Nutrient removal without carbon source for achieving maximum biogas production and phosphorus recovery

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Global warming

can be counteracted by substituting fossil fuel with biogas from digesting sewage sludge, thus reducing climate impact from carbon dioxide emissions. Biological nutrient removal requires carbon source which decrease the amount of organic material which can be separated as primary sludge and thus decrease the possibilities to produce biogas.

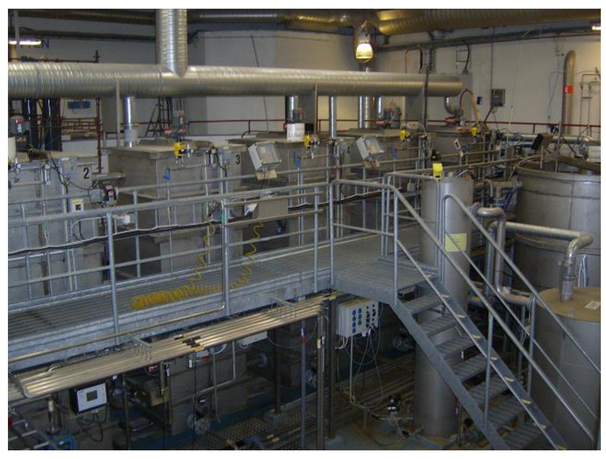
Levlin made 2003 a study of emissions of greenhouse gases and other air pollutants from the islands of Åland.
Using the biogas, witch gives 1.3 GWh energy, to replace fossil fuel would save 178 ton oil and reduce the global warming impact from wastewater treatment from estimated 5200 to 4200 ton CO_2-equivalents.

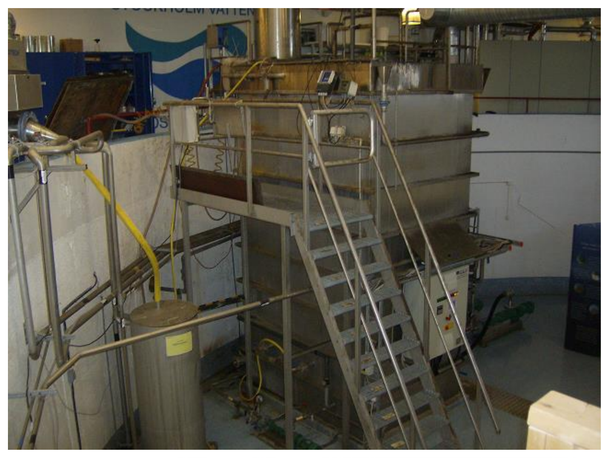
Hammarby Sjöstadsverk

was 2008 jointly taken over by KTH Royal Institute of Technology and IVL Swedish Environmental Institute with wastewater treatment lines in pilot plant scale (150 p.e. = 1,5 m^3/day) :

- Aerobic treatment with activated sludge process and sedimentation.
- Aerobic treatment with membrane bioreactor (MBR), an aerobic reactor with submerged micro filter, and drum filter for separation of primary sludge.
- Anaerobic treatment with UASB-reactors (Upstream Activated Sludge Blanket). With anaerobic treatment high biogas production can be achieved, however, without possibility for biological nutrient removal.
- The produced sludge can be thickened, digested and dewatered.

http://sjostad.ivl.se





Process proposal

Struvite (magnesium ammonium phosphate, $MgNH_4PO_4$) precipitation with magnesium and the anammox reaction are processes that can be used for nutrient removal without need of carbon source. Struvite can be precipitated by increasing the pH value by adding base. In the proposed process the amount of produced struvite and added magnesium, correspond to the phosphate content in the wastewater. Half of the ammonia exceeding the phosphate content is extracted as ammonia and the rest as struvite. By oxidizing ammonia in struvite to nitrate, the amount of struvite larger than the phosphate content is redissolved. The nitrate of the dissolved struvite can with the extracted ammonia in an anammox process be converted to nitrogen and the magnesium and phosphate can be returned for struvite precipitation. This process can preferentially be used together with an anaerobic treatment process such as UASB, there all nitrogen is in form of ammonia.