ENERGY AND NUTRIENT FACTORY AT AMERSFOORT WWTP IN THE NETHERLANDS

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Abstract

The Amersfoort wastewater treatment plant (WWTP) in The Netherlands has been upgraded to become a regional sludge processing hub for a number of WWTPs in the area. By using a combination of innovative energy and nutrient recovery technologies, energy is recovered by the application of LysoTherm® thermal pressure hydrolysis technology which enables the plant to become energy positive. Phosphorus is also recovered, creating a valuable fertiliser product which will generate non-regulated revenue. This paper provides a description of the project which currently is in the commissioning phase.

Keywords

energy recovery; nutrient recovery; thermal pressure hydrolysis, anaerobic digestion, sludge treatment centre

Introduction

Amersfoort wastewater treatment plant (WWTP) in The Netherlands is owned and operated by Dutch Waterboard Vallei & Veluwe. In 2013 it was decided to transform the plant into a regional sludge processing centre using innovative energy and nutrient recovery technologies.

In line with the growing trend in The Netherlands and Western Europe, the focus was on the recovery of energy and nutrients from municipal wastewater and waste activated sludge; the upgraded plant will act as a so-called 'energy and nutrient factory'.

Eliquo achieved this objective by adding to the existing arrangement a number of innovative solutions: Wasstrip® reactor, LysoTherm® system and Pearl® 2000 reactor. Old CHP units have been replaced by 3 efficient 500 kW units. Sludge processing equipment has also been updated. This comprehensive upgrade has been carried out without disruption to the normal function of the WWTP. A process flow diagram of the new configuration is shown in figure 1.

Figure 1: Process flow diagram - sludge line Amersfoort WWTP
Sludge from both Amersfoort WWTP and imported sludge from surrounding works is introduced into a Wasstrip® reactor, where the excess phosphate is stripped from the sludge. The sludge is pre-thickened and fed to 3 existing digesters. Each digester is equipped with a LysoTherm® sludge hydrolysis module. The heat needed for sludge hydrolysis is provided from the plant's CHP engines operating on biogas. The centrate from the sludge dewatering and the filtrate from the Wasstrip® process is treated in a Pearl® reactor to produce Crystal Green® fertiliser.

Increasing digestion capacity and energy recovery

The wastewater treatment capacity of Amersfoort WWTP is 335,000 PE. The upgraded sludge processing facilities process a total of 10,000 tonne dry solids per annum. This includes approximately 40% imported sludge from surrounding locations.

The processing capacity and biogas production of the three existing anaerobic digesters, each with a volume of 8,100m³, is increased by adding one LysoTherm® sludge hydrolysis module per tank. Three new 500kW Combined Heat and Power (CHP) units with increased electrical efficiency have been installed to recover energy from the total flow of biogas produced.

An important innovation is that the heat produced by the Combined Heat and Power (CHP) engines (cooling water and exhaust gas heat) is utilised to heat the digesters and to drive the sludge hydrolysis process. A diagram of the LysoTherm® heat exchange concept is shown in figure 2.

In contrast to traditional thermal pressure hydrolysis systems, LysoTherm® does not require steam as a heat transfer medium. Instead, a thermal oil circuit is used to transfer heat. This has a positive impact on economic viability, safety requirements, plant availability and operability.

![Diagram of LysoTherm® Thermal Pressure Hydrolysis](Image)

**Figure 2:** Diagram of LysoTherm® Thermal Pressure Hydrolysis

LysoTherm® is a novel modular THP for small scale and large scale WWTP’s. The technology has been developed from in-house knowledge and construction of heat-exchangers. The system comes ready-made from our own factory. LysoTherm® allows continuous operation, based on the indirect heating of sludge using two heating circuits. A closed water circuit to pre-heat and cool the sludge prior to discharge; a thermal oil circuit with heat recovered from the CHP units. Note: No steam is used. Operation is low cost, safe and maintenance friendly. LysoTherm® is designed for continuous operation, has a reliable and proven heat exchange design and is prevented from blocking or scaling by an incorporated CIP system (Clean In Place): LysoClean™. The technology has a proven 5 years full scale pedigree.

The application of LysoTherm® thermal pressure hydrolysis brings the following advantages:

- Increased throughput for existing digesters.
- Increased gas production.
- Reduced biosolids for disposal.
- Increased sludge dewatering capability.
- Reduced chemical consumption for sludge dewatering.
The combination of the application of LysoTherm® technology and new CHP units resulted in the upgraded Amersfoort WWTP becoming energy positive, i.e. a net producer of energy that will be sold back to the electricity grid. In addition, the throughput of the digesters has been increased without enlargement of the digestion volume. Figure 3 shows the LysoTherm® set-up at Amersfoort WWTP. To minimise construction on site, the modules are manufactured and tested in-house and transported ready-made to the site.

![Figure 3: LysoTherm® Thermal Pressure Hydrolysis Amersfoort WWTP](image)

**Phosphorus recovery**

Amersfoort WWTP and the other surrounding plants exporting sludge to the Amersfoort sludge processing facility use biological Phosphorus removal. Phosphorus is recovered from the waste activated sludge by producing a high quality magnesium ammonium phosphate (MAP) fertiliser called Crystal Green®.

Phosphorus is extracted from the activated sludge prior to digestion by applying the Wasstrip® process. Phosphorus rich filtrate from the Wasstrip® is treated with the reject water from the sludge dewatering in a Pearl® reactor, where Crystal Green® pellets are produced. The Crystal Green® pellets are dried, classified and bagged for transport. The reactor has a capacity to produce 2 tonne of Crystal Green® per day.

The Crystal Green® product has significant economic value, as it generates non-regulated revenue for the Waterboard. This revenue is secured through long term off-take agreements with the technology provider – the Waterboard has no further involvement once the product leaves the plant.

**Conclusion**

The upgraded Amersfoort WWTP is a showcase of sustainability in the public water sector that makes sound economic sense. It comprises the application of innovative technologies to recover energy and nutrients from municipal wastewater and waste activated sludge. The plant will be a net producer of energy and will be generating non-regulated revenue from the sale of a valuable fertiliser product.

**References**