BIOGAS
Production

PURAC

Why Biogas?

Nature is great at waste management. Growth, death, decomposition and new growth – this is the natural circle of life. But, the problem is that we humans create enormous amounts of waste that needs to be taken care of in a responsible manner. One such method is to extract biogas from various kinds of biodegradable substrates.

Welcome to Purac, a world leading company in biogas production.

Experience, quality, availability

Purac was one of the pioneers in the biogas industry. Over the years we have designed and built more than 100 biogas plants, in 20 countries, using every conceivable substrate. Today, we have comprehensive experience in pre-treatment of substrates, digestion, post-treatment of digestate and effective extraction of biomethane. We are known throughout the industry for the quality of our installations and high system availability to maximise return on investement.

The circle of life

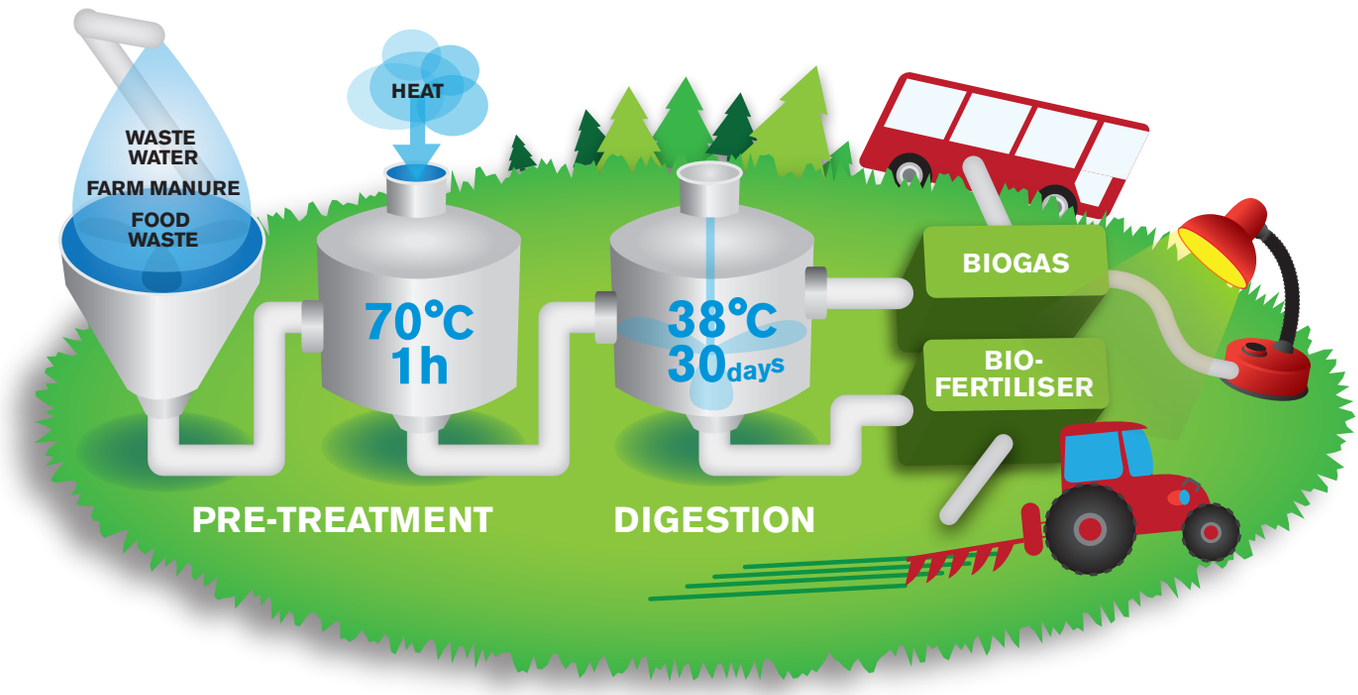
Biodegradable waste follows a natural decomposition process where anaerobic bacteria breaks down the material and releases energy in the form of methane. Naturally occurring methane, a greenhouse gas about 20 times more aggressive than carbondioxide, is re-leased into the atmosphere. The remaining material becomes a bio-fertiliser and eventually ends up as a nutrient rich soil. With custom designed biogas plants, Purac can speed up this process and, most importantly, extract the bio-methane and make it available for a multitude of environment friendly applications and stop uncontrolled emissions of methane.

Waste - a valuable resource

Interestingly enough, organic waste can become a very valuable resource. Sewage sludge, agricultural waste, restaurant and slaughterhouse waste, household waste and waste water from industries such as pulp and paper mills, breweries, dairies and sugar mills can all be used to extract large amounts of biogas. The remaining composted sludge can be utilised as a soil improver replacing industrially produced fertiliser.

The oldest bacteria

Anaerobic bacteria are very old. They presumably first appeared before oxygen was a major part of the atmosphere. Anecdotal evidence indicate that biogas was used for heating bath water in Assyria during the 10th century BC. The first digestion plant was built in Bombay, India in 1859.



Biogas production in principle

1. **Pre-treatment** of substrates to ensure optimal digestion.
2. **Pasteurisation** (if needed). The biomass is heated to 70 °C during one hour.
3. **Digestion** over 20-30 days.
    - Hydrolysis. Macromolecules are broken down by enzymes into smaller molecules.
    - Acid formation. Organic compounds are converted into fatty acids, hydrogen and carbon dioxide.
    - Methane formation. Methane gas is formed from acetic acid, hydrogen, carbon dioxide, methanol and ethanol.
4. **Biogas**. The produced biogas can be used as fuel for heating or power generation. It can also be upgraded to natural gas quality.
5. **Biofertiliser**. A useful by-product is also formed. After quality assurance it can be used as fertiliser on farmland.

Waste water sludge

Residues from municipal and industrial waste water treatment contain organic matter, which can be converted to biogas.

At waste water treatment plants, primary, secondary and tertiary sludge is being produced during the waste water treatment process. The sludge streams has to undergo treatment to enable final usage as fertilizer in agricultural applications or being disposed in other ways:

- Thickening to reduce volume of the sludge streams, heating to 70 C or higher temperature to meet hygienic requirements,
- Degradation of organic content by anaerobic digestion
- Volume reduction by dewatering.

Purac has the knowledge and technologies to offer complete systems for treatment of WWTP sludge or parts of the system. Purac has extensive experience in anaerobic digestion technologies with mesophilic and termophilic processes. This also includes efficient energy usage and recovery system to maximize the net energy production from the energy content in the sludge.

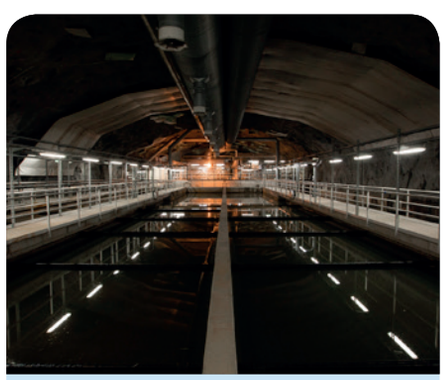
References

Narva STP, Estonia

At the Narva sludge treatment plant in Estonia, municipal waste water sludge is thickened in a mechanical thickener, digested and finally dewatered in a centrifuge. The digester is a completely mixed tank ensuring a homogenous substrate for efficient biogas production. Biogas from the digester is used to heat the digester and the buildings of the sewage treatment plant. The plant handles 500 m^3 of municipal sludge per day, producing 900 Nm^3 per day of biogas.

Lindum, Public Waste Handling Company, Norway

The Lindum biogas plant receives dewatered and liquid sludge from nearby municipal WWTPs. The plant is designed to receive 25 000 ton sludge annually. Dewatered sludge, as the dominating fraction, is diluted to be pumpable. The sludge is pre-treated by thermal hydrolysis followed by mesophilic digestion. The residual sludge is reduced to 11 000 ton sludge after dewatering by centrifuges. The daily biogasproduction is 8 000 m^3 and the biogas is used for combined heat and power production.



Bekkelaget WWTP, Oslo, Norway

The Bekkelaget WWTP serves 350 000 pe in the capital of Norway, Oslo. All sludge streams from the waste water treatment are being processed at the plant. Thickening takes place by use of centrifuges, the sludge is further treated by termophilic digestion and dewaterd by centrifuges. Energy is recovered by use of heat pumps to minimize usage of external energy. The biogas is upgraded to natural gas quality and used as vehicle fuel for city buses.

Agricultural waste

Every year around 700 million tons of agricultural waste is produced within the EU alone. The farmers are required to take care of the waste. How? Biogas production is one profitable opportunity.

On-farm biogas production facilities typically use manure as the main substrate, but other materials such as animal processing waste and crop residues can be added to increase biogas production. In addition, energy crops can be grown that are used directly as a biogas feedstock.

Because of the mixed nature of the feedstock, careful pre-treatment of the digestate is often needed. Slaughterhouse waste and manure may need Pasteurisation. Other feed stocks may need biological, chemical or mechanical pre-treatment to ensure a homogenised and readily biodegradable substance needed for high-yield biogas production. Pre-treatment of biogas substrates is a Purac speciality and we offer various technologies to ensure an optimal digestate for biogas production.

References

Sävsjö Biogas, Sävsjö, Sweden

Every year, approximately 100 000 tons of manure and silage are digested at the Sävsjö biogas plant in Sweden, yielding 16 000 Nm^3/day of raw biogas. After collection and pre-treatment, the process starts with a Pasteurisation stage where the manure is heated to 70 °C in order to destroy pathogens. In the next stage, the biogas is extracted in two digestion chambers. The raw biogas is then upgraded to pure methane, which is used as vehicle fuel. Finally, the remaining digestate is returned to the farmers as a greatly improved fertiliser product.

Svensk Biogas, Linköping, Sweden

At one of the biggest biogas plants in the world, biomethane is produced from agricultural waste, slaughterhouse waste and manure. The plant produces 3.5 million m^3 of high-grade biogas and 100 000 tons of biofertiliser per year. The methane gas is used as vehicle fuel for the city of Linköping's 40 buses and 500 other vehicles. The remaining digestate is cooled and returned to the fields as nutrient rich fertiliser, and the heat is re-circulated into the plant. This is a high-quality, closed-loop system that has been operating efficiently since 1996.

More Biogas, Kalmar, Sweden

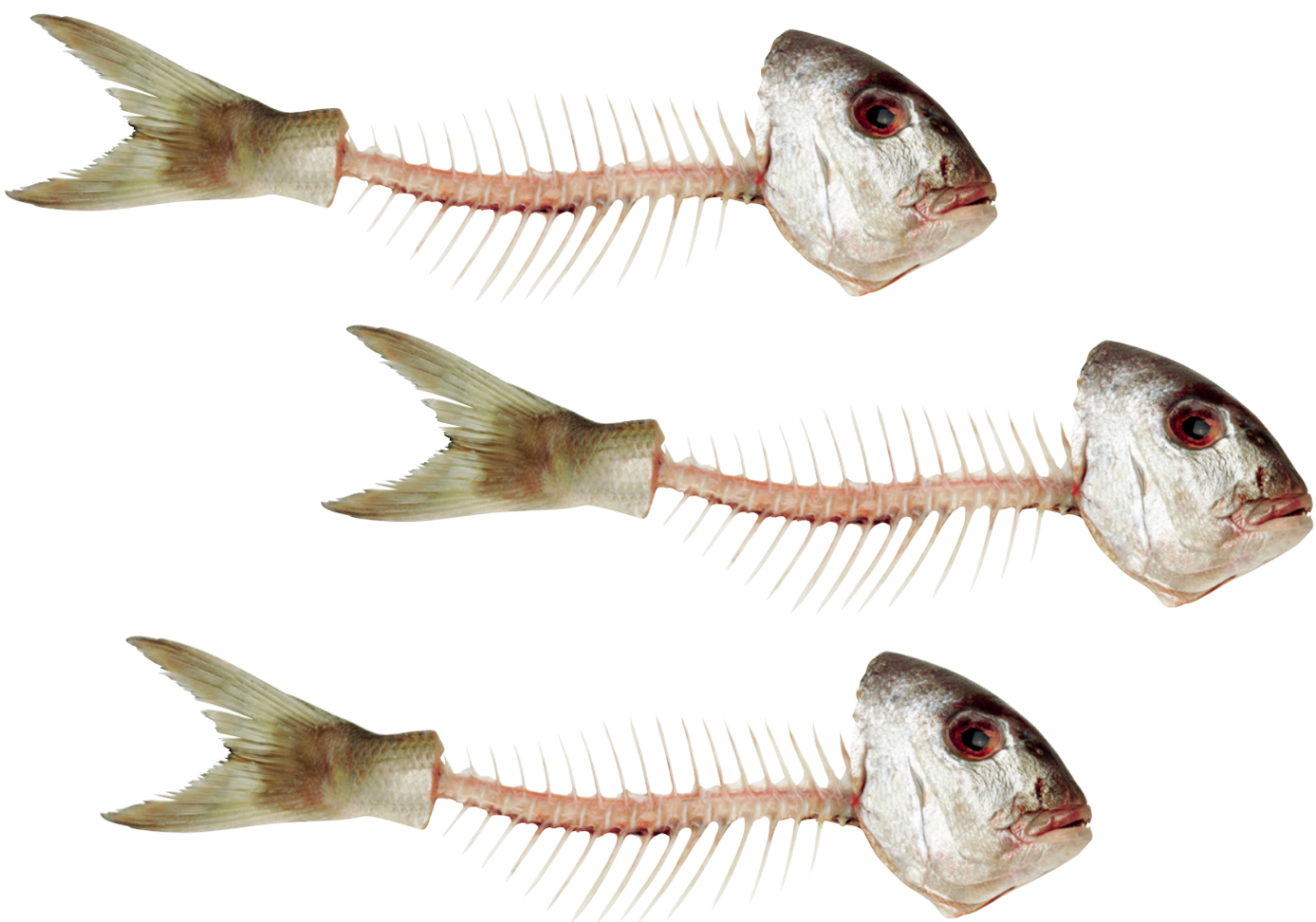
Every year, approximately 100 000 tons of manure and silage are digested at the More biogas plant in Sweden, yielding 16 000 Nm^3/day of raw biogas. After collection and pre-treatment, the process starts with a Pasteurisation stage where the manure is heated to 70 °C in order to destroy pathogens. In the next stage, the biogas is extracted in two digestion chambers. The raw biogas is then upgraded to pure methane, which is used as vehicle fuel. Finally, the remaining digestate is returned to the farmers as a greatly improved fertiliser product.

Household and food waste

Domestic food waste and residue from food processing and production, all contain organic waste matter, which can be converted to biogas. This includes the waste separated in households, as well as much of the food waste from restaurants, large-scale kitchens and shops.

Purac EFWA – Efficient Food Waste Application

Effective pre-treatment of food waste is important to ensure that the biogas plant works efficiently. The food waste has to be processed into a homogeneous, clean, organic pulp for digestion. Our installations separate and effectively remove unwanted material from food waste, such as plastics, metal and other packaging materials. As a result a larger proportion of the collected biodegradable material is converted into biomass, which is then digested into valuable biogas. Some substrates from domestic agricultural waste may require pasteurisation or thermal hydrolysis. These are techniques that Purac has provided to customers in several countries.



References

Chongqing, China

Taking care of restaurant waste is a challenge in one of the world's biggest cities. Stage 1 of a thermophilic digestion biogas plant is already built and in operation taking care of 67 tons of restaurant waste per day. A second stage designed for 330 tons per day is under construction, and stages 3 and 4 handling 500 tons per day are planned. Right now 6000 m^3 of raw biogas is produced daily, which is used for heat and power production.

SRV Biogas Plant, Stockholm, Sweden

The SRV plant is processing source separated household waste, packaged and non-packaged food waste from stores and restaurants, and liquid organic waste. The plant has a capacity of processing 33 000 ton/year. Processing and separation of unwanted content i.e. metal and plastics take place in two paralell hammer mills. The waste slurry is diluted to be pumpable (12 -20 % dry solids). The waste reception and pre-treatment system gives an optimal combination of low loss of organic matter, high removal of unwanted content in the slurry and high DS content.

Mosserud Biogas Plant, Karlskoga, Sweden

Karlskoga Biogas has built a new biogas plant in Mosserud, Karlskoga. The biogas plant receives manure, organic household waste and grass silage from the nearby region. The produced biogas is upgraded to vehicle fuel and distributed through a filling station at the plant and with container trucks to the region's filling stations. The produced waste product, digestate, goes back to the farmers and acts as a very good fertilizer for the cultivation of food and feed. Purac AB has installed three separate lines for three different substrates.

Industrial waste water

Anaerobic digestion for the production of biogas is ideal for many concentrated waste waters, such as production facilities for beverages, chemicals, food, meat, milk, pulp and paper. This process is space efficient and offers low sludge production, high loading rates, low nutrient requirements and low maintenance.

Purac pioneered the development of a completely stirred tank reactor, CSTR which was applied commercially at the end of the 1970's, and Purac's ANAMET™ is the CSTR process most commonly used throughout the world for organic waste waters containing high loads of suspended solids, e.g. from sugar and yeast production.

Today, high-rate granular sludge processes combine the well-mixed attributes of the CSTR system with an internal biogas separation and clarification mechanism. The mixing within the reactor results from the gassing which occurs as the organic components are distributed within the granular biomass bed at the bottom of the reactor.

Anaerobic treatment to produce methane has considerable potential for industries with organic waste streams. Many of these industries use it as a pre-treatment step to lower sludge disposal costs, control odour, and to reduce the costs of final treatment in the subsequent aerobic process or at the municipal waste water treatment facility.

References

Bulmers Cider, Clonmel, Ireland

The existing aerobic waste water treatment plant has been upgraded with an anaerobic pretreatment process for the total effluent, where crushed apples from cider production are the main COD source. Bigger particles are removed and the remaining effluent passes to an equalisation tank and a neutralisation tank before reaching the anaerobic reactor. After anaerobic pre-treatment, the cider effluent is fed to the existing aerobic treatment plant and finally to municipal sewage treatment. The biogas produced is used to heat the incoming waste water and as fuel in the factory thereby reducing imported oil. Total COD removal is more than 90%.

AgroEtanol, Norrköping, Sweden

Agroetanol AB is the largest producer in Northern Europe of grain-based ethanol that is used as a blending component in gasoline. On an annual basis, the plant produces 150 000 m^3 of ethanol and 130 000 tons of animal feed, DDGS. Waste water from the industrial process is fed to the anaerobic biogas plant. The 80% pure methane is recirculated to the production process where it is used as a substitute for fossil propane gas. The biogas plant is designed to treat 1 400 m^3 of waste water per day, reducing COD by more than 80%.

Estonian Cell, pulp & paper mill, Kunda, Estonia

In order to improve outlet water quality a new high-rate anaerobic treatment plant was built prior to the existing aerobic treatment. The new treatment plant takes care of the COD-rich effluent from BCTMP production and is designed for a flow of 8 000 m^3 per day and a load of 100 ton COD per day. The high rate ECSB-process is performing successfully. COD reduction is more than 75% and 30 000 Nm^3 of biogas is produced every day replacing fossil fuels in the pulp mill.

Purac is a world leader in contracting for the treatment of wastewater, process water and drinking water, as well as innovative treatment of biological waste. The contracting business consolidates broad expertise and experience with our internally developed and licensed technologies for innovative solutions that deliver increased efficiency and more economical operation. To date, this concept has earned us more than 4,000 contracting assignments in 70 countries.

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