



# PALM OIL MILL EFFLUENT

## *Revenue generation from waste liquids*

The objectives of a project designed to recover energy from Palm Oil Mill Effluent (POME) are:

- The installation of an anaerobic digester which will generate and capture waste gases currently produced from the factory's treatment lagoons
- Reduce odours and harness energy in the form of methane
- Generate renewable electricity to offset the use of fossil-fuels
- Improve treatment of factory wastewater
- Reduce greenhouse gas emissions and create Certified Emission Reductions (CERs) by reducing greenhouse gas emissions

Organics can 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 and energy generation using engines operating with biogas.



## COMPONENTS INVOLVED IN A COMPLETE WASTE TO ENERGY SYSTEM USING POME

Anaerobic digester

Gas collection system

Hydrogen sulphide scrubber

Gas pumping equipment

Flare station

Dewatering system

Pipelines

Burners

CDM instrumentation systems

Power generation equipment

With the exception of engine-generator sets, 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 a anaerobic reactor volume, a gas holder to store the biogas, and a gas-burning engine/generator set, if electricity is to be produced. The organic waste is broken down in the reactor with up to 60% of this waste 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 and should be maintained in the mesophilic range (30°C to 35°C - 86°F to 95°F). It is possible to operate in the thermophilic range (approx. 55°C - 131°F) but the digestion process at this temperature is subject to relatively easy upset if not closely monitored.

## 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 palm oil processing can be expected to produce hydrogen sulphide concentrations in biogas of between 3,000 to 4,000 ppm (mass). However, if sulphate levels are high this maximum can reach up to 5,000 ppm.

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 and 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.





## CDM FLARING

Successful flaring according to CDM regulations may no longer be considered an activity for the enthusiast or layman. There are a great many detailed regulations which must be adhered to completely in order for Certified Emission Reduction certificates to be issued. The whole industry has been shaken by the depth of audit into data recording and record-keeping required by Designated Operational Entities. 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 CDM projects in SE Asia, China, South Africa and South America. The company has extensive experience in discussing detailed standards and results with Verifiers and Validators. Against this background Organics is confidently able to provide systems which will meet the requisite standards.

## CDM Instrumentation

The real heart of the CDM recording process is contained within the instrumentation used to record the destruction of greenhouse gases. Every Project Design Document 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. Where CDM revenue is an integral part of a project's financial success it is essential that data be treated as if it were actual money.

This is such a fundamental element in a successful CDM project, Organics will not play a key role in any project unless this aspect of the project is properly financed and delivered. To do less is to ask for a project to needlessly fail.

## BIOGAS UTILISATION

Biogas may be used in several ways to generate both energy and carbon credits. Where fossil fuel is offset, and can be clearly demonstrated to have been offset, carbon credits will be available.

The simplest route for biogas utilisation is to pipe gas to a burner, whether in a boiler or a kiln. As with all greenhouse 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 Palm Oil 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, in which Organics has experience in delivery, 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 the global experience with CNG in vehicles. However, Compressed Bio-Methane (CBM) is not suitable for vehicle use whilst generating carbon credits because of the problem of destruction-verification. Simply put, it would not be viable to have a set of instrumentation on every vehicle monitoring CBM used and fossil fuel offset.

Each technology has its own optimum point of application. The decision as to which route to take will be a function of cost, opportunity, technology and practicality. Organics is able to assist in such decisions making from a perspective of knowledge, experience and familiarity with all relevant costs.

## KEY FEATURES

TURNKEY DESIGN, MANUFACTURE AND INSTALLATION SERVICES AVAILABLE 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 CDM PROJECTS



**PALM OIL MILL EFFLUENT**

At an average, about 0.1 tonne of raw Palm Oil Mill Effluent (POME) is generated for every tonne of fresh fruit bunch (FFB) processed. POME consists of water soluble components of palm fruits as well as suspended materials like palm fibre and oil. Despite its biodegradability, POME cannot be discharged without first being treated because POME is acidic and has a very high biochemical oxygen demand (BOD).

A typical mill rated at 40 tonne per hour of FFB can produce between 1 and 2 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 POME.

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**PROCESS DESCRIPTION**

Liquid effluent from the palm oil 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 one to two days. Lagooning systems will be designed to hold liquors for fifteen to twenty days. During the time in the lagoon, 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 POME requiring some level of settlement prior to anaerobic digestion; extremely high hydrogen sulphide levels, resulting from co-disposal of effluent from rubber factory and a palm oil mill; highly acidic POME 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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