

# Fuel Production from Sewage Sludge using TORWASH for highly efficient dewatering and salt removal



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dewatering and salt removal

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#### Abstract Introduction

Water Authorities are facing high costs for the disposal of sewage sludge, in particular when the sludge cannot be used as fertilizer. Disposal costs for landfill or incineration are linked to the total mass of the sludge and since the bulk of the mass is water, simple dewatering can bring substantial savings. Commonly used presses for mechanical dewatering produce a sludge with 75-80% moisture. Since it classified as a waste, only waste incinerators can burn it and they charge high gate fees. Waterboard Zuiderzeeland is the water authority for Flevoland in the Netherlands. Together with ECN they have investigated whether how TORWASH is capable to improve the dewatering and the fuel quality of sewage sludges. TORWASH is under development by ECN for converting wet, salt-containing biomass into clean solid biofuel suitable for energy production, e.g. by co-firing in power plants. Preliminary test had shown that applying TORWASH to sewage sludge leads to sludges with significantly less water (well below 50% moisture content) and a net calorific value similar to municipal waste.

#### Purpose of the Work

The TORWASH technology is used to experimentally determine the conditions for optimal mechanical dewatering of sewage sludge (digested or undigested), converting it into a fuel that can actually be used for energy production.

#### Approach

Two kinds of sewage sludge one produced with anaerobic digestion and one without were collected at two sewage treatment plants, WWTP Lelystad en WWTP Dronten and directly transferred to ECN for processing. The samples of thickened sewage sludge were used without any pre-treatment. First, the optimal conditions for TORWASHing of sewage sludge was determined. Subsequently, batches of TORWASHed sewage sludge were produced for in a 20 litre autoclave for evaluation of dewatering- and fuel characteristics. Overall mass balances were made for solid and liquid fractions. Samples of the input materials, the output slurries of the hydrothermal treatment, and the pressed-out product were analysed for elemental composition. The solid products were assessed for their suitability as biomass fuel.

## Scientific Innovation and Relevance

The TORWASH technology is a mild hydrothermal treatment that is based on wet torrefaction and makes all kinds of biomass suitable for mechanical dewatering, densification and desalination. The TORWASH principle can also be applied to sludges for changing the chemical characteristics so that it loses its gelatinous character and can be efficiently dewatered. TORWASH results in solid product with a solid-matter-content of 65% or more. No other technology can accomplish this with sewage sludge. TORWASH means a reduction of the sludge disposal of at least 75% compared to currently used mechanical dewatering techniques. Added benefits are the sterilization of both all outputs and the possibility to recovery of nutrient like phosphorous.

### Results

Both digested and un-digested sewage sludge may benefit from application of the TORWASH process. The sludge can be used without any pre-treatment. It was demonstrated that the slurry can be mechanically dewatered to a level of 54% dry matter for digested sludge and 67% dry matter, corresponding to 90% and 95% removal of water from the original sludge. Therefore, application of un-digested sludge seems to be more attractive. The cost savings are substantial. A treatment plant that is producing 30,000 ton sewage sludge with 21% dry matter (commonly used press) can install a TORWASHer and produce only 6,400 ton press cake with a dry matter content of 65%. When disposal costs are €50 per ton, savings are over € 1 million per year. The effluent that is expelled can be digested for the production of biogas, either as a supplement in the existing digester or in a separate fast throughput digester like a UASB. The extra energy generated by this extra biogas is sufficient to run the whole TORWASH installation. The alkali, phosphorous and chlorine end up in the effluent, where P,K and N can be recovered after digestion. The solid fraction can be used as a fuel in fluidized beds and grate stokers.

#### Conclusions and future work

TORWASH can be successfully applied to sewage sludge, resulting in a reduction of over 80% in sludge disposal and the production of a solid biomass fuel. Due to TORWASH the net energy production of sludge digestion increase and valuable nutrients can be recovered en re-used in the bio based economy of concerted into nutritious substances. A follow-up project for a pilot-facility is planned (and will be started in first half of 2016). When this facility demonstrates to be successful, TORWASH-for-sewage-sludge can be implemented to waste water treatment plants, starting in the Netherlands, the UK and Germany. The TORWASH technology, combined with digestion and recovery of nutrients, will be extended to other kinds of industrial sludge, e.g. from potato processing plants.

