New Biogas Purification Method Produces Renewable Natural Gas (RNG)

Introduction

Energy Tech Innovations LLC (ETI) has developed a new low-cost patent pending biogas purification method that utilizes water as a natural solvent in this proven gas separation technology. Biogas can be used in many of the same energy applications as natural gas with minimal processing. However, biogas applications can benefit by ETI's biogas upgrading process that produces a clean purified high quality methane supply with increased energy density and significantly improved fuel characteristics. This type of gas separation process is well known around the world as the "biogas water wash process" or "biogas water scrubbing process".

Biogas is formed from an anaerobic (non-oxygen) decomposition process involving naturally occurring bacteria. Biogas generated from this decomposition process is typically composed of a mixture of methane (CH4) ranging from 50-65% by volume and carbon dioxide (CO2) ranging 35%-40% by volume. The remaining biogas balance is composed of smaller amounts of oxygen (O2) and nitrogen (N2) along with trace amounts of other gas constituents including hydrogen sulfide (H2S).

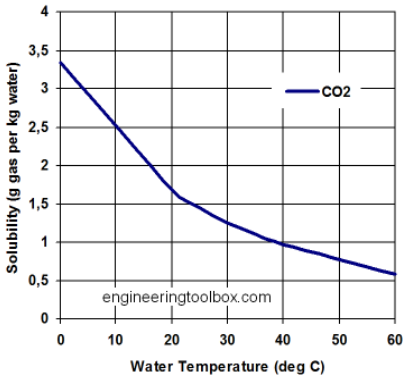
Proven Biogas Process

As mentioned above, when water is mixed biogas, it acts as a solvent that readily absorbs carbon dioxide (CO2) and removes other contaminants such as hydrogen sulfide (H2S) and siloxanes as well. The resulting purified methane gas is commonly referred to as "Renewable Natural Gas" (RNG). This process works on the principle that CO2 and H2S is approximately 25 times more soluble than CH4 is in water. The solubility difference is explained by "Henry's Law of Solubility", the basic underlying science principle behind this process.

Biogas water wash systems are used most commonly in Europe and other parts of the world for projects that purify (or upgrade) biogas into high quality RNG for pipeline injection. RNG is also used as a compressed natural gas (CNG) as a lower cost fuel for vehicles. Upgraded biogas in the form of RNG provides the flexibility that can allow this fuel to be utilized directly or blended with utility supplied natural gas for multiple energy related uses while providing operational flexibility as well. RNG can also be used for electric generation and thermal processes such as for boilers, dryers or for many other purposes. It is also important to note that H2S can be removed ahead of this water wash process so that it is not present in the process off-gas, if needed. ETI's process also supports the potential use of the CO2 for a number of beneficial uses such as in waste water treatment for; pH, alkalinity control and phosphorous/struvite process control treatment or for other beneficial uses.

Biogas Separation Details

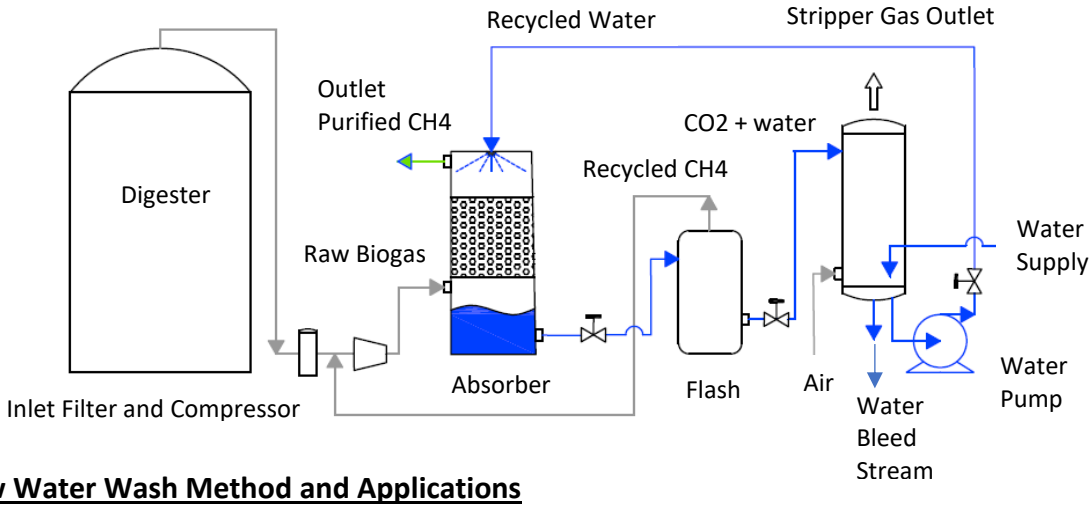
The variables involved in the biogas water wash process are dependent on pressure, temperature and the time necessary for the absorption process to occur. Absorption efficiency of CO2 and H2S increases with higher pressure and colder water temperature. An example solubility graph below assumes a constant pressure value.



TYPICAL SOLUBILITY CURVE EXAMPLE (REF: HTTP://WWW.ENGINEERINGTOOLBOX.COM/GASES-SOLUBILITY-WATER-D_1148.HTML)

More specifically, in the first step of this process (see below), water and biogas are combined under pressure causing the CO2 and H2S to be absorbed given adequate contact time. The insoluble CH4 portion of the biogas stream is purified and exits the top of the absorber as RNG fuel. In addition, a flash process recovers additional CH4 by capturing "slip" methane (CH4) that exits the bottom of the absorber along with the water containing the dissolved CO2 and H2S. The flash unit operates at a lower pressure causing this small amount of slip CH4 to exit the top of the flash vessel. This slip CH4 is then recycled back to the inlet side of the absorber. The water still containing the dissolved CO2 and H2S exits the flash unit and is then routed to the aeration stripper. Within the stripper, an air supply is utilized at near atmospheric conditions and the temperature is often increased to fully desorb the CO2 and H2S to the system outlet. After some minor treatment, this water is then recycled to start this process all over again. The overall make-up water utilized in this regeneration process is very low. Shown below is a typical biogas water wash schematic and for additional information, see the biogas upgrading technology comparisons on the referenced web page, http://ohioline.osu.edu/factsheet/AEX-653.1-14.

A Typical Biogas Water Wash System Schematic (below)



ETI's New Water Wash Method and Applications

ETI's new lower cost biogas upgrading process is modular utilizing standardized components making it easy to install, relatively easy and cost-effective to operate. One the unique aspects of this new process is that ETI's lower cost approach is much less costly as compared to the typical vessels that are utilized by others. ETI's process is also scalable and can be economical for use with small to large scale anaerobic digestion systems.

Summary of ETI's New Water Wash System Advantages

- Integrates with any biogas producing site.
- Modular standardized units.
- Substantially lower equipment costs.
- Relatively easy to construct.
- Overall, more economical to construct and operate.

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