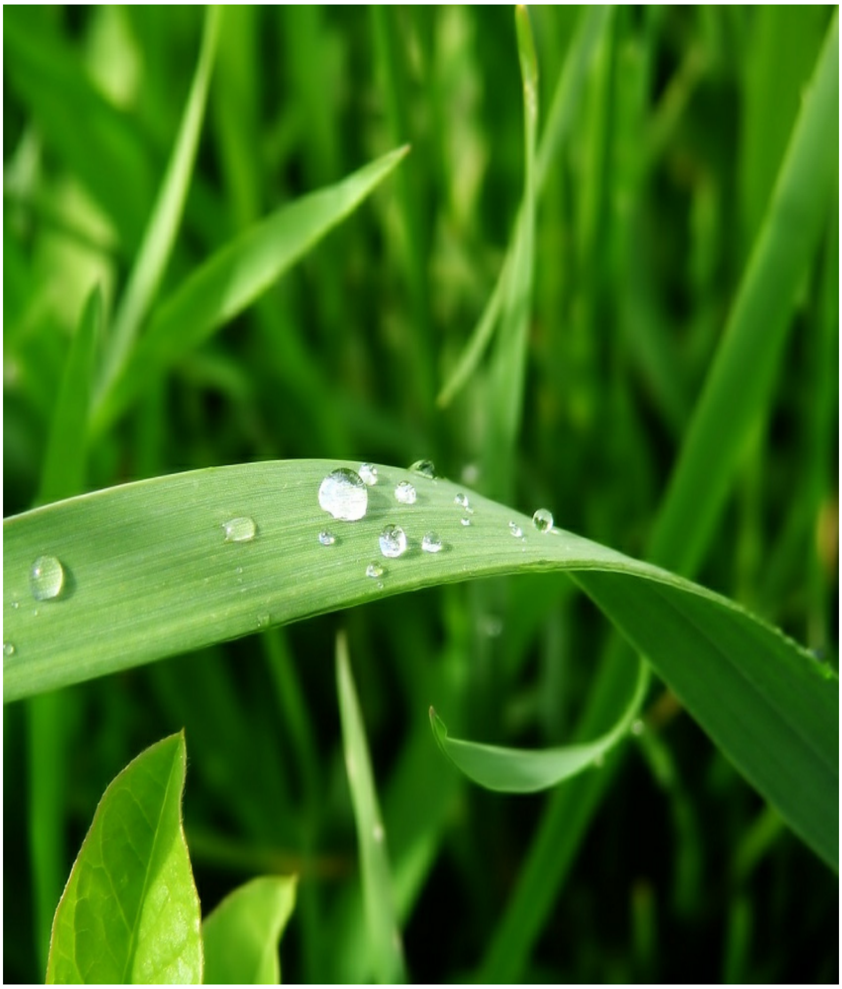
COMPRESSED BIO-METHANE

The use of methane in biogas as a vehicle fuel

The total worldwide Natural Gas Vehicle (NGV) fleet is now nearly 9.2 million when only counting cars, trucks and buses. It is estimated that worldwide NGV fleets could reach 50 million vehicles by 2020, and between 100 and 200 million by 2030. This would correspond to the use of approximately 200,000 to 400,000 million litres of diesel per annum. It is similarly estimated that the bio-methane share of these figures will be approximately 10%.

The technology involved in the production of Compressed Bio-Methane (CBM) is well developed, tried and tested. Bio-Methane may be produced from different sources, such as landfill gas or biogas produced by the anaerobic digestion of municipal solid waste, manures, agricultural waste, tapioca mill effluent and palm oil mill effluent (POME), to name but a few. Once produced and collected the bio-methane must be cleaned of impurities, such as carbon dioxide, hyrdogen sulphide, siloxanes and volatile organic carbons. It is then compressed, typically to 200 atmospheres, ready for dispensing and use as a fuel.



KEY FEATURES

CONVERSION OF BIOMASS TO METHANE FOR USE AS A VEHICLE FUEL

ENVIRONMENTALLY SOUND

COMMERCIALLY VIABLE IN MOST CIRCUMSTANCES WITHOUT SUBSIDIES

PRODUCTION OF VALUABLE BY-PRODUCTS SUCH AS COMPOST AND CARBON DIOXIDE

CAN BE USED TO OBTAIN VEHICLE FUEL FROM ANY BIODEGRADABLE WASTE STREAM

OPTION FOR COMPRESSED GAS OR LIQUEFIED GAS PRODUCT

FOR USE WITH BIOGAS OR LANDFILL GAS

QMS ISO 9001 REGISTERED FIRM

KEY FEATURES

CONVERT BIOMASS TO BIOGAS AND THEN VEHICLE FUEL IN ONE LOCATION

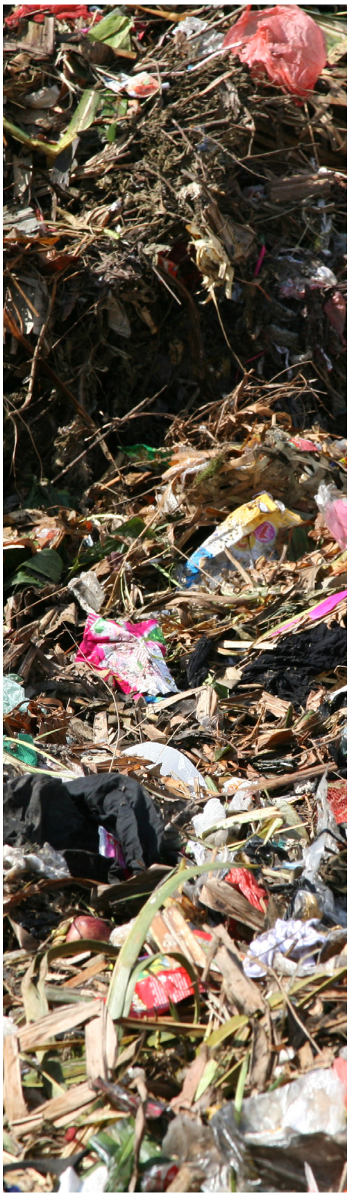
IMMEDIATE USE POSSIBLE TO OFFSET DIESEL FOR TRANSPORT

OPTIONS FOR SECONDARY REVENUE STREAMS, SUBJECT TO BIOMASS AND BIOGAS SOURCE

LANDFILL GAS AND BIOGAS SEPARATION RESULTS IN PURIFIED CARBON DIOXIDE

SIMPLE AND RELIABLE

GREENHOUSE GAS AND CARBON CREDIT FRIENDLY



SOURCES OF BIOGAS

Biogas is produced by the decomposition of organic substrates in the absence of air. The bacteria involved in the production of methane cannot tolerate the presence of oxygen and will die if oxygen is introduced into their environment.

Organic substrates can originate from many sources. A major societal source of organic material is municipal solid waste. In Europe, the content may typically be 40% to 50% by wet weight mass. In SE Asia, the organic content can be as much as 80% to 85%.

Other sources of suitable organic substrates are Palm Oil Mill Effluent (POME), tapioca mill effluent, brewery waste, animal manures, other agricultural waste and human sewage.

All such waste streams have to be converted to biogas in an anaerobic digester. The exact form the digester should take is a function of many factors, including moisture content, solubility, ambient temperature and available land area, to name but a few. The Organics Group of companies is able to work with CSTRs, UASBs, dry fermenters and in ground reactors. For landfill sites, the landfill itself is the reactor, removing one item from the biogas production chain.

GAS CLEAN-UP

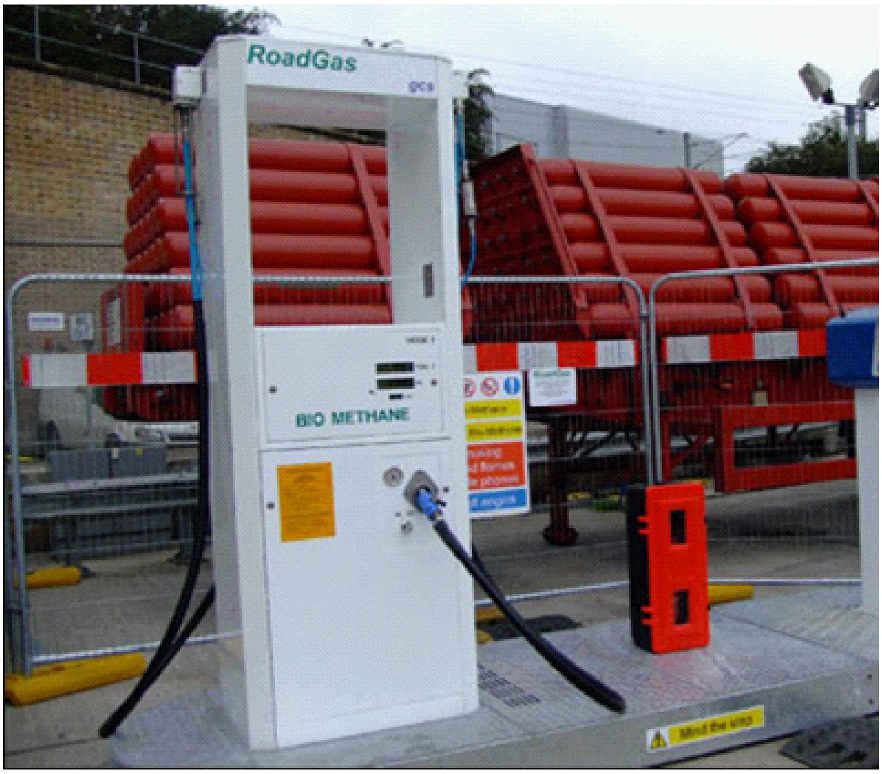
Once biogas is produced, it must be collected and brought to a central location for processing. Processing will include removal of any gaseous impurities, removal of moisture and particulates, and compression of the product methane gas for storage as CBM.

Landfill gas is generally less complicated to create, more complex to collect and significantly more complex to process. This is because of the range of trace gases that may be present in the collected gas. As well as carbon dioxide and hydrogen sulphide, these can include siloxanes, which are particularly difficult to address, as well as a range of potentially corrosive volatile organic carbons. Of particular concern is the oxygen content, which can be variable. An elevated nitrogen content would also reduce calorific value.

By contrast, biogas from an aerobic digester is generally more defined in terms of content. It will typically contain the following:

Methane: 60% to 70%
Carbon dioxide: 30% to 40%
Hydrogen sulphide: 0 to 3%

Other trace gases may be found where there is a significant non-organic content to the feedstock, such as in rubber processing waste streams.



Operational parameters based upon 1000 Nm3/hr of biogas from an anaerobic digester:

Methane content:
60%

Carbon dioxide content:
40%

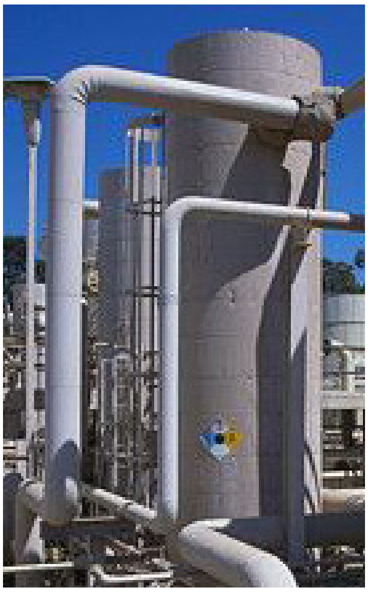
Methane mass flow rate:
10.3 tonnes per day

Carbon dioxide flow rate:
18.6 tonnes per day

Methane energy content:
6.0 MW thermal

Diesel equivalence:
13,400 litres/day

Process efficiency:
87%



IMPORTANT PARAMETERS

As with all facilities involving a series of processing stages, there several are critical elements which must be secured. In general, the production of CBM from biodegradable substrate is comprised of proven and bankable technologies. There is no innovation and invention required. All of the unit processes involved are in daily use in many hundreds of applications around the world.

However, integration of such technologies is very much application-specific. For example, it is critical to define and understand the nature of the feedstock to correctly select the appropriate anaerobic digestion technology, where a biogas supply does not already exist.

With landfill gas, it is essential to define the range of gas compositions likely to be encountered to select the correct gas processing technologies. Landfill gas can contain elevated levels of nitrogen and oxygen, which may need to be removed with cryogenics. Cryogenic separation is not a process which needs to be re-invented, but its duty and performance requirements do need to be correctly defined.

With a very substantial track record in the use of processing technologies, stretching over thirty years and several hundreds of installations, Organics is as bankable as the technologies it is able to deploy.

ISSUES RELATED TO MSW FEED

A typical municipal solid waste feed will arrive at site mixed with a measureable percentage of non-biodegradable components. These will either need to be removed or passed though the anaerobic digester. A front-end separation process, therefore, allowing recovery of recyclables may be advantageous to the whole process. This would allow for recovery of materials of value as well as facilitating the removal of materials that will lead to difficulties within the digester.

An alternative approach is the use of a dry-cell fermenter. The great advantage here is that waste can be received direct into the digester, minimising delays at the point of receipt, and permitting stabilisation of the biodegradable element prior to separation.

Finalisation of the processing sequence should only be made after a full waste-characterisation study has been completed and the nature of the feedstock has been adequately defined.

It should be noted that a municipal solid waste feed will result in a reject stream, comprised of elements which cannot be used in the anaerobic digester and cannot be recycled or re-used. For this reason it may not be considered a zero-waste option.

Residue from the anaerobic digester does, however, have a use as fertilizer and soil conditioner.

ADVANTAGES

- Conversion of biomass to commercially viable energy
- Applicable to a wide range of biodegradable feedstocks
- Methane production for use as a vehicle fuel
- Can be located close to the source of waste, thus reducing transport distances and costs
- Varied plant configuration option allows for a wide range of waste types to be utilised
- Carbon dioxide by-product provides opportunities for a parallel revenue stream
- Technologies can be employed with biogas or landfill gas
- Options for cryogenic separation or Pressure Swing Adsorption (PSA) separation, subject to feed-gas composition
- Carbon dioxide by-product provides opportunities for an additional revenue stream
- Product final bulk storage ready for transport or direct to dispensing facilities for use as a vehicle fuel
- Options for vehicle conversion, gas storage vessels, both compressed and liquefied

WASTE TO ENERGY

There are many types of organic waste stream produced by both industry and society at large. Such waste has historically been viewed as a public liability, difficulties arising from transfer, handling, storage and long-term disposal.

There exist a number of options for conversion of such waste streams to useful energy. Gasification, pyrolysis, electricity generation and various forms of conversion to liquid fuels are all technologies that may be applied. Many electricity generation projects rely entirely on a supported price to be commercially viable.

In contrast, CBM production is one opportunity where direct government support of prices is not required. The technology can produce fuel at the pump which is viable in its own right, being based as it is upon global energy prices.

In certain instances, where a vehicle fleet is in use nearby, whether this be waste collection trucks, taxis or delivery vehicles, CBM may be used to offset the purchase of liquid fuels, significantly increasing viability and giving very short payback periods.

The choice of which technology is best employed in any one given location is complex. CBM has a role in this decision matrix. Capital costs may typically be higher than those of electricity generation but running costs will normally be less, on a unit energy or unit revenue basis. Being able to supply all such systems, Organics is well placed to assist in making the best decision.

ADVANTAGES OF CBM

The production of CBM is an environmentally sound method of recovering the energy content of organic waste. The final product may be used as a vehicle fuel or transported to be used for energy production at a location remote from the point of production.

Many different types of waste stream may be employed within such a system. The key to success is to ensure that the components selected are optimum for the speicfic waste stream, the specific opportunity and the specific location of production.

The engineering technologies employed are all proven in many applications, so there need be no technology-risk to account for. As a vehicle fuel sold into the market, the demand is guaranteed. Where there are existing CNG distribution systems, the product gas can be made interchangeable. If a local vehicle fleet can use the CBM, the viability is further enhanced by facilitating direct replacement of commercial fuels.

A typical installation will take between six and twelve months to build and commission, subject to location and scope. Engineering, whilst relatively sophisticated, may be manufactured in local or low-cost locations without concern for standards of safety or performance.

For further information on the possible use of this technology please contact your nearest Organics office.

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