

CO₂ Wash™ Technology Cleans Landfill Gas to Power Heavy Duty Trucks

Background

Methane, a significantly more potent greenhouse gas than CO₂, is a major by-product of landfill decomposition processes. Landfill gas, which consists mostly of methane (CH₄) and CO₂, also contains a number of contaminants (siloxanes; compounds which contain chlorine, bromine, fluorine and sulfur; and aromatic hydrocarbons such as benzene and toluene) and is currently a largely wasted resource. Collection and conversion of landfill gas can provide methane feedstock for electricity, pipeline natural gas and liquid methane, as well as methanol and hydrogen. To use landfill methane as transportation fuel, however, contaminant removal must take place, and most of the CO₂ must be separated to produce methane with an appropriate degree of purity.

With a 1998 Small Business Innovation Research Grant from the Department of Energy (DOE), Acirion Technologies, Inc., continued to develop its CO₂ Wash™ technology as a way to remove contaminants from landfill gas, and successfully demonstrated the process at Al Turi Landfill in New



LNG storage tank and fueling station (Photo courtesy of Acirion)

York. Building on this success, and in contract with Acirion, Brookhaven National Laboratory supported efforts with the Rutgers EcoComplex and Burlington County Landfill (New Jersey) to separate CO₂ from methane and produce clean liquid natural gas for transportation fuel.

The Technology

The CO₂ Wash™ process uses a conventional packed column. Landfill gas rises to the top of the column where refrigeration causes a portion of the CO₂ component to liquefy. This liquid CO₂ is available as product, except for a small portion sent down the column to “wash out”

volatile organic compounds. The contaminant-laden CO₂ is vaporized for refrigeration recovery and delivered to the landfill flare for thermal oxidation of contaminants. Methane collected at the top of the column is free of volatile organic compounds (<100 ppb), but still contains substantial CO₂. Using MEDAL™ membranes, Acirion successfully reduced the CO₂ concentration of this mixture to 50 ppm, and then liquefied the pure methane. (Solid CO₂, or “dry ice,” will form and accumulate if methane containing over 50 ppm CO₂ is liquefied, eventually clogging heat exchangers.) Liquid methane purity was continuously monitored by Acirion and confirmed



commercial success

through independent analysis by Atlantic Analytical Laboratory.

Commercialization

As a result of the work at Rutgers EcoComplex and Burlington County Landfill, 10,000 gallons of liquid natural gas (LNG) were produced from landfill gas. Two new Mack refuse haulers owned by Waste Management, and equipped with dedicated spark ignited natural gas engines, were operated on commercial refuse collection routes for 600 hours each using the liquid natural gas fuel. Initial examinations and engine tests after 300 and 600 hours of service revealed no discernable engine harm from the use of liquefied natural gas obtained from landfill gas. As a next step, other landfill operators will be sought to work with Mack Trucks, Inc.; Acrion Technologies, Inc.; and their partners to further assess the potential for

widespread commercialization of the landfill gas to vehicle fuel model.

Benefits

- Recovers renewable energy contained in landfills
- Reduces emission of greenhouse gases to atmosphere: recovers >99% of methane and >80% of CO₂
- Removes and destroys volatile organic compounds from landfill gas and improves local air quality
- CO₂-based contaminant control is *in situ*: no regeneration, purchase, or disposal of solvent is required
- Simple, conventional, and robust process

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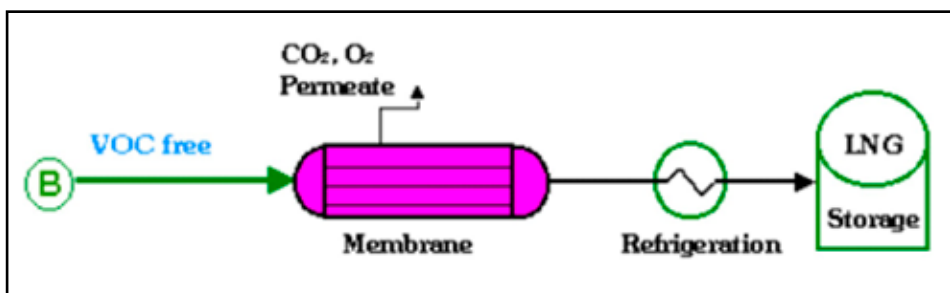
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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



LNG production requires recovery of pure CH₄ from landfill gas. Additional CO₂ is removed from clean methane product after CO₂ Wash™ (B) to prevent solid CO₂ formation during methane liquefaction. (Photo courtesy of Acrion)

For more information contact:

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