Oxford STW

Bio Thelys® thermal hydrolysis plant provides green energy from sewage sludge

by Ray Tillier FCIWEM

Thames Water has a programme of utilising the biosolids produced by its sewage treatment operations to increase the generation of green energy by the use of thermal hydrolysis prior to anaerobic digestion. The process also provides the benefits of a higher throughput by the anaerobic digestion plant and treated biosolids are pasteurised and can be used for agricultural and horticultural applications. Oxford STW has been designated as a strategic sludge centre and sludge treatment activities are being intensified with the introduction of a thermal hydrolysis plant (THP).

Thermal Hydrolysis plant under construction August 2013 - Courtesy of Veolia Water Solutions & Technologies

Background

As a result of population growth and tighter environmental regulations the need for additional sewage sludge treatment capacity was identified to be required in the Western Area of Thames Water's region.

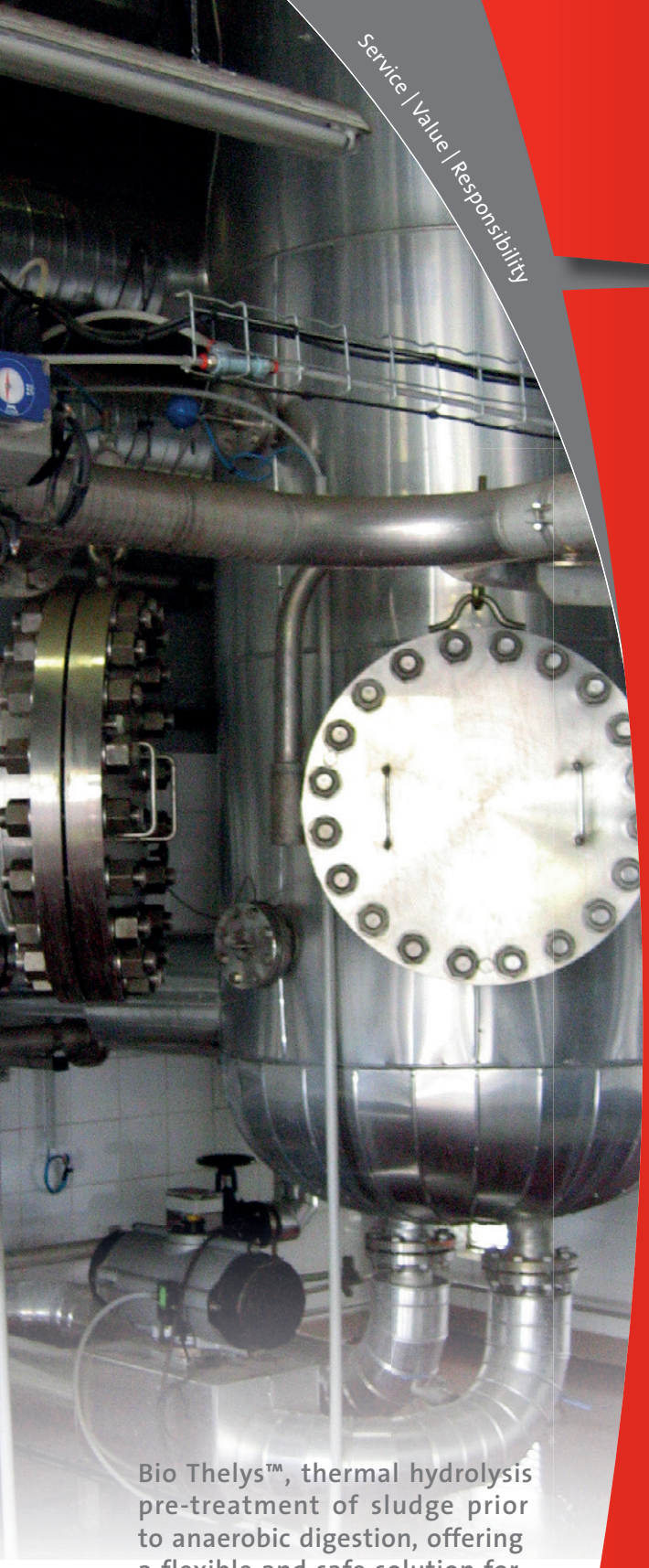
The upgrade of Oxford STW will provide the required additional sludge treatment capacity, thus enabling sludge from a number of sludge dewatering centres and satellite sewage treatment works to be treated to current standards for disposal.

Imported sludge will arrive at the site in both cake or liquid form and the existing digestion and dewatering process stream will be modified to handle the thermally hydrolysed sludge including the feed pumps, mixing systems, gas stream and pipework etc.

What is thermal hydrolysis?

Thermal hydrolysis (TH) is a process which is used to pre-treat sewage sludge by the application of high temperature and pressure (165°C and 6 bar) for a period of 30 minutes, prior to feeding to an anaerobic digestion plant.

Its effect is to disintegrate the cellular structure of the sludge into an easily digestible feed for anaerobic digestion. This results in a considerable increase in biogas yield, as well as producing a product which is classed as an Enhanced Treated Sludge, is free



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Bio Thelys™, thermal hydrolysis pre-treatment of sludge prior to anaerobic digestion, offering a flexible and safe solution for municipal and biological industrial sludge

- Increases biogas yield by more than 50%
- Produces enhanced treated sludge
- Existing digestion plant throughput doubled
- Reduces amount of sludge for final disposal

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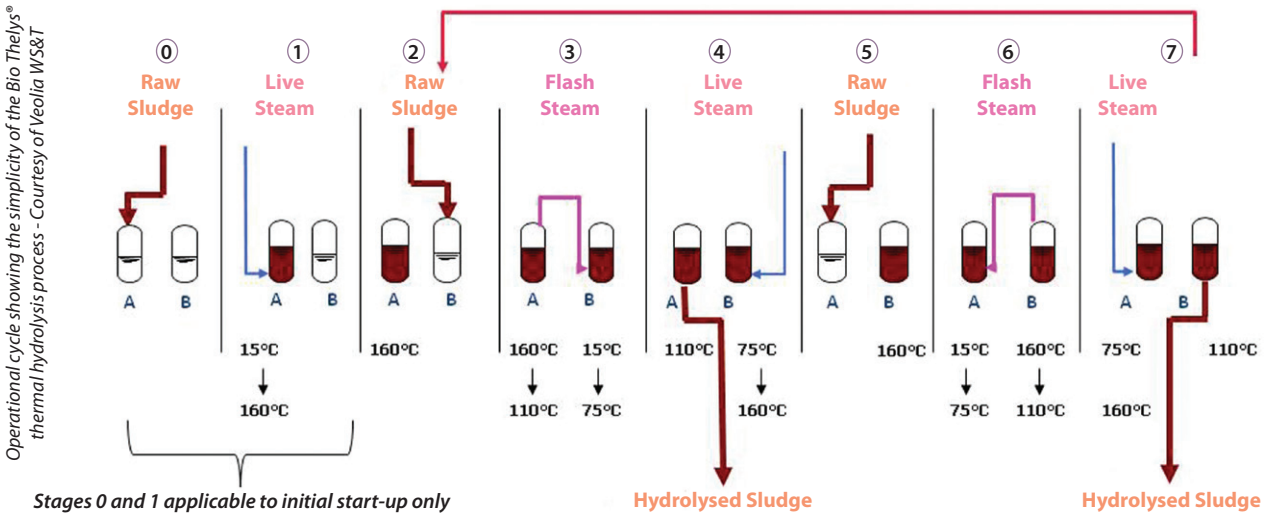


from *salmonella* and where 99.9999% of the pathogens have been destroyed (i.e. a 6 log removal). This biosolids material is approved under the ADAS *Safe Sludge Matrix* for use as a fertiliser or soil conditioner for all crops including cereals, vegetables and salads as well as for horticultural applications. Although 6 log removal is not currently required at Oxford, it may be necessary in future.

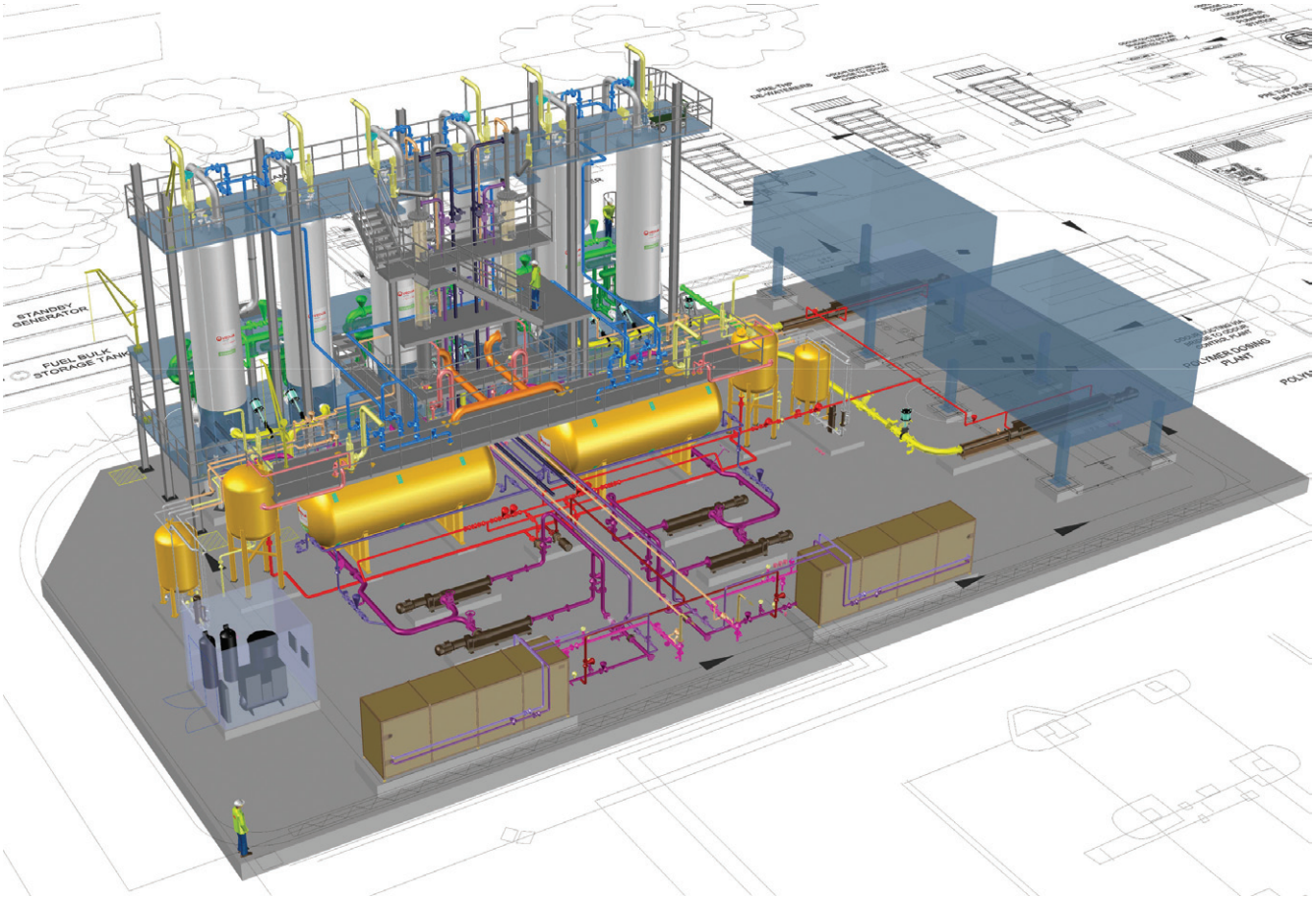
The biogas produced by the anaerobic digestion process can be used to fuel a combined heat and power (CHP) plant or cleaned and injected directly into the national gas grid, thus providing a source of green energy.

The Bio Thelys® thermal hydrolysis process

The Bio Thelys® thermal hydrolysis process was originally developed independently by Veolia in the late 1990s for the treatment of surplus activated sludge, with the objective of producing a zero-sludge sewage treatment works. It subsequently underwent further development for the treatment of both primary and secondary sludges to provide the benefits of increased biogas production and an enhanced biosolids product.

A number of small Bio Thelys® TH plants with throughputs of between 1,000 and 2,000TDS/year were built in France from 2004 to 2008, which fully demonstrated the capabilities and reliability of the process. This was followed, in 2009, by the 10,200TDS/year plant in Monza, Italy, which became fully operational in March 2011.

Other Veolia thermal hydrolysis plants are currently under construction at Lille and Versailles in France. The Oxford STW plant follows on from the success thermal hydrolysis plant which Veolia built for Yorkshire Water at Esholt STW, which treats 30,000 tonnes of dry solids per annum.



View of 3D model showing the Thermal Hydrolysis plant at Oxford STW - Courtesy of Veolia Water Solutions & Technologies

Advantages of the Bio Thelys® Process

In all TH processes, the actual 'cooking' of the sludge is identical, although the way in which it is achieved is different for each process. The Bio Thelys® TH system uses only two types of vessel, the reactors and the hydrolysed sludge buffer tank.

In the Bio Thelys® process, raw sludge is introduced directly into the reactor which eliminates a pumping stage. Bio Thelys® reactors operate in parallel pairs and the thermal energy from the flash steam is recovered from one reactor to its paired unit.

There is no requirement for a separate mixing stage, thus eliminating the need for a recirculation pumping system. Treated sludge is transferred to the hydrolysed sludge buffer tank by the differential driving head and gravity (i.e. does not require a further pumping stage). Hydrolysed sludge is then continuously pumped from the hydrolysed sludge buffer tank to the anaerobic digestion plant.

Some TH processes use a radioactive method of measuring the sludge level in the reactor vessel. This is not necessary in the Bio Thelys® process, thus eliminating the precautions and procedures required for the use of radioactive isotopes.

The simpler design of the Bio Thelys® process therefore provides a system with both reduced capital and operating cost by using fewer vessels, pumps, valves and instrumentation.

Oxford STW Bio Thelys® plant: Facts & figures

- The Oxford Bio Thelys® plant is designed to treat an average daily throughput of 58.8 tonnes of dry solids per day (21,242TDS/annum) with a maximum throughput of 70.03TDS/day (25,561TDS/annum). The feed is composed of a mixture of primary and secondary sludges produced both at the Oxford works itself together with those imported from a number of outlying works.
- The treated sludge produced by the Bio Thelys® process will be fed to the existing downstream anaerobic digestion plant at a dry solids concentration of 10-12% compared with only 5-6% which is currently experienced with untreated sludge. This will, in effect, double the existing digester throughput.
- The Bio Thelys® plant comprises 3 (No.) pairs of reactors each of which has a volume of 18.7m^3 with dimensions of 1.65m diameter x 8.7m high, together with 2 (No.) hydrolysed sludge buffer tanks each of which has a volume of 30m^3 with dimensions of 2.44m diameter x 6.4m long.
- The Bio Thelys® plant at Oxford will also substantially increase the amount of biogas produced by the existing anaerobic digestion plant. This biogas will then be used to generate green electricity via a combined heat and power (CHP) plant.
- In addition, due to the higher destruction of volatile matter, there will be less sludge left at the end of the process for final disposal.

Conclusion

The contract for the Bio Thelys® plant at Oxford was awarded to Veolia by Kier Infrastructure and Overseas Ltd who are the main contractors for the overall scheme which also includes a major upgrade of the sludge treatment facilities at the works including refurbishment of the existing anaerobic digestion plant as well as new sludge storage and handling facilities.

The Bio Thelys® plant will be in operation in the Spring of 2014.

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