WASTEWATER AND OTHER LIQUIDS
Methanation techniques
Within the scope of the EPOS project, extensive literature and market research reviews were performed in order to identify different technological, organisational, service and management solutions that could be applied to different industrial sites and clusters. The collected information will aid in establishing on-site and/or cross-sectorial industrial symbiosis opportunities; additionally, to enhance overall sustainability, performance and resource efficiency of different process industry sectors. Through the cooperation of project partners, a longlist of different technological options was created. Resource material for this list included: scientific articles, project reports, manufacturer’s documentation and datasheets.

**WASTEWATER AND OTHER LIQUIDS**

Similar to heat and electricity, water is a key resource for many process industry activities. Industrial sectors aim to improve efficiency in water consumption and wastewater disposal. Efficient use of water (and other liquids) is achievable through the integration of new/upgraded technological solutions for purification and recycling, implementation of advanced liquid management systems and better utilisation of available wastewater streams.

Wastewater handling is one of the main challenges for industrial sectors. Urban areas also produce large amounts of wastewater. Proper treatment of wastewater is required to reduce its environmental footprint.

Opportunities exist for the utilisation and re-use of recycled/purified water using adequate technological solutions. Examples include re-use of wastewater in other processes on an industrial site, using wastewater from urban areas for cooling on industrial sites, etc.

The focus for the identification of technological options is on the mechanical, physicochemical and biological techniques for the treatment of wastewater. Additionally, sludge treatment options, methanation, liquid waste incineration and advanced ICT systems for control, monitoring and management of the liquid processes are considered.

**METHANATION TECHNIQUES**

Methanation is the biological process in which bacteria break down organic matter in the absence of oxygen. The conditions of humidity and temperature should be controlled to enhance the breakdown of the organic matter in the digester. The main products of the methanation are biogas (mainly methane) and a soil conditioner (known as digestate). Based on the solids content of the feed, different types of anaerobic technologies can be identified.

- Anaerobic filter
- Up-flow anaerobic sludge blanket
- Expanded granular sludge bed digester
- Internal circulation reactor
- Anaerobic membrane bioreactor
- Continuous stirred-tank reactor
- Plug-flow anaerobic digester
- Batch dry anaerobic digester
METHANATION TECHNIQUES
Anaerobic filters are biological reactors that use several chambers of solid media with high surface areas in order to remove suspended solids. There is typically a 12-36h hydraulic retention time. This technique requires pre- and primary treatment as other solids have the potential to clog the filters.

Figure 1 Anaerobic filter

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**Applicability**
Anaerobic filters are used to treat liquid effluents.

**Maturity**
Commercial.

**Project/product reference**
Hydroflux’s solutions.
The up-flow anaerobic sludge blanket is a technique which utilises small agglomerations of microorganisms for the granules. The granules are 1-3mm in diameter and resist being taken away in the up-flow due to their weight. The microorganisms degrade the organic compounds in the introduced wastewater, this results in the productions of gases. In turn, these gases rise through the mixture without assistance and are then collected for further use. For this technique, primary settling is typically not necessary.

Figure 2 Up-flow anaerobic sludge blanket

Applicability
Up-flow anaerobic sludge blankets are used to treat liquid effluents.

Maturity
Commercial.

Project/product reference
Nisarg Enviro Consultants' solution.
Expanded granular sludge bed digesters are derived from up-flow anaerobic sludge blankets. Granulated sludge beds are used in these digestors. Using a high hydraulic load increases the expansion of the bed. These conditions lead to an increase in the contact that occurs between the substrate and the biomass. This type of digester can be used with limited amount of space.

**Technology 3: Expanded granular sludge bed digester**

**Applicability**
Expanded granular sludge bed digesters are used to treat liquid effluents.

**Maturity**
Commercial.

**Project/product reference**
Veolia’s solution.
Internal circulation reactors are vertical tanks which vary in both height and diameter based on space and need. The wastewater enters the reactor at the bottom, where it mixes with the granular anaerobic biomass. The organic components are broken down in the lower part of the reactor, resulting in the production of gas, typically methane and carbon dioxide. These gases force the wastewater upwards through the riser towards the liquid/gas separator at the top of the reactor. The water returns downwards while the gas leaves through the separator.

**Applicability**
Internal circulation reactors are used to treat liquid effluents.

**Maturity**
Commercial.

**Project/product reference**
Passavant Impianti’s solution.
The anaerobic membrane bioreactor is an effective approach to treating wastewater, as it is a combination of both anaerobic digestion and membrane separation. These bioreactors are suitable for wastewater treatment in numerous conditions given their operational stability.

**Technology 5: Anaerobic membrane bioreactor**

**Applicability**
Anaerobic membrane bioreactors are used to treat liquid effluents and substrates with a low solids content.

**Maturity**
Commercial.

**Project/product reference**
Suez Water Technologies and Solutions.
The continuous stirred-tank reactor uses flocculent biomass in a reactor that is completely mixed. The system is considered steady state as reactants are continuously added while products are continuously removed.

**Applicability**
Continuous stirred-tank reactors are used to treat substrates with a high content of solids.

**Maturity**
Commercial.

**Project/product reference**
GWE ANAMIX CSTR.
The plug-flow digester typically consists of a long, heated tank that is insulated and can be made of numerous materials, so long as there is a gas tight cover on top. There is no need for internal agitation, as the flow is controlled by the introduction of more waste material.

Technology 7: Plug-flow anaerobic digester

Applicability
Plug-flow anaerobic digesters are used for the treatment of substrates with a high solids content.

Maturity
Commercial.

Project/product reference
RCM’s solution.
Batch dry anaerobic digesters are considered to be a static, dry fermentation process that takes place in a gastight apparatus. It is typically used for the treatment of waste with a high dry matter content. Contamination susceptibility is not usually an issue with this type of digester. The anaerobic digestion is prompted by the addition of a liquid which has previously been fermented. As the digestion takes place, percolation liquid drains at the bottom, where it is collected then recirculated and sprayed over the biomass, further distributing the bacterial matter. Unlike in other digestion systems, the biomass does not need to be mixed throughout the process. A benefit to this type of digestion is that post-fermentation dehydration is not necessary.

![Figure 8 Batch dry anaerobic digester](image)

**Applicability**
For the treatment of substrates with a high solids content.

**Maturity**
Commercial.

**Project/product reference**
Elsinga’s solution.
REFERENCES


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