CASSAVA MILL WASTEWATER

Energy from anaerobic digestion

The anaerobic digestion of cassava mill wastewater is an established and proven method of using a troublesome wastewater stream to commercial and environmental benefit. The technology is now well past the development phase. It may be considered as proven, bankable and predictable. From the early systems installed in various locations around the world, the technology involved has developed and improved.

There are many forms of anaerobic digestion system from which to choose. From the Upflow Anaerobic Sludge Blanket (UASB) to the Anaerobic Baffled Reactor (ABR), the Continuously Stirred Tank Reactor (CSTR) and the in-ground covered-lagoon reactor, the choices are many, complex and varied. For an interested developer or investor, the choice is a difficult one. It will often depend more upon the degree of trust placed in an advisor than an understanding of the principles involved. In reality, each of these anaerobic digestion systems has its optimum point of use. There are many factors which define the best system for a specific application. There is no universal solution. Organics is able to deploy all of the above named technologies, each as appropriate for an individual duty, to maximise investor benefit.

COMPONENTS INVOLVED IN A COMPLETE WASTE-TO-ENERGY SYSTEM USING CASSAVA MILL WASTEWATER

Anaerobic digester

Gas collection system

Gas pumping equipment

Flare station

Dewatering system

Pipelines

Instrumentation systems

Burners and/or power generation equipment

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

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.

ANAEROBIC DIGESTION

Anaerobic digestion involves the breakdown of organic waste by bacteria in an oxygen-free environment. It is commonly used as a waste treatment process but also produces a methane-rich biogas which can be used to generate heat and/or electricity.

Anaerobic digestion equipment consists, in simple terms, of an anaerobic reactor volume, a gas holder to store the biogas, and a gas-burning engine/generator set, if electricity is to be produced. Alternatively, biogas may be used to fire a boiler or to power converted spark-ignition vehicle engines. Organic waste is broken down in an anaerobic digester with up to 95% of the biodegradable organic content being converted into biogas. The rate of breakdown depends on the nature of the waste, the reactor design and the operating temperature. Biogas has a calorific value of typically between 50% and 70% that of natural gas and can be combusted directly in modified natural gas boilers or used to run internal combustion engines.

Organics offers a number of anaerobic digestion systems suitable for varying feedstocks and specific operating conditions.

The process of anaerobic digestion (AD) consists of three steps:

The first step is the decomposition (hydrolysis) of plant or animal matter. This step breaks down the organic material to usable-sized molecules such as sugar.

The second step is the conversion of decomposed matter to organic acids.

Finally, the acids are converted to methane gas.

Process temperature affects the rate of digestion. Usually it will be maintained in the mesophillic range (30^{o}C to 35^{o}C - 86^{o}F to 95^{o}F). At higher temperatures the process requires a greater degree of attendance and understanding.

HYDROGEN SULPHIDE REMOVAL

It is 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).

Organics would always 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. The great advantage in SE Asia is that ambient temperatures are such that external heating is not a requirement.

It is important at an early stage in the project design to determine from where the bio-scrubber make-up liquids will originate. The bio-scrubbing process requires that bacteria are kept moist. Excessively acidic liquors are removed and made up with clean water containing nutrients. Such a feed can often be obtained on site from an existing lagoon effluent. It is not normally possible to take such a supply directly from the anaerobic digester as the solids content may well be too high.

FLARING

Successful and safe flaring may no longer be considered an activity for 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 SE Asia, China, South Africa and South America. The company has extensive experience in discussing detailed standards and results with both Regulators, Validators and Verifiers. Against this background Organics is confidently able to provide systems which will meet the applicable standards.

Instrumentation

The heart of the recording process is contained within the instrumentation used to record the destruction of greenhouse gases. Every project must be treated as unique and understood in its entirety in order to design the instrumentation system. Certain elements, such as flow recording protocols, may be similar but the overall quality of data recording and data integrity must be high. It is only to be expected that standards will continue to increase and become more demanding.

Instrumentation is a fundamental element in a successful project.

BIOGAS UTILISATION

Biogas may be used in several ways to generate both energy and carbon credits. Where methane is destroyed and fossil fuel is offset carbon credits will also be available.

The simplest route for biogas utilisation is to pipe gas to a boiler or a kiln. As with all green-house destruction, it is essential that the actual destruction of methane is proven beyond any doubt.

Should such an option not be available at a specific location, as is often the case at tapioca mills, the next option is to generate electrical energy, either for in-house use or for sale to the national electricity grid. In either case, the electricity produced should preferably be used to offset fossil fuel electricity, such as power from diesel engines, rather than power generated by means of clean biomass.

One further option is that of converting biogas into bio-methane. This involves the removal of carbon dioxide from biogas and the compression of the balance-methane to approximately 3000 psig. This technology draws upon global experience with CNG in vehicles. Compressed Bio-Methane (CBM) may be suitable for vehicle use and creation of carbon credits but careful attention must be paid to the problem of destruction-verification. Simply put, it is difficult to prove methane destruction in a vehicle that is travelling around.

As with anaerobic digestion, each technology has its own optimum point of application. The decision as to which route to take is a function of cost, opportunity, technology and practicality. Organics can assist in such decisions from a perspective of knowledge, experience and familiarity with all relevant costs.

KEY FEATURES

TURNKEY DESIGN, MANUFACTURE AND INSTALLATION OR COMPONENT SUPPLY ONLY

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

OPERATION AND MAINTENANCE SERVICES PROVIDED

A ONE-STOP SOLUTION FOR A COMPLETE SERVICE RELATING TO THE DEVELOPMENT OF RENEWABLE ENERGY PROJECTS

The objectives of a project designed to recover energy from cassava processing waste are:

- The installation of an anaerobic digester which will generate and capture waste gases currently produced from the factory's treatment lagoons
- Reduction of odours and harnessing energy in the form of methane
- Generation of renewable electricity to offset the use of fossil-fuels
- Improvement of factory wastewater treatment
- Where applicable, reduction of greenhouse gas emissions and creation of Certified Emission Reductions (CERs) 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. Organics has been active in this sector in SE Asia since 2002 and has a wide experience with all elements of such systems, from equipment design, instrumentation set-up for CDM compliance and CDM compliant gas flaring to gas production technologies as well as energy generation using engines operating with biogas.

CASSAVA MILL EFFLUENT

An average of about 15 to 16 tonnes of cassava mill effluent are released for every tonne of starch produced. This wastewater consists of water soluble components of the processed cassava roots, as well as wash-water. Despite its biodegradability, cassava mill wastewater cannot be discharged without first being treated. It may be acidic and has a very high biochemical oxygen demand (BOD).

A typical mill rated at 200 tonnes starch production per day can produce between 2 and 3 MW of electricity from the biogas that can be generated in an anaerobic digester. In certain countries such facilities will also qualify for Certified Emission Reductions (CERs), adding to the overall project viability.

Organics offers a number of anaerobic systems suitable for cassava mill processing waste streams.

PROCESS DESCRIPTION

Liquid effluent from a tapioca mill is received into a buffer lagoon where it can be inspected and treated prior to being entered into the anaerobic digester. Although not commonly a requirement, it may be necessary to adjust pH or attend to high solids concentrations in the buffer lagoon. The buffer lagoon will also ensure that high-temperature liquids do not pass directly into the anaerobic digester, avoiding possible damage to methanogenic bacteria.

Process liquors are held in the anaerobic digester for varying periods of time, subject to the incoming flow rate and the specific technology involved in the anaerobic digester itself. High-rate systems will have a retention time of two to three days. Lagooning systems will be designed to hold liquors for twenty to thirty days. During its time in the digester, carbonaceous material is broken down into various gases, including methane and carbon dioxide. This gas is drawn off from the anaerobic digester in a controlled manner.

Upon exit from the anaerobic digester, the biogas must be cleaned of hydrogen sulphide. This gas is highly corrosive, highly toxic and detrimental to any form of utilisation component in a project, should such exist. The removal of hydrogen sulphide is normally undertaken by means of a bio-scrubber.

Following this first processing step, biogas may be compressed, filtered, dewatered and made ready for use as a fuel. It is normally necessary to dewater the gas as it is saturated at a high temperature and will condense in pipelines and equipment unless moisture levels are reduced.

At this point the gas may be used.

Every element of the process should be monitored to be able to conclusively prove how much gas has been produced and how much has been destroyed.

SPECIAL CONSIDERATIONS

As is well known by project developers, every situation is unique. Whilst rules of thumb are useful in rapidly assessing overall potential it is the specifics of each project which will influence long-term success. Factors which have been found to be of site-specific importance include: heavy solids loading of feed water, requiring some level of settlement prior to anaerobic digestion; extremely high hydrogen sulphide levels; highly acidic wasterwater requiring dosing with lime to prevent it from seizing up anaerobic bacteriological activity; and vastly increased carbon loading over that expected, resulting in the anaerobic digester being too small and the gas production too high.

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