TREATISE ON EFFICIENT BIOGAS PURIFICATION

Hydrogen Sulfide Removal and Efficient Energy Recovery

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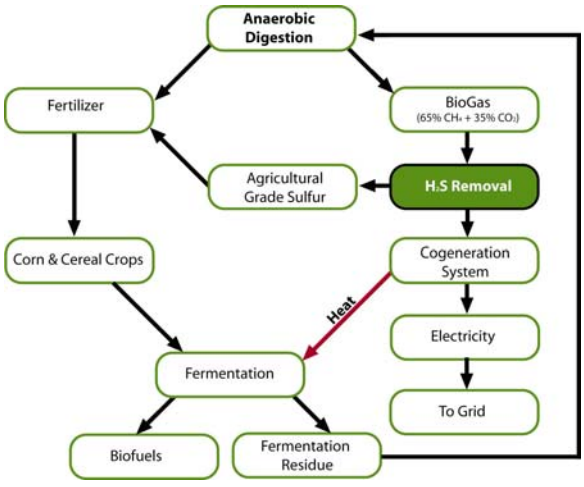
Energy recovery from biogas is becoming more common, but the processes are hampered with the presence of hydrogen sulfide (H_2S). Biogas is a mixture of methane and carbon dioxide (CO_2) and is often contaminated with toxic quantities of H_2S. Sources of biogas are: municipal landfills that produce landfill gas (LFG); wastewater treatment plants; industrial plants; and large scale livestock farms. The H_2S levels can range between 200-5000 ppmv from municipal facilities to over 30,000 ppmv from industrial facilities.

Hydrogen sulfide (H_2S) itself has an offensive odor of "rotten eggs" at concentrations as low as 50 parts per billion by volume (ppbv) and is toxic at concentrations above 100 parts per million by volume (ppmv). H_2S is a health and safety hazard, and when combined with carbon dioxide (CO_2) and water vapor (H_2O), corrodes plant equipment such as boilers and piping, and can ruin power-generating equipment.

High levels of H_2S can also interfere with other processes such as killing useful bacteria in anaerobic digesters. Reducing H_2S offers cost savings associated with less maintenance, increased process and energy efficiency, and reduced toxic emissions.

FULL-CIRCLE ENERGY FROM MANY SOURCES:

- landfill sites
- wastewater treatment facilities
- food processing plants
- large livestock farms

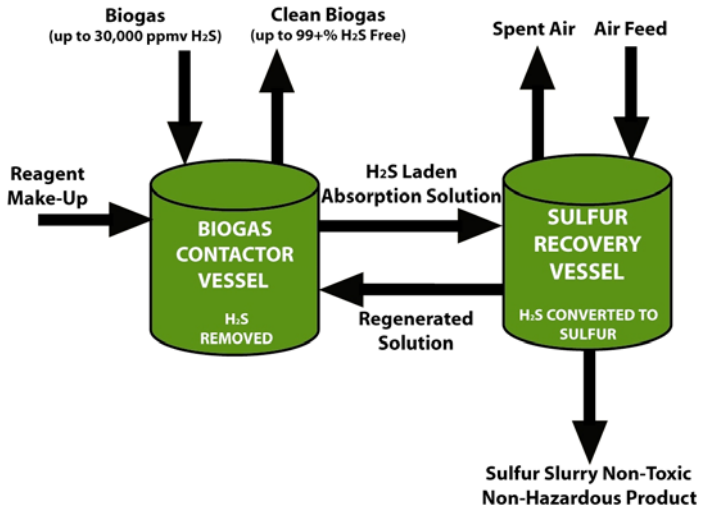


A growing percent of wastewater treatment plants use anaerobic digestion to reduce the volume of sludge requiring disposal. That process produces biogas and is generally contaminated with small quantities of H_2S. H_2S and other sulfur compounds must be removed from anaerobic digester gas streams before they can be used as fuel for stationary engines and cogeneration units. Biogas purification for energy recovery is also used in other places such as landfill sites and industrial anaerobic digesters.

Industrial digesters are used on wastewater streams produced by industries such as large-scale cattle farms, food processing, beverage manufacturers, and the pulp and paper industry. The level of hydrogen sulfide in the biogas from these industrial sources is often higher than that from anaerobic digesters in municipal waste treatment plants. An innovative biogas purification process has a powerful mixing unit that transfers gas into the scrubbing medium up to twenty times faster than conventional liquid contactors, thus enabling this compact unit to handle gas flows as effectively as competitor units several times its size.

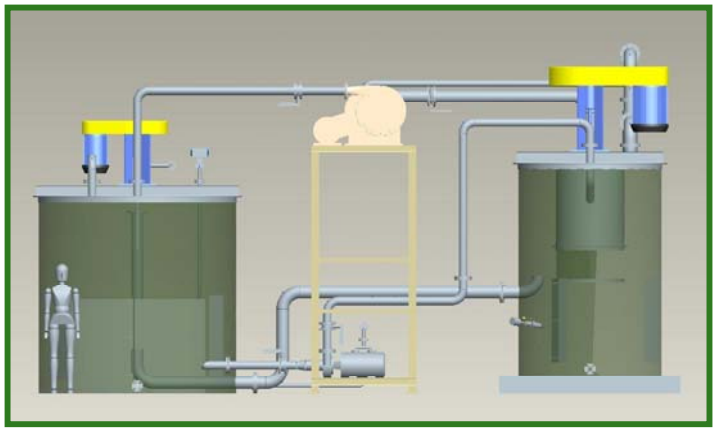
Upgraded biogas, free of H_2S, may be used as a low-energy content fuel for boilers as well as for stationary engines and cogeneration plants to produce heat for plant digestion tanks and control buildings. Due to the compact size of this system, it has fewer components, thus lowering the cost to build, own, and operate. The biogas purification system eliminates noxious odors and sulfur dioxide emissions, and saves money by reducing corrosion and downtime, extending equipment lifespan.

CLEAN FUEL FOR GREEN ENERGY:



- low operation & maintenance cost
- easy & reliable
- high mass transfer rate
- lower SO_2 emission
- reduced equipment corrosion
- consistent purification
- flexible design
- small footprint
- simple and economical operation
- environmentally friendly

Effective systems, with 99%+ efficiency in the removal of hydrogen sulfide, lower sulfur dioxide (SO_2) emissions, reduced equipment corrosion, and a solution to other process problems associated with H_2S. The key innovation, from which other advantages arise, is the extremely high mass transfer rate generated by the proprietary gas-liquid contacting system. Chemical costs are reduced through the combination of reduced catalyst inventories and concentration, a result of the increased mass transfer rates. The unit is not affected by fluctuations in biogas feed rates and H_2S concentration within the feed, and may be scaled up or down very efficiently. The system also includes self-induced gas flow, which may reduce or eliminate the need for a fan, blower or compressor, and low-pressure drop across the system.



First introduced commercially in 1995, this system has been recognized in Australia and Canada for its innovative efficiency and effectiveness. It recently was recognized as leading environmental technology with the award of the **2007 Canadian Innovation Award** for ***Environmental Technology,*** presented by Canadian Manufacturers & Exporters (CME).