



Turbocharge Your Digester

Technology for Enhanced Anaerobic Digestion of Municipal and Industrial Sludge



+ Increased Renewable Energy
Reduced Biosolids Volume

Unleash the Power of Anaerobic Digestion

Cambi Thermal Hydrolysis Sludge Pre-treatment

Cambi's Thermal Hydrolysis Process (THP) is a proven and reliable technology that has been used around the world since 1995 in existing and "green field" projects to reduce both disposal quantities and the cost of building and operating digesters.

Cambi THP is a high-pressure steam pre-treatment for anaerobic digestion of municipal and industrial sludge and bio-waste. Applying THP technology results in doubled digester loading, increased biogas production, and a pathogen-free and stabilized biosolids product with increased cake dewaterability. This saves both transport and energy costs, whether applying the end product directly in agriculture or drying it for fertilizer or bio-fuel.

The THP is highly energy-efficient with low operating costs. It also eliminates odour problems associated with the treatment of organic materials. The end product (digestate) – a pathogen free and pasteurized biosolids – can be applied to land directly, composted or dried.

Cambi THP plants can be combined with cogeneration plants, which produce green electricity and provide hot steam for the Thermal Hydrolysis Process. However, the biogas can also be cleaned to be used as vehicle fuel or as a replacement of natural gas.

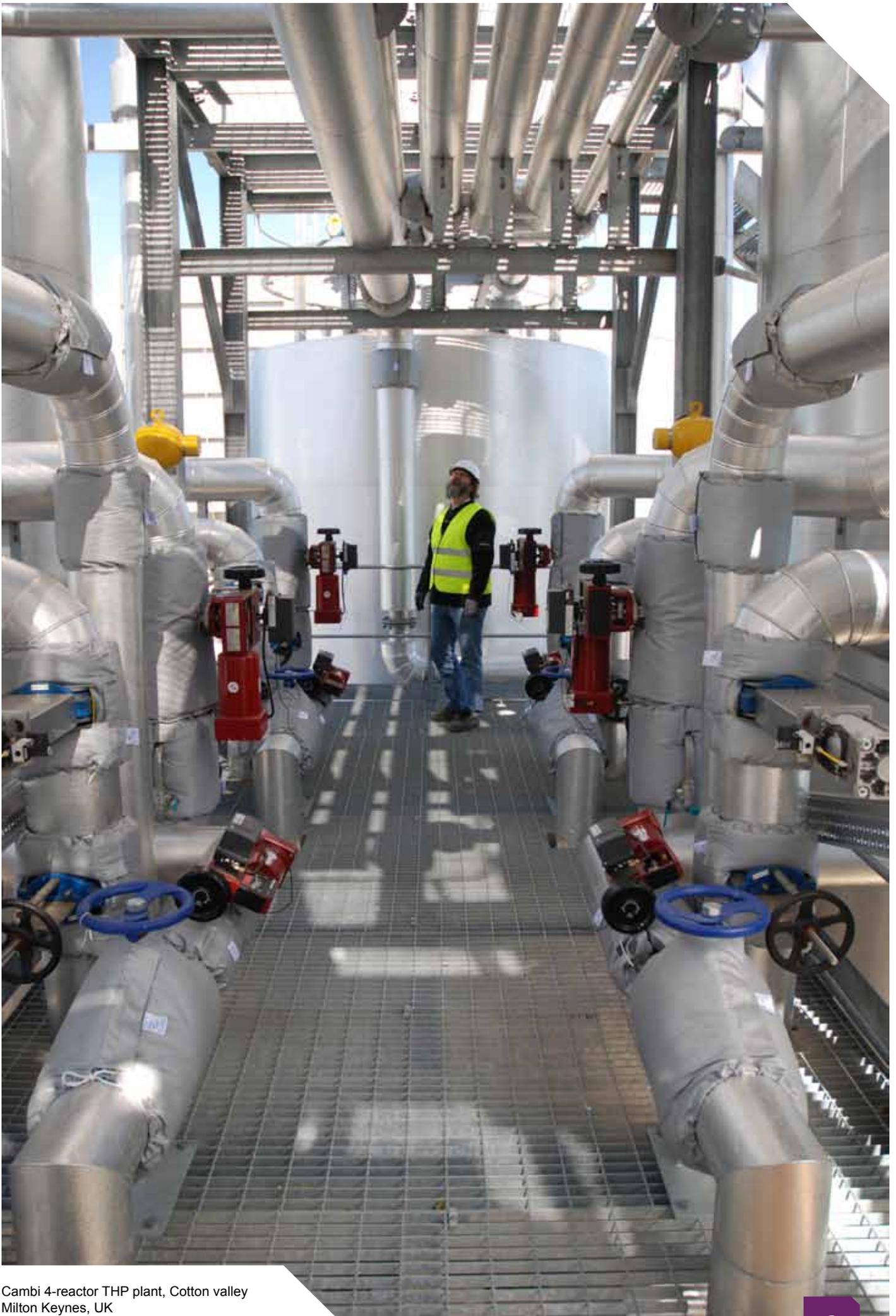
Cambi's scope of delivery varies from the core THP to complete turnkey digestion plants. We also offer plant operations & maintenance. The THP plants normally handles sludge from wastewater treatment plants for populations upwards from 150,000, or from approximately 5,000 metric tons/year of sludge.

Cambi's THP enhanced sludge treatment maximise both flexibility and profitability.

For additional information please visit: www.cambi.com

“Sludges that were difficult and expensive to dispose have been transformed into biosolids whose values are appreciated by those who receive them for recycling. Costs have been reduced dramatically and payback has been rapid.”

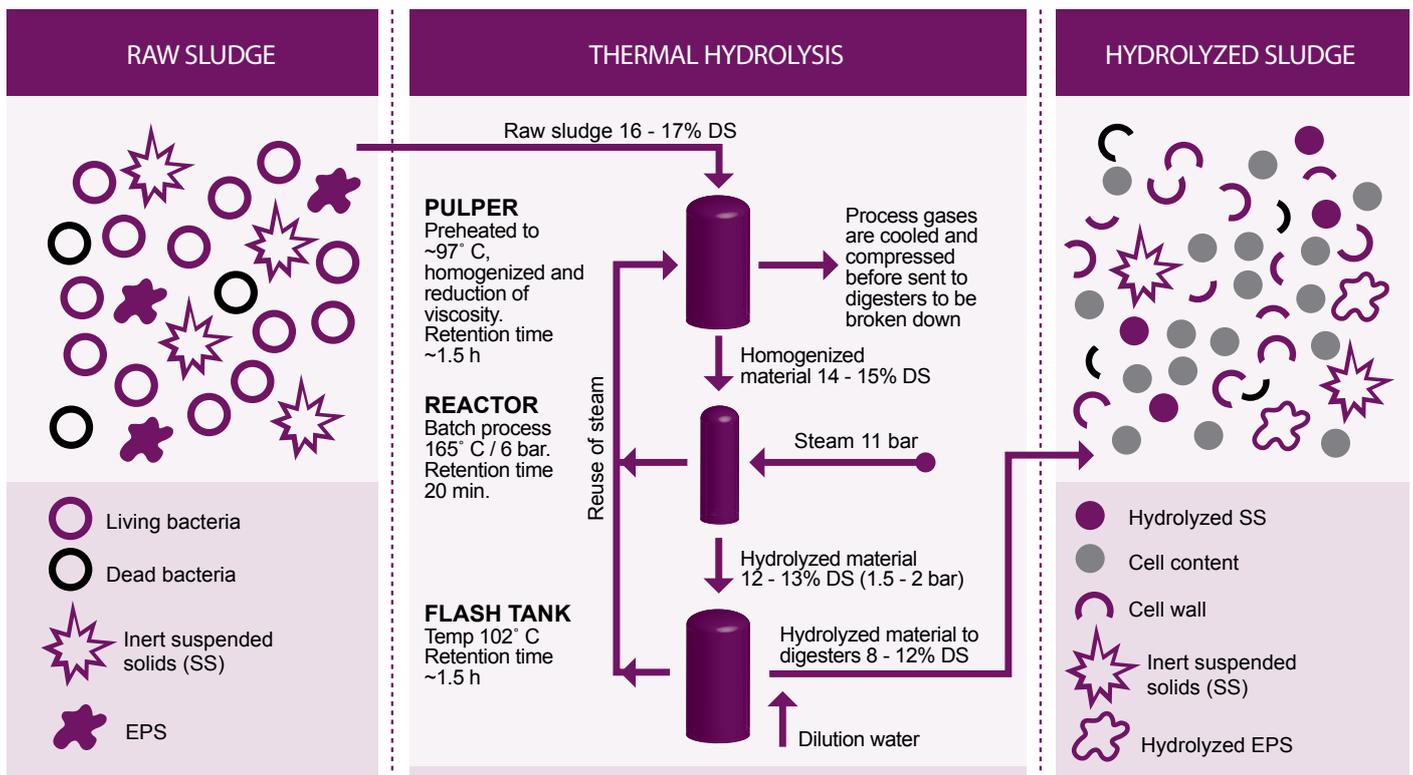
Næstved and Fredericia WWTPs, Denmark



Cambi 4-reactor THP plant, Cotton valley
Milton Keynes, UK



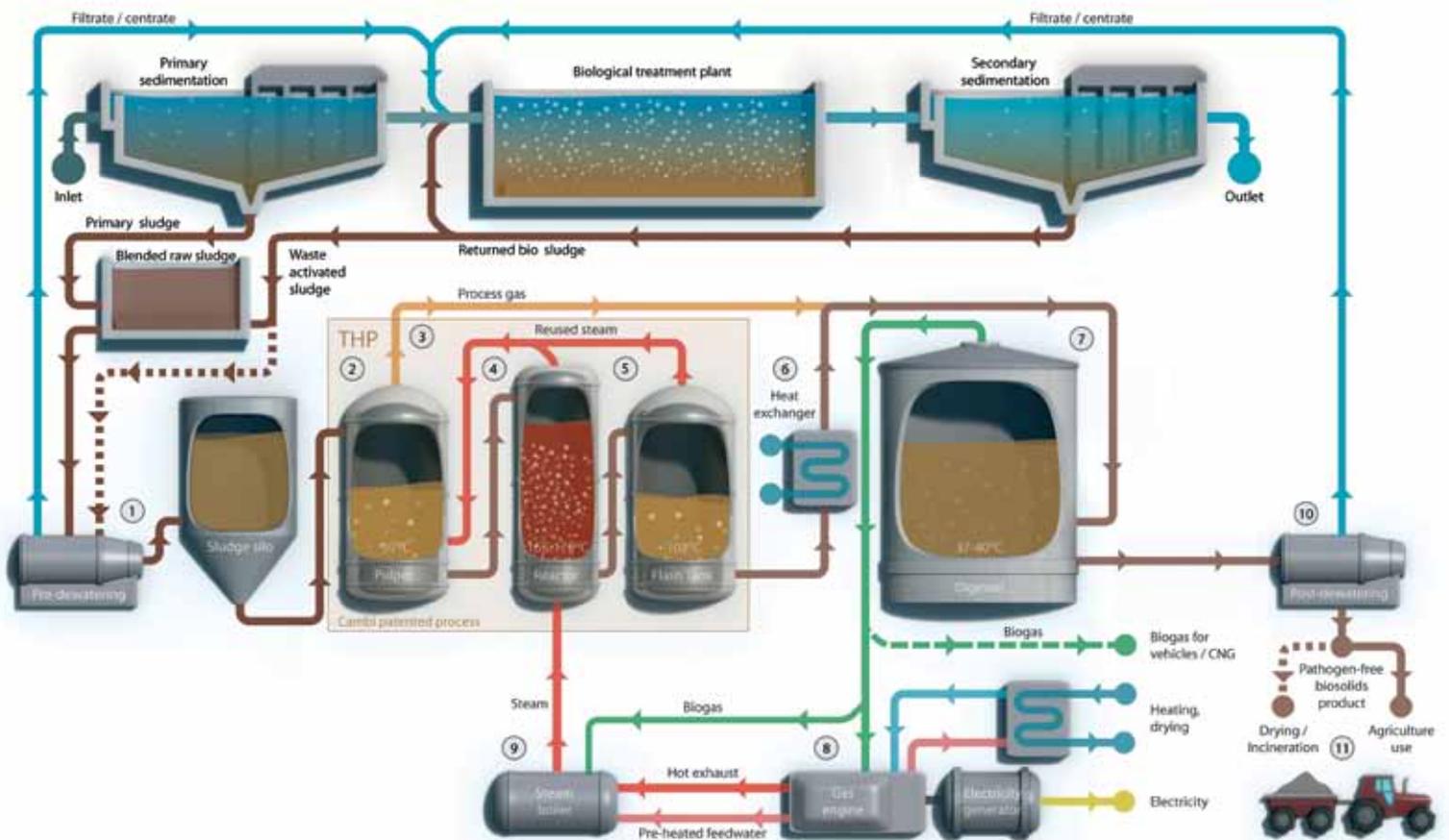
Cambi 2-reactor THP plant, Chertsey, UK



What is Thermal Hydrolysis, and what does it do?

- Disintegrates cell structure/organic materials and dissolves naturally occurring cell polymers (exopolymeric substances - EPS), a form of protein, into an easily digestible feed for anaerobic digestion
- The resulting less viscous (more fluid) sludge allows doubling of digester dry solids (DS) loading with stable operations
- Increases sludge and bio-waste biodegradability and therefore yields more biogas
- Better dewatering - up to 40% total dry solids - by releasing water bound in EPS (EPS binds 4 - 5 g water / g EPS). This gives less biosolids after digestion and dewatering
- Produces an efficient and pathogen-free fertilizer: Treating the material at 165° C for 20 minutes meets all known standards and requirements for sterilisation, including the EU Animal By Products Regulation (ABPR, 1774/2002/EC) category II & III materials

The Cambi Thermal Hydrolysis Process (THP)



“ The engine’s waste-heat is used to supply heat for the boiler that drives the THP process, so it’s very energy efficient. ... The farmers know we have a very high treatment standard and are happy to keep taking the sludge cake as it’s a great fertilizer and does not smell.”

HIAS WWTP, Hamar, Norway

Process Flow

1. Sludge is dewatered to 16-17% dry solids (DS) and led to a storage silo.
2. The dewatered sludge is fed into the pulper to be mixed and heated by recycled steam from the reactor(s) and the flash tank.
3. Process gases are compressed and broken down biologically in the digesters (no odour).
4. Thermal hydrolysis takes place in reactor(s) at 165°C for 20-30 minutes. The steam is gradually released and sent back to the pulper (2).
5. The sterilized sludge is then passed rapidly into the flash tank, resulting in cell destruction from the pressure drop. The sludge temperature is decreased to approximately 102° C by flashing steam back to the pulper.
6. The sludge is then cooled to the required digestion temperature partly by adding dilution water and partly in the heat exchangers.
7. The THP process is followed by anaerobic digestion, converting the organic matter (volatile solids) to biogas, mainly consisting of approximately 65% methane (CH₄) and 35% carbon dioxide (CO₂).
8. The biogas can be utilised in a gas engine with generator producing electricity. Alternatively it is cleaned (stripped) of CO₂ and used to substitute natural gas in gas grid/vehicles.
9. Steam for thermal hydrolysis is mainly produced in a cogeneration waste-heat boiler using exhaust gas and cooling water from the gas engine. Alternatively, biogas or other fuel sources can be used.
10. The digested sludge is dewatered into a high-class biosolids product with 30 – 40% dry solids.
11. The resulting cake/biosolids is applied directly on agricultural land or dried and used as fuel or bio-fertilizer.

Why Thermal Hydrolysis?

Enhanced biogas production

- 50-65% of the organic matter (Volatile Solids – VS) in sludge converted to biogas
- High quality biogas, rich in methane, low in H₂S
- Ideal for green electricity, as renewable vehicle fuel, or substitute for natural gas

Improved dewaterability after digestion by 50% - 100%

- Dewatering up to 40% DS (dry solids)
- Less material handling/transport
- Significant mass reduction
- Less water evaporation for sludge drying
- Digested and dewatered Cambi cake stockpiles and composts easily without any additional structural material

Pasteurization and stabilization of final biosolids product/cake

- Thermal treatment at 165°C for 20-30 minutes before digestion eliminates all pathogens
- No regrowth or reactivation of bacteria
- Increased stabilization of cake after digestion due to high organic matter conversion

The digested sludge has no negative odour

- Odour nuisances prevented due to the closed process cycle

Highly energy-efficient and reliable process

- Maximum reuse of steam in thermally insulated vessels
- Maximum dry-solids feed (16-17% DS) to the Thermal Hydrolysis Process
- Thermal energy use is thus comparable or even less than other methods of pasteurization
- Direct steam injection avoids clogging and unexpected shut downs of heat exchangers

Lower retention time and higher dry-solids content in digesters

- Reduced viscosity from thermal hydrolysis (making the sludge more fluid)
- Digesters can be fed with a sludge concentration of 8-12% dry solids (DS), twice that of a conventional digester
- Increased speed of digestion
- Together these factors increase digester capacity 2-3 times, with loading rates up to 6kg/m³/day of organic matter

Robust anaerobic digestion process

- Ideal feed for anaerobic digestion; consistent and free of unwanted micro-organisms
- Elimination of foam-causing filamentous bacteria
- High alkaline buffering capacity
- High active biomass concentration

Compact design makes THP easy to retrofit to existing sludge treatment plants

Existing digester assets can be used to treat sludge or other biowastes from a wider region without further investment

- Existing digester systems can be fed at more than double conventional rates, thus increasing the capacity of existing plants or minimising capital expenditure for new digesters

Cambi™ THP vs. Conventional Anaerobic Digestion

INCREASED DIGESTER YIELD	ENERGY EFFICIENT AND CLOSED PASTEURIZATION	INCREASED BIOGAS PRODUCTION	HIGH CLASS BIOSOLIDS/ FERTILIZER
<p>Conventional</p> 	<p>Conventional</p> 	<p>Conventional</p> 	<p>Conventional</p> 
<p>Cambi THP</p> 	<p>Cambi THP</p> 	<p>Cambi THP</p> 	<p>Cambi THP</p> 
<ul style="list-style-type: none"> - 2-3 times enhanced digester capacity - Per m³ digester volume: <ul style="list-style-type: none"> - 3.5 m³ biogas/day - load up to 6 kg VS/day 	<ul style="list-style-type: none"> - All steam recycled – comparable to heating sludge to 102° C - High dry-solids feed (16-17% DS) 	<ul style="list-style-type: none"> - 30-100% more biogas production than conventional technology 	<ul style="list-style-type: none"> - 50% mass reduction after dewatering - Recycling of resources - Class A / 100% pathogen destruction

“ The Dublin THP digestion plant ... can produce 3.5m³/day of biogas per m³ of digester capacity, which is 350% of the normal situation.”

Dublin, Ireland



“ The installation of CAMBI at Nigg has more than met the requirements of the client. It has low operator requirement but does require a production and maintenance focus not normally applied in the water industry. However, this focus is more than justified in the payback of lower than expected volume of cake for export and profitable electricity production.”

Aberdeen, UK

The Cambi THP Digestion plant at Cotton Valley, UK

Advantages of Cambi Thermal Hydrolysis

- Increased sludge bio-degradability and therefore more biogas production
- Significant sludge cake volume reduction
- Higher digestion rate and 8 – 12% dry solids feed to digestion increases digester capacity two to three times
- Stable and reliable digester operation
- Highly energy-efficient process
- Eliminates foaming problems caused by filamentous bacteria (Nocardia, etc.)
- Sludge dewaterability improved up to 40% dry solids
- Pasteurized cake: Guarantee of pathogen kill (class A biosolids) with no regrowth or reactivation of bacteria
- Proven process: Cambi THP has been used in projects around the world since being launched in 1995 to reduce both disposal quantities and the cost of building and operating digesters

“ *The average dry solids content of the sludge increased from an average of 20% in 2004 to 31% in 2006, within the first full year of Cambi THP operations.... Cake production decreased to less than half... No load change occurred in the wastewater treatment plant within the same period”.*

Kapusciska WWTP, Bydgoszcz, Poland



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