types of activated carbon are often used in adsorption systems.



This particular package was constructed from Fiberglass Reinforced Plastic according to ASTM D3299-10. GCES supplied this carbon adsorber with a specialized H₂S removal carbon designed for approximately 1-year of uninterrupted operation in the main vessel, and approximately 2 months of operation in the side vessel for adequate planning and replacement of the main vessel activated carbon.

Carbon is thermally or chemically activated with the objective of providing a large surface area. One way of considering carbon's potential is to consider that 1 pound of carbon has more than 100 acres of surface area, which enables activated carbon to have the tremendous ability to adsorb different chemicals. Initially for carbon adsorber system design, isotherm(s) are studied for particular chemicals. Other considerations include air volume, pressure, elevation, relative humidity, temperature, and the potential effects of multiple compounds in the airstream. Adsorption is a heat-sensitive and relative humidity sensitive process. Additional considerations are particulate, oils, or other contaminants that may prevent the carbon from adsorbing at optimal rates.

While the initial layers of the packed carbon bed may attain high working saturation during the adsorption mode approaching those of the isotherm, the last third of the bed is basically a polishing zone. The effect leads to an empirical dynamic working capacity of 15% to 25% of the value given by the isotherm.

Subsequent steps in the cleaning process is to remove the CO₂ and other unwanted chemicals using sieves and other technologies to 'clean' the gas to natural gas specifications to allow for injection into the local pipeline. During the cleaning process, reject waste gas is produced that must be treated before being released to atmosphere. With this client, a Vapor Combustor was the best option. The Vapor Combustor or Enclosed Flare (often called a Thermal Oxidizer by mistake in industry) provides for over 99% removal of the reject gas's harmful VOCs.

The method of reduction of Volatile Organic Compounds (VOCs) in a Vapor Combustor or Thermal Oxidizer revolves around thermal destruction. The chemical process of thermal oxidation is quite simple; the exhaust stream temperature is raised to a point that the chemical bonds that hold the molecules together are broken. The VOCs in the process exhaust stream are converted to various combinations of carbon dioxide (CO₂), water (H₂O), and thermal energy by the high temperature of the combustion or reaction chamber.

Once all processes are complete, the client is left with a product that is considered a renewable natural gas which can be used as a fuel source in many operations or to produce electricity and heat.



THE VALUE IN ABATING LANDFILL BIOGAS STREAMS:

As of March 2015, there were about 645 operational Landfill Gas projects in the United States through the Landfill Methane Outreach Program (LMOP), and that number was expected to steeply rise.

Renewable natural gas (RNG), also known as sustainable natural gas (SNG), or biomethane, is a biogas that can now be used as a pipeline energy source. Natural gas and energy companies can purchase the waste gas from landfill gas abatement and sell it to their customers. RNG qualifies as an advanced biofuel under the Renewable Fuel Standard.

These RNG credits created by landfill gas abatement are incredibly valuable because they can be used interchangeably with natural gas and the U.S. government incentivizes energy companies to purchase and use them. Because of this, these gases often sell at a higher rate than conventional natural gas. The end result of RNG development takes dangerous gases and turns them into valuable sources of energy while aiding in the prevention of global warming.

