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TNO report

Project Summary

Efficiënte Cascadering en Opwerking Rioolslib voor Energie-neutrale bedrijfsvoering (EnCore)

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Summary

Sewage sludge is a waste stream produced at urban wastewater treatment plants and is largely being disposed of by truck transportation and incineration. With existing technologies sewage sludge can be dewatered up to 22 wt.% dry matter which is quite low and therefore makes current method of disposal inefficient and unsustainable. ECN.TNO has developed a hydrothermal treatment technology (TORWASH®) which is capable of improving the dewatering and the quality of sewage sludge as a fuel without the use of flocculants. Also, the mild thermal treatment conditions render the effluent digestible and makes recovery of phosphorus possible. Overall, TORWASH® can convert a wet waste stream that has no fuel value into gaseous and solid biofuels that can be used for the production of heat and power.

The aim of this project is to produce more biogas and raw materials from sewage sludge. The application of TORWASH® treatment: (1) enables efficient mechanical dewatering of the biomass, (2) allows for sufficient biogas production from the effluent because of the mild conditions used, (3) facilitates the recovery of phosphorus and (4) makes the use of additives redundant. TORWASH® was originally developed to produce clean bio-pellets from wet agro-residue streams. In this project, we use second-generation TORWASH® technology to serve a new purpose, namely to significantly reduce the volume of wet slurries. This results not only in less material to be transported, but also produces biofuel, reducing the overall CO₂ emissions.

The EnCore project lasted for a total of three years (May 2016-May 2019). The first year, lab scale testing was realized in order to set the optimal conditions for the subsequent pilot testing. The second year, the pilot plant was being constructed and therefore this delayed the testing which was eventually completed in the third year of the project.

The lab scale results were performed on two types of sewage sludge: undigested and digested sludge. The results showed that the sewage sludge after TORWASH® treatment could be dewatered into a solid cake containing 60-70 wt.% dry matter. This is in agreement with previously obtained results on lab scale and proves that the sewage sludge waste stream can be reduced by ~85%. The effluent was tested on lab scale and showed a 60-75% anaerobic biodegradability. These conditions were established as the optimal ones for applying on pilot scale further in the project.

The TORWASH® pilot plant (50 L/h throughput) was installed on location of the urban wastewater treatment facilities of the city of Almere, The Netherlands. The functional tests were performed until August 2018 when commissioning of the plant was completed. The months that followed the rest of the pilot train was installed on site (membrane filter press and effluent treatment) and tests were successfully completed by May 2019.

Tests were realized with two types of sewage sludge, namely undigested and digested sludge, containing around 6 wt.% dry matter. The sewage sludge after TORWASH® treatment was pressed into a solid cake containing 50 wt.% dry matter using the membrane filter press on pilot scale. Testing with the effluent treatment pilot showed that the chemical oxygen demand (COD) of the water stream could be

converted by ~75%. The impact of this result is that the treatment of wastewater can become cheaper for citizens, and that wastewater treatment plants can become more sustainable by generating their own bio-based energy and by recovering phosphorus from the waste water.

Additional lab measurements performed showed that the remaining COD loading and effect of inhibition on nitrification of the effluent poses no issue on the loading of the WWTP and what it is legally allowed to emit on surface waters.

On basis of the calculations for the TORWASH® business case and from all the data collected during this project, the conclusion can be drawn that sludge processing and disposal by TORWASH® results in a cost reduction of 31% compared to current common practices and current disposal prices. When the TORWASH® process is combined with a digester then a cost reduction of 24% can be achieved.

Signature

Petten, 16-9-2019

A handwritten signature in black ink, appearing to read 'P. Nanou', with a long horizontal flourish underneath.

Dr. ir. P. Nanou

TNO Project leader