DP CleanTech
Creating value from waste

Anaerobic Digestion Plant

Benešov, Czech Republic

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Introduction

In 2006, the city of Benešov in the Czech Republic decided to expand the existing MSW sorting plant with an anaerobic digestion (AD) plant for the conversion of organic waste materials to electricity. The proposed AD plant would process the organic fraction of MSW from households and other locally sourced organic waste from industry, food processing, slaughterhouses and commercial operations within the local area.

A joint investment and operating venture (Bio Servis Benešov spol.s r.o) was formed with leading waste specialist IUT Group (Austria) and established as an International Public Private Partnership (PPP) to develop and operate the plant. The IUT Group became part of DP CleanTech Group in 2018, bringing additional waste management capabilities and technology to DP.

The plant has been operational since 2009, and has a maximum throughput of up to 105Mg/day, while the installed electrical capacity is 1MWe. The electricity is delivered to the public grid.

The Solution and Overview

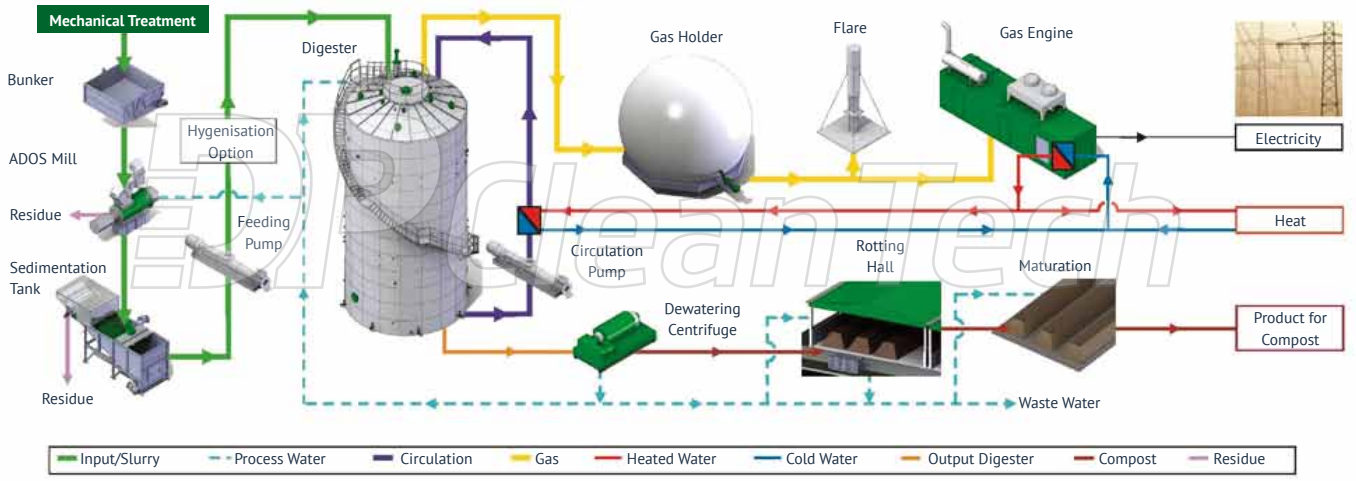
The IUT- designed solution is based on the well-proven ADOS process, a 'semi-dry' anaerobic digestion process that incorporates the benefits of both dry and wet digestion and operates under thermophilic conditions. Although the thermophilic process needs enhanced control compared to the mesophilic process, it produces a greater gas yield. This superior solution has been developed, refined and successfully implemented by IUT GmbH since 2004.

In the Benešov plant, the processes of sorting, hygienisation, digestion, and fertilizer production are all co-located on one site creating synergies and overall efficiency. The feedstock is primarily treated to remove inorganic materials and then passes through the ADOS mill to create an organic slurry that is pumped into the digester. In the digester the slurry is broken down by bacteria to generate biogas. The biogas is extracted and converted in Combined Heat-Power units (CHP) to generate electricity (1MW) and heat. Residual slurry is removed and treated before being used as fertiliser on local farms. Construction work started in Autumn 2007, the plant was commissioned in 2008 and full operations commenced in February 2009. The plant has been running successfully for almost a decade.

Design Data

Feeding Waste	Organic fraction of MSW (OFMSW), 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
ADOS Mills	2 units
Sedimentation Tank	1 unit
Hygienisation	2 units for treating cat. III waste (slaughterhouse, food waste, expired meat)
Fertilizer Production	in house production of ~70 tons/day
Biogas Production	up to 12.000m^3 of biogas/day
Electricity to the Public Grid	0.9 - 1 MWe

ADOS Process Overview



Detailed Process

OFMSW Pre-treatment

The MSW is loaded into a bag breaker which splits the bags and loosens the material. Subsequently, the MSW is conveyed through a drum screen and divided into 2 fractions: >60mm and <60mm. The >60mm fraction is sent to landfill and/or incineration, and the smaller fraction <60mm undergoes a metal separation step and another screening (fraction <10mm is removed as ash). The remaining material (25-30% of the initial waste) can be transported to the loading station of the AD plant.

Bag breaker *Drum screen* *Pre-treatment equipment* *OFMSW for digester*

Slurry Production

There are two loading stations; one for OFMSW, and a second one for commercial organic waste. This is because particular types of commercial waste, such as slaughterhouse or kitchen waste, must firstly undergo hygienisation (at 70°C for 1 hour), and must be kept separated.

From the loading stations the material is dosed into the ADOS mills. The mills shred the feedstock, while plastics and other light compounds get removed efficiently. Recycled digestate is added to ADOS mills to give the feedstock the correct consistency for pumping.

Hammer mill

Commercial waste hygienisation vessel

Once shredded, the slurry is pumped to a Sedimentation tank (SEDI tank) where yet more inorganics are removed. Lighter particles float on the surface and are collected at one side of the separator; heavier particles will sink to the bottom, where they are collected at the other side of the separator. The liquid slurry is extracted from the middle and pumped to the digester

Sedimentation tank *Floating particle separation* *Heavy particle collection*

Digester

2 x 1000m3 digesters are filled with slurry. Each digester has two circulation lines which are installed with heat exchangers and supplied with heat generated by the 2 CHP's. The circulation lines promote the correct mixing and enhance efficient temperature control. In the digesters the slurry is pumped into the top of the digester and continuously circulated at this ideal temperature for bacteria to break down the organics and generate biogas.

Up to 50 tons per day of slurry can be processed by each digester to produce a total output of 12000m3 of biogas/day. Ferric Chloride (Fe2Cl3) is added into the digester to reduce the H2S concentration in the biogas, which reduces or avoids potential CHP failures or frequent and expensive maintenance schedules.

After approximately 3 weeks, the digestate is extracted from the bottom of the digesters and can be used as fertilizer. At Benešov, this high quality fertiliser is given to farmers at no cost.

Power Generation

The biogas is stored in a double membrane gas holder and is used in internal combustion engines. Each CHP unit can generate 500kW of electricity and a similar amount of heat.

Plant Performance

The ADOS process is highly effective and proven at all scales of operation. The thermophilic conditions produce a higher biogas yield compared to other systems available in the market.

In 2017 average gas yield was 173 m^3/ton. This was calculated from the total produced power and the sum of all incoming waste to the AD bunker was. At its peak, monthly yield was 195 m^3/ton.

The overall plant design and detailed configuration are focused on achieving efficiency of operation and simplicity of maintenance. The digesters are designed with all mechanical parts outside the digester, and maintenance can be conducted during operation, without shutdowns. The feeding materials require no additional handling after being fed to the receiving bunker. The plant is fully automated, and does not need to be staffed overnight or on weekends. The result is a very cost-effective plant with the highest level of performance. The plant is certificated in accordance to ISO 9001, 14.001 and 18.001.

Apart from technical excellence, depth of knowhow is required to implement and operate the plant successfully, and DP's expertise in design and operation is based on IUT's technology and experience in over 60 waste projects.