Energy Optimisation Sludge treatment (EOS) at the Vienna main wastewater treatment plant

This paper briefly describes the sludge treatment concept that is currently implemented at the Vienna main wastewater treatment plant.

Authors: Günter Langergraber and Norbert Weissenbacher

Abstract

The paper describes the new sludge treatment concept of the Vienna main wastewater treatment plant. The current design of the plant for 4 Mio p.e. is described. For the description of the Energy Optimisation Sludge treatment (EOS) public available material has been used.

The Vienna main wastewater treatment plant

The Vienna main wastewater treatment plant was designed for carbon removal with a design capacity of 2.9 Mio p.e. and went into operation in 1980 (von der Emde, 1982). The original design was

- primary sedimentation: 28‘500 m³ (2 x 14‘250 m³)
- aeration tanks: 42‘000 m³ (4 x 10‘500 m³)
- final clarifiers: V=65‘400 m³ (8 x 8‘175 m³)

A few years after the start up discussions on the necessity of nitrification for further improvement of the river water quality began. After frequent changes of the legal standards including the implementation of nitrogen removal requirements and the adaptation of the Austrian ordinances to the EU legislation the final plant design was developed. The new plant design had to scope with additional requirements regarding nitrification and nutrient removal.

The plant was extended by addition of a second biological stage to the original plant (Kroiss et al., 2004). The tank volumes of the plant extension amount to

- aeration tanks: V ~ 175‘000 m³ (15 x 11‘700 m³)
- final clarifiers: V ~ 200‘000 m³ (15 x 13‘300 m³), diameter = 64 m, mean depth = 4.1 m

The plant now fulfils the Austrian effluent standards according to 1.AEVkA (1996). The requirements are BOD_5 = 15 mg/L, COD = 75 mg/L, total nitrogen removal rate = 70 % in average over all periods with temperatures T > 12°C, maximum NH_4-N = 5 mg/L in daily composite sample at temperatures T > 8°C, and maximum total phosphorus effluent concentration = 1 mg/L as yearly average of daily composite samples.

The extended 2-stage plant has a capacity of 4.0 Mio p.e. and went into operation in 2005. The first biological stage is designed for a maximum flow of 12 m³/s, the second for 18 m³/s (Wandl et al., 2006).

Key facts:

- Currently the Vienna main wastewater treatment plant has capacity of 4 Mio p.e. and consumes 60 GWh electricity per year (about 1 % of Vienna‘s total energy demand).
- The EOS (Energy Optimisation Sludge treatment) project aims to cover its entire demand of electricity and heat demand through energy generated on site by utilizing gas from anaerobic digestion of sludge.
- After finalisation of the EOS project in 2020, GHG emissions of Vienna will be reduced by 40‘000 t CO_2 per year (equivalent to the GHG emissions of a small town with 4‘000 people).

Figure 1: The Vienna main wastewater treatment plant (http://www.ebswien.at/hauptklaeranlage/service/presse/)

Sludge disposal at the Vienna main wastewater treatment plant is undertaken by gravity thickening, centrifugation and incineration of raw sludge. Raw sludge is pumped directly to the nearby incineration plant. The sludge age in the original plant was 1 day, i.e. a large part of organic matter is removed in the first stage with the excess sludge. In the new plant, under normal operating conditions, the excess sludge is withdrawn from the first stage only. The excess sludge of the second stage is pumped into the first stage. Sludge containing nitrifying bacteria from the second stage enters the first stage and thus enables nitrification in the first stage. Raw sludge incineration contributed to 40% nitrogen removal in the two stage concept (Kroiss et al., 2004).

Energy Optimisation Sludge treatment (EOS)

Currently the Vienna main wastewater treatment plant consumes 60 GWh electricity per year (about 1 % of Vienna's total energy demand). Since 2008 measures to increase energy efficiency and the use of renewable sources (solar and wind) the energy demand could be already reduced by 11 %.

In 2012 the city of Vienna decided to utilise the energy in sewage sludge for the generation of electricity and heat and started the project EOS (Energy Optimisation Sludge treatment) with the objective to cover its entire demand of electricity and heat through energy generated on site. It is projected that about 20 Mio m^3 methane gas per year will be produced. The gas will be converted into electricity and heat in a co-generation plant.

Methane gas from sewage sludge is recognised as renewable energy source that is available reliable all around the year. The GHG emissions of Vienna will be reduced by 40'000 t CO_2 per year.

The space required for the sludge treatment plant is created by renewing the pre-sedimentation stage and the first biological stage (tanks are made smaller but deeper). The tanks are renewed step by step while the plant remains in full operation. An EOS pilot plant has confirmed project assumptions and has led to the first results based on which design the mechanical engineering equipment for the sludge digester could be optimised.

The construction of the EOS project will start in 2015 and should be finalised end of 2020 (Figure 2). Estimated costs are about 200 Mio EUR (100 Mio EUR for rehabilitation of the first stage of the treatment plant and 100 Mio EUR for the new digesters).

Figure 2:The Vienna main wastewater treatment plant in 2020 (ebs, 2014).

References

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Name: Günter Langergraber
Organisation: Institute for Sanitary Engineering and Water Pollution Control, BOKU University
Country: Vienna, Austria
eMail: guenter.langergraber@boku.ac.at

Name: Norbert Weissenbacher
Organisation: Institute for Sanitary Engineering and Water Pollution Control, BOKU University
Country: Vienna, Austria
eMail: norbert.weissenbacher@boku.ac.at