DP Biogas Production

Anaerobic Digestion Of Organic Slurry (ADOS) Plant

The IUT Group
Member of the DP CleanTech Group

DP CleanTech
Creating value from waste

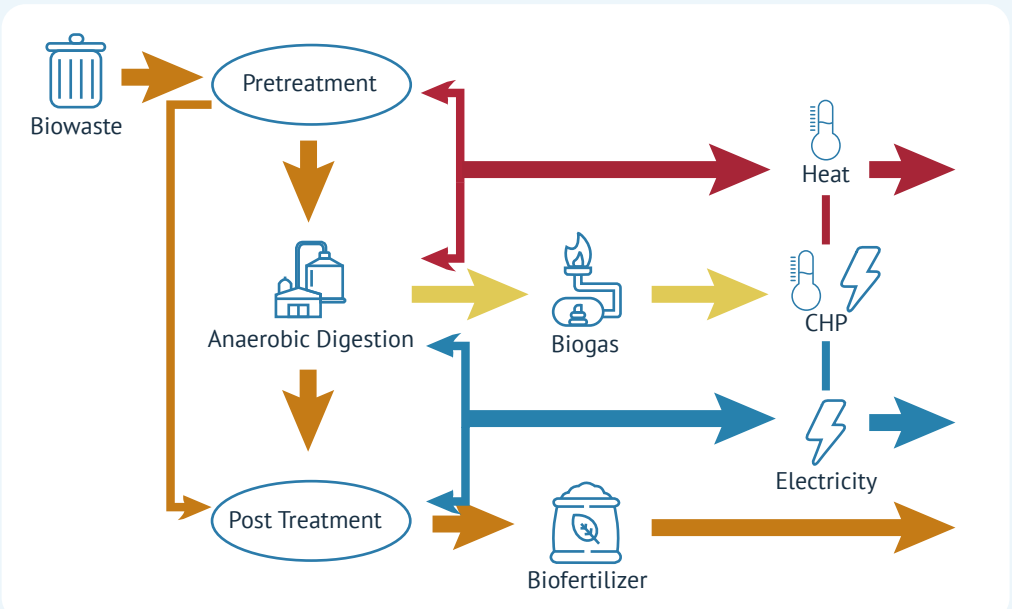
Introduction

The management of municipal solid waste (MSW) has undergone many developments since the early 1980's, when the primary methods of disposal were landfilling and mass burn of unsorted waste. Today, the emphasis has turned to more sustainable solutions which are less environmentally damaging, and which can use waste to produce energy. For mixed or unsorted MSW, incineration or gasification processes are still widely used methods for conversion to energy. However for organic waste, Anaerobic Digestion is perhaps the most efficient, effective and scalable solution. Significant improvements in material recovery/waste separation technologies and an improved understanding of organic waste characteristics are facilitating the ongoing development of AD solutions, however performance optimisation is dependent on knowhow and experience as well as proven technology.

A Summary of The Anaerobic Digestion Process

Anaerobic Digestion (AD) is a natural process by which micro-organisms decompose organic matter in the absence of oxygen. It is a well-refined process for the generation of an energy-rich gas which can be converted into clean (thermal and electrical) energy, or upgraded to natural gas quality. The production of high quality natural fertilizer (rich in Nitrogen, Phosphorous and Potassium) is another benefit for these applications. The organic fraction of municipal solid waste (OFMSW) and other organic wastes can be used as a feedstock for anaerobic digestion.

The AD process requires a precise, biologically balanced environment to perform well, and therefore the technology and the knowhow are critical.



General Benefits of AD

- Sanitizes the feedstock/waste during the process
- Reduces odour
- Avoids environmental pollution
- Produces organic fertilizer
- Generates an energy-rich biogas that can replace the use of fossil fuel.

The ADOS System

DP's ADOS system (**A**naerobic **D**igestion of **O**rganic **S**lurry)) is an end-to-end integrated system for use in Anaerobic Digestion plants. It was developed by IUT GmbH based on decades of research, plant operation experience and process refinement. It uses a "semi-dry" process which has the benefits of both the typical "dry" and "wet" AD processes. From pre-treatment to post-treatment, the ADOS system efficiently converts organic waste from many sources to high quality biogas and digestate.


Mechanically Separated MSW (OFMSW)


Agriculture


Households


Slaughterhouses


Restaurants


Markets


Commercial Kitchens


Food Processing Industry

ADOS plants are highly scalable and are suitable for many contexts and applications – from small towns to large cities. The most cost-effective plant size starts from 60-70 tons per day (tpd). Colocation or downstream location from MSW collection and treatment plants can further improve efficiencies.

Typical ADOS plants:

- 105 tpd ADOS plant using separately collected organic waste – City of Benesov, Czech Republic,
- 180 tpd ADOS plant using sorted organics co-located with MSW treatment plant – Cebu City, Philippines,
- 300 tpd ADOS plant using food waste from different sources – Singapore. This plant was awarded the highly prestigious National Energy Globe – World Award 2007 for Sustainability.

DP Waste Management

Key Equipment

The complete ADOS plant is composed of separate components which can either be integrated or deployed individually, depending on requirements.

Pretreatment
- ADOS Mill
- SEDI tank

Digestion
- Buffer tank
- Digester

Post Treatment
- Biogas/fertiliser

Specialist knowledge of the sedimentation and digestion processes is needed to maximize and optimize the homogenization and conversion of the slurry to high quality biogas. This knowledge within DP has been perfected over many years.

The Detailed ADOS Process for MSW

Pretreatment:

Effective segregation and pretreatment is the key to high quality biogas production. DP's pre-treatment system is based on 30 years of transforming organic waste into high quality feedstock.

Segregation of Organic Fractions MSW

• ADOS pre-treatment using a 2 stage "ADOS Mill" and "SEDI Tank" semi-dry process (slurry solid content of ~15%) to separate, treat and homogenise feedstock to the buffer tank.

• ADOS MILL. Treatment in the specially designed 'wet-mill' is the first step in conversion to high quality pumpable slurry. By adding digestate, reducing particle size and removing lighter particles the mill is effectively the key to the success of the subsequent processes of sedimentation and digestion.

• SEDImentation tank. The slurry leaving the ADOS mill goes to the sedimentation tank, where it is homogenized and then separated into three fractions. Heavy sediments and floating particles are removed, while the middle layer with the highest content of putrescible material is pumped to a buffer tank. The efficient separation of cooking oil is possible at the floating layer.

Digestion:

In the buffer tank, the slurry quality is further improved before the digestion process.

• Additional separation of sediments and floating particles by removing trace contaminants and initializing the hydrolysis and acidification processes. The buffer tank is a closed vessel to prevent odours. Depending on the local conditions, it can store sufficient slurry to maintain continuous 7 day operation, on 5 day waste delivery.

• The conditions in the digester are critical for high quality biogas. Based on years of experience, the digester has been specifically designed to create and maintain the optimal environment for biological activity. Inbuilt systems ensure that slurry is constantly monitored and that continual adjustments are automatically made to ensure constant, ideal conditions.

• From the buffer tank the substrate flows into the digester(s). These are fully sealed, dedicated tanks which have no internal moving parts. External recirculation lines ensure the necessary heat supply and temperature control. The complete digester volume is entirely recirculated within 24 hours. Inside the digester(s), the biological activity of specific bacteria enhances the conversion of organic matter into an energy-rich biogas.

Post Treatment:

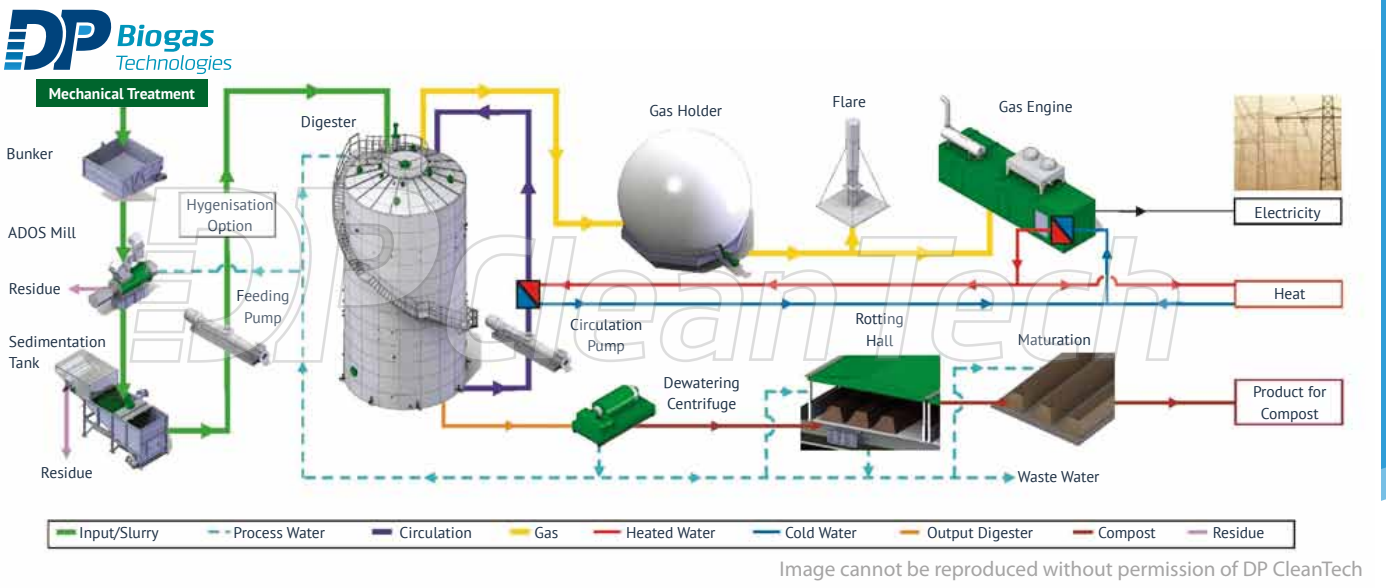
Various post treatments are available for extraction and treatment of the biogas and digestate, depending on the requirements.

• Biogas is extracted from the top of the digester and stored in a double-membrane gas holder. Co-generation units (CHP) can transform the biogas into electrical and thermal energy. Alternatively, the biogas can be upgraded and cleaned before being used directly.

• After the digestate is discharged from the digester, a dewatering step creates 2 fractions. The solid fraction can undergo a composting process, and the liquid fraction can either be recirculated back to the ADOS Mill; used as liquid fertilizer or further treated depending on the local requirements.

Key Features of ADOS Plants	Benefits
Effective pre-treatment equipment, ADOS Mill and SEDI Tank	✓ Maintains a semi-dry process, using a homogeneous slurry of ~15% solids content in digester – optimal for bacteria activity ✓ Speeds up the initial biological processes ✓ Enables higher organic load inside the digester ✓ Avoids big digester volumes ✓ Insensitivity to feedstock fluctuations ✓ Incorporating the benefits of dry and wet digestion. This process requires better control than mesophilic digestion, but it produces a greater quantity of biogas.
Maximises the quality of material going to digester and the resulting gas yield	✓ Facilitates maintenance ✓ Avoids the need for shutdowns - and enables the necessary 4-6 months bacteria cultivation period.
Thermophilic conditions within the digester (53-55°C)	✓ Creates and maintains the optimal environment for bacteria and maximizes gas yield
Inbuilt superior process and system knowledge	✓ Ability to maintain semi-dry slurry and thermophilic conditions in digester to maximize the gas yield ✓ Total solution, adaptable to different waste streams, output requirements and other customer needs
Standardized design	✓ Rapid, cost competitive delivery ✓ Scalable solution, extensions possible
Fully automated	✓ Increased operational stability, reduced operation costs and lower risk of human error

ADOS Plant - Typical Configuration



Typical Output Data

For a small ADOS plant of around 70 tpd (25,000 tons per year):

- 200m³ biogas per ton of feedstock
- 5 million m³ biogas per year
- 11.5 Gwh of green energy per year
- 11.3 Gwh of thermal energy per year
- 5,000 t of high-quality compost per year

How is DP CleanTech Different?

DP's unique approach and portfolio provides clients with

✓ A Complete Portfolio of Technologies and Fuel Expertise

DP understands the complex issues around waste management and has acquired and refined the most advanced solutions to address all stages of the waste management process - from collection to landfill mining; from waste processing to energy conversion and emissions management.

DP is a fuel expert across many technologies - solutions are designed based on a deep understanding of the specific fuel characteristics.

✓ An Optimised, Cost Effective Investment

DP's solutions are designed holistically to ensure that solutions are performance-optimized, custom made and properly integrated from the outset.

DP understands the economics of waste power plants and is dedicated to designing and delivering cost competitive solutions that provide long term value and economic viability.

✓ Performance Certainty and Minimised Risk

DP offers only the most reliable advanced and proven technologies in order to guarantee performance.

ADOS Projects

Client	Location	Scope	Tons / Year
Yutong Heavy Industries	Zhengzhou, China	Design for 300 tpd separate collected food waste	90,000
Slovunit S.A.	Bratislava, Slovakia	Design for 200 tpd organic fraction of MSW	50,000
Responso S.A.	Vyskov, Czech Republic	Design for 55 tpd food and commercial waste	20,000
FDR-IMRRI / Cebu Philippines	Naga, Cebu, Philippines	Extension and improvement of the existing anaerobic digestion plant with an ADOS system	30,000
APBB spol.sro	Benešov, Czech Republic	Extension and improvement of the plant with a buffer tank	
IUT Singapore	Singapore	300 tpd AD plant with ADOS system for separate collected organic waste	93,000
VIA spol. s r.o	Mimon, Czech Republic	Design for 100 tpd AD plant with ADOS system for separate collected organic waste	30,000
Bio Servis Benešov	Benešov, Czech Republic	Design and installation 105 tpd AD plant with ADOS system for separate collected organic waste	31,500
SAB GmbH	Salzburg, Austria	100 tpd separate collected biowaste	30,000

City of Benesov, Czech Republic
(ADOS Biogas)

Situation

In 2006, the existing waste sorting plant in Benesov, Czech Republic required an upgrade to add a 1MWe digestion plant for the conversion of organic waste to energy. The feedstock was primarily organic waste - waste from households, industry, foodwaste, slaughterhouses and other organic waste from the local area.

A joint investment and operating venture (Bio Servis Benešov spol.s r.o) was established as an international Public Private Partnership (PPP) with the IUT Group (Austria) to develop and operate the plant. Work began on the plant in 2006.

The Solution

A food waste treatment plant (105 tpd) was designed to sort the waste and convert it to energy and fertilizer, using the ADOS System of anaerobic digestion and composting. The process of sorting, digestion, hygienisation and fertilizer production are all co-located on one site. The ADOS process involves thermophilic digestion of the organic waste; incorporating the benefits of dry and wet digestion. This process requires better control than mesophilic digestion, but it produces a greater quantity of biogas.

The MSW fuel is shredded and sorted using rotating drums and screens and metal separators to remove inorganic materials - metal, plastics >60mm in size and ash <10mm. The reject waste that cannot be used in the digester is separated and sent to landfill.

After separation, the remaining 25-30% of the initial waste is fed to the 2 ADOS mills to create an organic slurry that is pumped into the 2 x 1000m^3 digester units. In the digesters the slurry is continuously circulated at the ideal temperature for bacteria to break down the organics and generate biogas. The biogas is extracted and stored in a storage tank prior to being used in 2 x gas engine generators which generate electricity (up to 1MW). Hot air from the engines is extracted and used to heat the slurry in the digesters. Residual slurry is removed and treated before use as fertiliser on local farms. The plant is air controlled using scrubbers.

Construction work started in Autumn 2007, the plant was commissioned in 2008 and full operations commenced in February 2009.

Plant Performance

Feeding waste: organic fraction of MSW, food and kitchen waste, market waste, commercial and industrial organic waste
Daily waste capacity: up to 105 tons
Digesters: 2 units x ~ 1.000 m^3 each producing up to 35m^3 of slurry per digester
ADOS Mills: 2 units
Hygienisation: 2 units for treating Cat. III waste (slaughterhouse, food waste, expired meat)
Fertilizer production: in house production under air control of ~ 70 tons per day
Biogas production : 12, 000m^3 of biogas a day can be produced.
Electricity to the public grid: 0.9 - 1 MW

Contact Us

DP has 9 offices around the world in 8 countries – Austria, China, Czech Republic, Denmark, Poland, Thailand, UAE and UK.

To ensure that we can address your needs appropriately, please email **info@dpcleantech.com** for enquiries or further information.

About DP CleanTech

- ✓ Founded in 2004, DP CleanTech Group designs, engineers, manufactures and commissions biomass and waste to energy power plants, providing complete solutions for turning waste materials into clean energy.
- ✓ DP's core technologies originate in Europe and are behind over 300 biomass and waste projects around the world.
- ✓ DP has facilities and multiple references across Europe and Asia; and has projects under development in Africa and South America.
- ✓ DP's pioneering tradition continues with an expanded portfolio of innovative waste-to-energy and environmental management technologies with which to lead the advancement of renewable energy and environmental protection.

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