An Evolution in Biosolids Thermal Hydrolysis Technology – Kruger's Exelys™ Continuous Thermal Hydrolysis System

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Challenged with the goal of converting wastewater treatment systems from energy consumers to energy producers inevitably leads to an evaluation of the potential of biosolids. Biosolids are the largest energy resource available within a wastewater treatment plant. Therefore the use of biosolids needs to be optimized to take full advantage of its renewable energy properties. Enhancement of biogas yields are generally achieved from the application of a pre-treatment process. The most effective of these is thermal hydrolysis. However, thermal hydrolysis generally consumes more energy than it is responsible for producing. The efficiency of these processes can be significantly improved, if the solids fraction in the incoming biosolids is increased.

Thermal hydrolysis has traditionally been performed within a batch system. Although proven and effective, the batch mode has involved high capital and operational costs, restricting the applications to only very large wastewater treatment facilities. Kruger's Exelys™ process was developed to overcome these challenges of thermal hydrolysis and build upon the efficiencies of the process. Exelys™ is a continuous process that handles biosolids with a dry solids (DS) content greater than 20% w/w. This leads to a considerable savings of steam required to reach hydrolysis conditions, while the continuous operation allows for optimal energy recovery. Relative to traditional batch thermal hydrolysis, Exelys™ provides the same process conditions and hydrolysis product, but in a much more energy efficient manner. Exelys™ is the next generation thermal hydrolysis that can drive wastewater treatment plants towards net energy production.

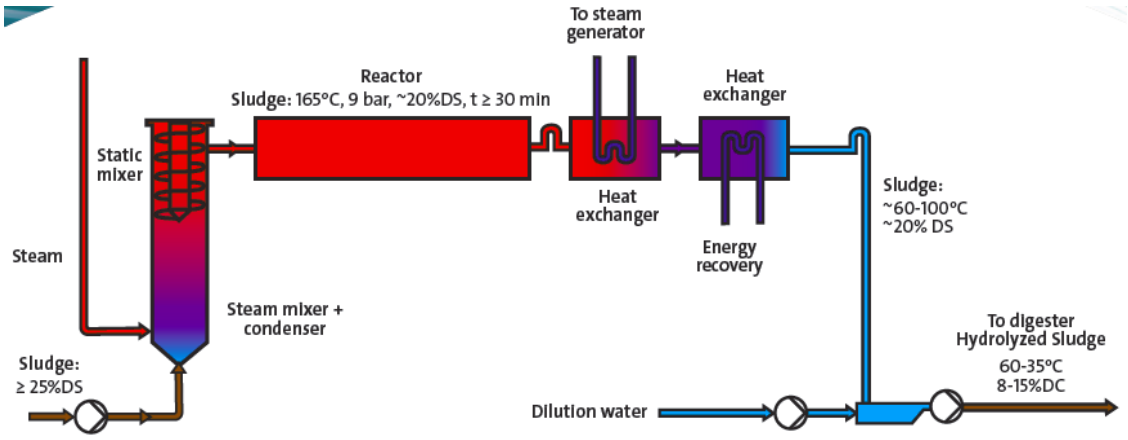

Figure 1: Exelys Continuous Thermal Hydrolysis System

The Exelys™ Process

The Exelys™ Process is shown herein in Figure 1. Dewatered biosolids from a storage silo or hopper is continuously fed to the Exelys™ process via a progressive cavity pump. As the biosolids enter the system, steam is continuously added to the system through a series of injection nozzles. As the mixture moves up the steam condenser section, the steam condenses transferring heat to the biosolids and raising the temperature to a required level for thermal hydrolysis to occur. The heated biosolids pass through a self-cleaning static mixer which ensures that the heat is distributed evenly resulting in a homogenous biosolids/water mixture. The static mixer will also catch any steam that has not yet condensed. This ensures that all of the energy available from the steam injected is utilized effectively in the Exelys™, maximizing the energy efficiency of the process.

After the biosolids are at the required temperature and pressure for thermal hydrolysis, the biosolids enter the reactor and flow at a low velocity resulting in plug flow. This plug flow ensures there no short-circuiting and all the biosolids are under thermal hydrolysis conditions for the required amount of time.

After the reactor, the biosolids enter a heat exchanger system to cool the biosolids to a suitable temperature for the downstream mesophilic or thermophilic digestion process without requiring supplemental heating in the digesters. The heat exchangers are a tube in tube design which allows for easy cleaning and maintenance. The cooling water from the heat exchanger system can be used for pre-heating boiler water, building heat or for other low temperature heat sources at the plant.

After the heat exchanger system, there are provisions to inject treated wastewater into the biosolids. The water injection can be used to dilute and cool the biosolids as required by the downstream digestion process.

The final component of the Exelys™ system is the pressure holding pump. This pump is controlled to maintain a pressure set point in the Exelys™ system. In most cases, the pressure holding pump can also be used to feed the downstream digestion process.

Further Optimization of Thermal Hydrolysis with Exelys™ -DLD

Exelys™ can be utilized in a number of process configurations. Normally, it would precede digestion. However, Exelys™ can be incorporated into an innovative, patented process configuration to further improve energy efficiency – Exelys™ -DLD (Digestion-Lysis-Digestion) system. Energy consumption in Exelys™ is decreased because there are less biosolids for hydrolysis after the first digestion step. By digesting the hydrolyzed biosolids again, biogas yields from the raw biosolids are even greater than if a conventional LD (Lysis-Digestion) system was used. Because the Exelys™ unit is smaller, its energy requirements can generally be covered by waste heat recovered from electricity production from the biogas. The Exelys™-DLD provides an increase in biogas production. Biogas can be used for electrical generation – increasing income and reducing carbon footprint.

Demonstration Facility

Since October 2010, an Exelys™-DLD process has been in continuous full-scale operation at Hillerød WWTP, Denmark. Before the installation of the Exelys™-DLD system, the plant utilized a highly effective thermophilic anaerobic digestion process with a retention time of 25 days and a DS reduction rate of 35-40%. With the Exelys™-DLD configuration installed, the treatment plant operator has recorded an estimated increase of 30% in biogas production (which is sold to the local heating network), improved dewatering and a reduction of an estimated 25% in biosolids to be disposed. The Hillerød WWTP is continuing to operate the Exelys™-DLD process for further evaluation and optimization of the system performance.

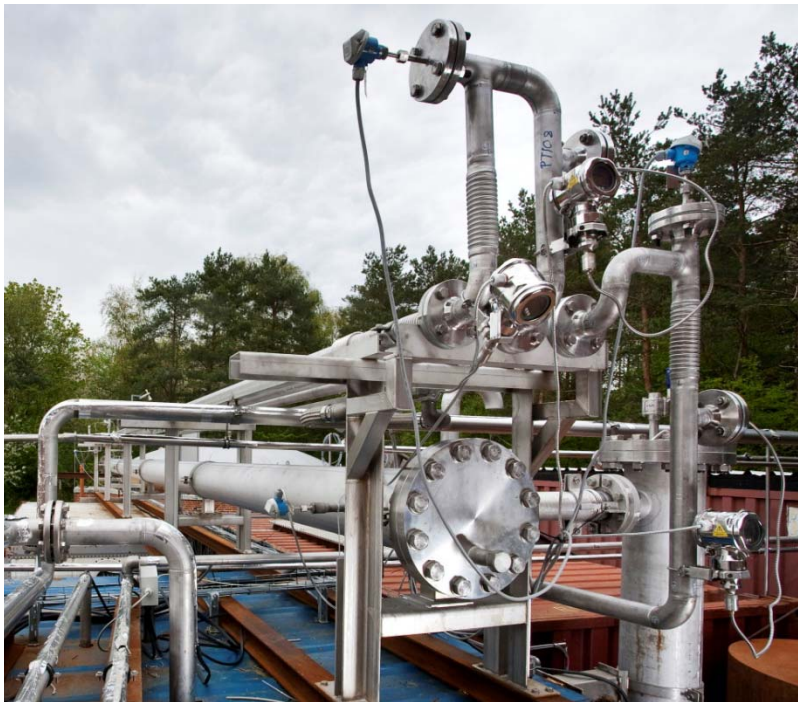

Figure 2: Exelys™ demonstration system installed in Hillerød, Denmark