THE BIOGAS FEED TRAIN

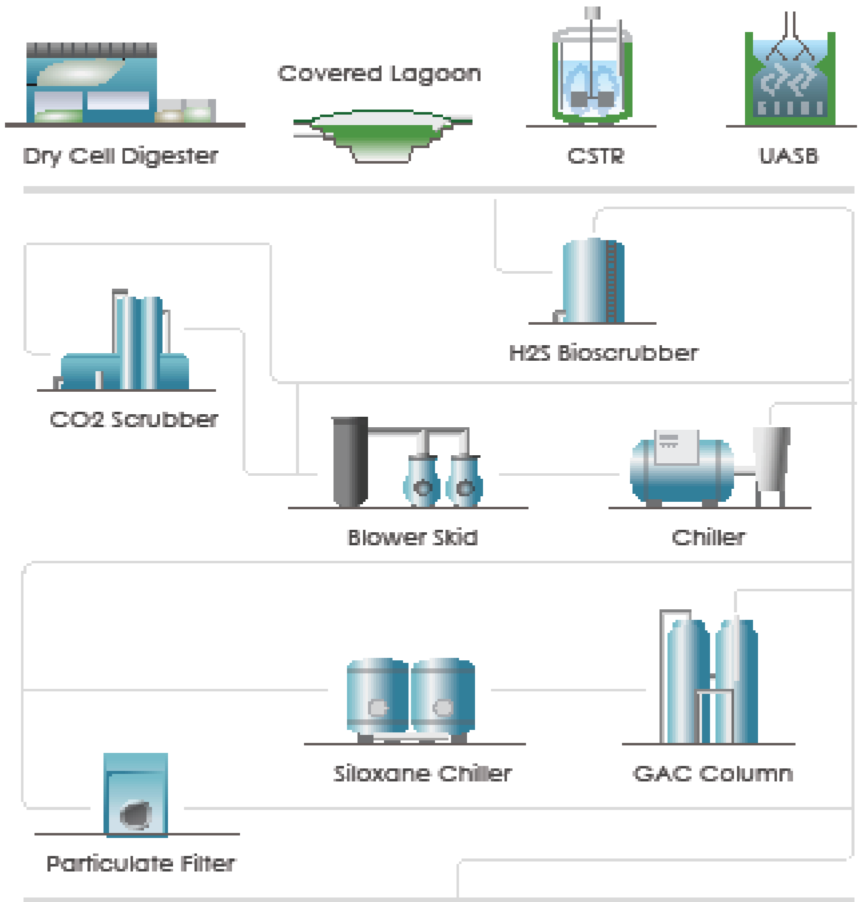
Biogas processing options

Biogas may be produced from many different biodegradable organic substrates. In general, however, its composition will be very similar, being comprised mostly of methane, at between 40% and 65% by volume, carbon dioxide, at between 30% and 40% by volume, and a number of trace gases. Some trace gases, such as hydrogen sulphide and siloxanes, can be particularly detrimental to gas utilisation systems and may need to be reduced to acceptable concentrations.

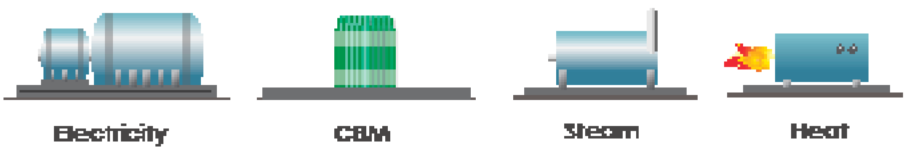
In outline terms, a biogas feed train will consist of a gas blower, normally with automatic feed or suction pressure control and equipment to treat the biogas. Treatment may be in the form of reducing trace gas composition, reducing or removing bulk gases, drying the biogas to acceptable levels of moisture content and filtering the biogas to a micron level for particulates. Organics offers a range of such technologies, as a single package of plant, to perform the duty of preparing biogas for use.

With the correct application of this technology, biogas, even from difficult sources, may become a reliable fuel for long-term economic use.

Biogas Production Options



Biogas Use Options



Organics

COMPONENTS INVOLVED IN THE BIOGAS FEED TRAIN

Hydrogen sulphide scrubbers

Cryogenic siloxane systems

Gas pumping equipment

Flare stations

Pressure swing adsorption

Gas chilling and dewatering systems

Instrumentation systems

Burners and/or power generation equipment

All of the above items are available directly from Organics using project-proven proprietary technology

ISO 9001 REGISTERED FIRM

DATA SHEET ODSR19

PROJECT ROUTE

Organics has developed a project delivery structure over many years that ensures reliable completion and quality control whilst maintaining specification requirements, and time-schedules.

SITE ASSESSMENT AND SPECIFICATION

Establishing a clear statement of the design parameters is the first step determining scope. This will require a detailed study of each specific situation.

DESIGN

Each project is designed as a unique entity to ensure that all details are fully addressed.

PROCUREMENT

The procurement function takes full responsibility for maintaining delivery schedules. Their remit is from drawings and component specification through to all parts ready for final fit-out and commissioning.

MANUFACTURE

Manufacture may either be completed to “good engineering practice” or, where specifically requested, under the supervision of a Third Party Inspector, such as Lloyds.

FIT-OUT AND INSTALLATION

Fit-out may occur in our factory or on site, for larger installations. Fit-out work is completed by suitably qualified personnel, under the supervision of an Operations Department engineer.

COMMISSION AND HANDOVER

Commissioning is undertaken on site by the Technical Manager or a member of his staff. Established procedures are followed to ensure that equipment is fully operational at the point of handover.

SERVICE SUPPORT

Following handover, support can range from supply of spare parts and advice to regular servicing or complete operational management.

THE BIOGAS FEED TRAIN

A typical biogas feed train will consist of a prime mover, to drive the biogas through the various items of equipment involved and deliver it at the correct pressure to the point of use, gas cleaning equipment, typically for hydrogen sulphide reduction and/or siloxanes, gas filtration and gas dewatering facilities.

Gas dewatering may be accomplished to acceptable levels with a simple air-blast cooling system, although to prevent condensation it may often be necessary to employ a chiller. This unit can drop the dewpoint to below ambient conditions. As well as the general difficulty of having water condensing in gas burners or gas engines, the condensate can also pick up trace gases in the biogas, leading to highly corrosive acids, such as sulphuric acid, coming from hydrogen sulphide combined with water.

Organics has considerable experience with building biogas feed trains. Each application and each type of biogas needs to be assessed in its own right. Pressure losses through the system, temperatures and relative humidity all need to be taken into account when optimising design. As much as is possible, Organics specialises in mounting equipment onto factory-built skids, thereby simplifying installation.

As well as standard packages there is often a requirement to address specific issues and specific requirements. Removal of carbon dioxide, in whole or in part, will be necessary for the use of biogas as a vehicle fuel. Removal of oxygen and nitrogen may be necessary where these gases are found to be entrained and cannot be removed by means of prevention.

HYDROGEN SULPHIDE REMOVAL

It is often essential to remove hydrogen sulphide for all activities other than direct flaring of biogas. Hydrogen sulphide can combine with water to form sulphuric acid, which is highly corrosive to engines, burners and all steel surfaces.

Determining the correct capacity-specification for hydrogen sulphide removal equipment is an important part of project specification. It is too easy to accept a low default level only to find out that it is too low and the equipment installed on site needs to be upgraded. Such increases in capacity can be very costly and certainly more expensive than if the correct capacity were installed in the first place.

Generally, effluent from cassava root processing can be expected to produce hydrogen sulphide concentrations in biogas of between 1,000 to 2,500 ppm (mass). From POME it can be up to 5,000 ppm in biogas. However, occasionally, for both of the above examples, it may reach to levels of 30,000 ppm or more.

Organics would normally recommend a bio-scrubber for this application. The bio-scrubber is easy to operate. requires no chemical additions and no special equipment. The bacteria involved are ubiquitous and can be produced anywhere. One great advantage in the tropics and sub-tropics is that ambient temperatures are such that external heating is not a requirement. Typically, the make-up water would come from the supernatant effluent of the anaerobic digester. Where a suitable make-up water is not available, fresh water can be combined with nutrients on site.

In the event of requiring very low hydrogen sulphide levels a polishing system may be employed.

FLARE STATIONS

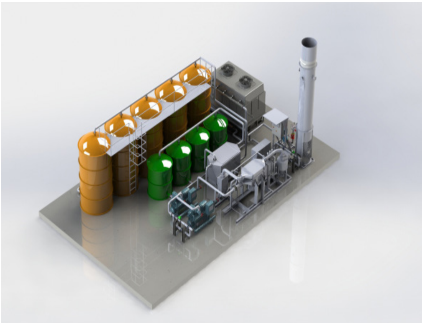
Successful and safe flaring may no longer be considered an activity for either the enthusiast or layman. There are a great many detailed regulations which must be adhered to in their entirety in order for safety and environmental concerns to be fully addressed. For example, the whole industry has been shaken by the rigorous depth of audits into data recording and record-keeping required by Designated Operational Entities under CDM protocols. Cutting corners and saving money in the face of such high standards can only be seen as a quick route to losing revenues.

Organics has worked on many biogas projects in Australasia, South Africa, North and South America. The company has extensive experience in discussing detailed standards and results with both Regulators and Consultants. Against this background Organics is confidently able to provide systems which will meet the applicable standards.

Safety Integrity Level 2 (SIL2) is gradually becoming the norm in many place. Whilst it may be viewed as excessive, it does ensure safe compliance.

PRESSURE SWING ADSORPTION

Where carbon dixoide removal is required without the use of a pressurised water scrubber, Organics will provide a carbon dioxide Pressure Swing Adsorption (PSA) unit which can take up to 100% of the feed gas stream for CO2 removal. This unit typically will consist of five vessels being arranged in a pressure swing configuration, complete with a purge vessel. The vent gas will contain some residual methane in the carbon dioxide removed from the process. This latter is passed to the standby flare. PSA is a very well understood and proven system for removing CO2 from landfill gas. The use of high-sepeed switching has resulted in a reduction in the size of adsorbent vessels and an increase in performance efficiencies.



KEY FEATURES

TURNKEY DESIGN, MANUFACTURE AND INSTALLATION OR COMPONENT SUPPLY ONLY

USE OF PROPRIETARY TECHNOLOGY DEVELOPED BY ORGANICS OVER THE LAST 25 YEARS OF BUSINESS

FINANCE AVAILABLE THROUGH AFFILIATED COMPANIES FOR BUILD, OWN, OPERATE AND TRANSFER PROJECTS

OPERATION AND MAINTENANCE SERVICES PROVIDED

RENEWABLE ENERGY PROJECTS A SPECIALITY

The objectives of a project designed to recover energy from wet biomass waste are:

- The installation of an anaerobic digester which will generate and capture biogas
- Reduction of odours and harnessing energy in the form of methane
- Generation of renewable electricity and boiler fuel to offset the use of fossil-fuels
- Improvement of factory wastewater treatment
- Where applicable, reduction of greenhouse gas emissions and creation of Emission Reduction Units by reducing greenhouse gas emissions

Organics is equipped to supply individual components within a complete system or all of the components required to make up a complete system.

BIOGAS DEWATERING

Biogas is usually fully saturated with water. This means that any cooling after the point of production will lead to condensation. Whilst there are means to remove most water droplets from a gas stream, any condensation occuring on items such as engine charge-air coolers, will raise the possibility of corrosion and component failure. The problem is that as water condenses it can absorb trace gases, such as ammonia and hydrogen sulphide, leading to the formation of highly corrosive liquids.

The Organics chiller, used to dewater biogas to required Relative Huimidity levels, is designed to maximise protection of downstream pipe and equipment, subject to environmental conditions in downstream lines. This may mean a dew-point of above a nominal 20ºC will be adequate, or it may mean that a dewpoint of 4ºC is required, coupled with trace heating of pipes and the use of insulation.

It is important that a chiller is placed after all wet processing has been completed. For example, a chiller should not go before a bio-scrubber in the flow path, as the dried gas would simply be re-saturated.

Chiller heat exchangers are usually made from a suitable grade of stainless steel, to ensure long-term operational reliability.

SILOXANES

Siloxanes are a subgroup of silicones containing Si-O bonds with organic radicals. They are widely used for a variety of industrial processes. They are also commonly added to consumer products, including detergents, medical products and devices, shampoos, cosmetics, paper coatings, and textiles. Although most siloxanes disperse into the atmosphere where they are decomposed, some end up in wastewater. Siloxanes do not decompose in the activated sludge process, but generally end up as a significant component in the sludge.

As sludge undergoes anaerobic digestion, it may be subjected to temperatures up to 60ºC. At this point the siloxanes contained in the sludge will volatize and become an unwanted constituent of the resulting biogas. This problem can be exacerbated by the fact that silicone-based anti-foaming agents are frequently added to the digesters; these silicones sometimes biodegrade into siloxanes. Unfortunately, when siloxanes gases are burned, they are usually converted into silicon dioxide particles, which are chemically and physically similar to sand. Needless to say, this can cause significant internal damage to turbines and other motors (just imagine sand grinding away in your automobile's engine). Siloxanes can also be a problem with biogas used for fuel cells.

The option adopted by Organics for removal of siloxanes is cryogenic refrigeration (c. minus 30ºC) followed by actived carbon for final polishing, if required. By this means it is possible to ensure long-term reduction of siloxanes to < 1 mg/Nm^3.

FILTRATION

If particulates in a biogas stream are allowed to pass downstream to a supply plant or consumer, they can cause damage to systems and equipment.

Particles can be controlled either by passing the gas stream through a filter pad (typically made of stainless steel or polypropylene wire) which can also double as a water droplet coalescing mesh, or alternatively using a cyclone separator. Cyclones are capable of removing particles down to 15 μm (or even 5 μm for a high efficiency cyclone), whereas filter pads are effective down to 2 μm.

In order to protect engines to an optimum maximum, Organics recommends an inlet mesh filter before a chiller, followed by a cyclone and additional mesh filter after a chiller. Finally the gas should pass through a micron-filter to ensure the gas is fully clean and dry.

All materials in such a treatment train should ideally be stainless steel. Where appropriate it is possible to use galvanised carbon steel for filter and mesh housings.

For further information please contact Organics through our web site or contact one of our offices in the UK, Thailand or Indonesia via email:

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Organics also has respresentatives in several areas around the world, detaisl of which may be found on our web site:

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