# Aberdeen STC

## large thermal hydrolysis plant for Nigg STC

**As part of the North of Scotland Water Authority's significant Public/Private Partnership investment in a major wastewater project for the north east coast of Scotland – a scheme which is broadly aimed at improving coastal/estuarine discharges – a major sludge treatment centre has been constructed at Nigg, near Aberdeen with a design capacity of 44tds/day, a population equivalent of 562,000, featuring a large state-of-the art thermal hydrolysis plant.**


Shows (from left) pulper 1, two of the reactors & pulper 2 *(courtesy Simon Hartley-Cambi)*

The Aberdeen PFI scheme, a major long term design, build, operate project was awarded to Aberdeen Environmental Services (AES) by NoSWA (now Scottish Water) in May 2000

Principal project parties were:

* **Client:**
  North of Scotland Water Authority (NoSWA);
* **Concessionaire:**
  Aberdeen Environmental Services (AES)
  A special purpose company owned by the Kelda Group (45%)
  *Balfour Beatty Group (45%) and Earth Tech Engineering Ltd (10%).*
* **Constructor:**
  *Balfour Beatty Construction & Earth Tech Engineering Joint Venture.*
* **Operator:** Grampian Wastewater Services (GWS)
  a subsidiary of the Kelda Group.

Main contractual vehicle is the Concession Agreement between NoSWA (Client) and AES (Concessionaire) which provides the framework for a thirty year concession period.

The Aberdeen Wastewater Project consists of five principal sites:

* Aberdeen, Nigg
* Aberdeen, Persley
* Fraserburgh
* Peterhead
* Stonehaven

All sludges produced at these sites must meet prescribed levels of pathogen kill for known disease causing organisms.

Consequently, a **Sludge Treatment Centre** was constructed at Aberdeen Nigg STW to receive and treat sludges from the sites at Persley, Peterhead, Fraserburgh and Nigg STW itself. A further 3,500 tonnes (dry solids) from other sites will be imported in cake and liquid form for treatment at the plant which has a designed capacity for treating up to 44 tds/day – a population equivalent of 562,000).

When the PFI was still at pre-qualification stage NoSWA had expressed a preference for either incineration or thermal drying. In 1999 Simon-Hartley Cambi (SHC) approached Earth Tech Engineering Ltd, and Yorkshire Water who are partners in AES, suggesting the CAMBItm Thermal Hydrolysis alternative.

The advantages claimed, compared to the conventional approach of digestion and drying were:

* smaller digestion project;
* energy surplus with at least 1MW CHP capacity;
* single shift automatic operations;
* low volume cake (30% DS)
* high VS destruction (54%)
* guaranteed pasteurised cake suitable for spreading on grass land as well as arable land.

Following visits by NoSW staff to existing CAMBItm plants a contract was awarded and *Simon-Hartley* supplied a package comprising:

* 5 belt presses for pre and post digestion dewatering; a 4 reactor thermal hydrolysis plant, twin thermal oxidisers, all pumps ancillaries and controls to allow automatic operations.

*Earth Tech Engineering Ltd* designed a digestion system with two 4000m³ digesters with a mixing system supplied by *Monsal Ltd.* The digesters are designed to operate on 18 days HRT and 10% hydrolised sludge feed. A 1.0MW *Jenbacher generator* was installed with integral waste heat boiler for providing steam to the Cambi system.

**CAMBItm**

Sludge is received as liquid and cake from other STWs. Indigenous and imported liquid is dewatered and pumped to a storage silo along with the imported cake. The cake is pumped from the silo into two low pressure pre-heat tanks where the temperature and pressure of the sludge cake is raised by using return steam from the pressure reactors and flash tank.

At this stage the sludge is about 14% DS and at boiling point. The pre-heated sludge is then pressure cooked in one of four batch pressure reactors which operate in sequence. The sludge temperature is raised to 165°C by injecting 11 bar steam. After holding this temperature for about 30 minutes the pressure is dropped by returning steam to a preheat tank No.2 and the sludge is passed to the flash tank. This is a sudden pressure drop which will cause further cell disruption. Steam from the flash tank is returned to the preheat tank No.1 and any excess steam is removed for condensation and odour treatment by thermal oxidation.

Downstream of the flash tank a sludge cooler controls the digester temperature in the mesophillic range and pre-heats the boiler water. The hydrolised sludge which is fed to the digester is now between 10-12% DS and is a thin liquid as the viscosity has been reduced in the hydrolysis process. The digested sludges is very dewaterable and is dewatered using Ashbrook belt presses to 33% DS.

Compared to conventional processes for activated sludge, there is up to a 100% increase in the amount of biogas produced. As much as 55-60% of the organic material is converted to biogas. This increase in energy production is significantly larger than the energy consumption needed in the hydrolysis process. Surplus biogas can be burned in a CHP installation in order to produce electricity.

**Integrated**

The CAMBItm Thermal Hydrolysis plant can easily be integrated into existing and new sludge treatment plant. The plant is designed as a modular system according to the customers' requirements. This means that the plant can be adapted to different needs and it is also possible to change the process at a later time. Each plant is optimised to achieve the lowest possible costs.

The Cambi process was invented in Norway in the early 90s and was first implemented in 1995 in Hamar, Norway. Since that time eight plants have been built, three in the UK and Ireland. The two largest are Aberdeen and Dublin.

**Comparison of conventional, predicted and actual performance for CAMBItm digestion**

| | Conventional Approach | Cambi Prediction | Actual (based on February 2002). |
|---|---|---|---|
| Dry tonnes per day | 44 | 44 | 36 |
| VS Loading (kg VSm³/day) | 2.2 | 3.8 | 3.3 |
| Digester Volume | 16,000 m³ | 8,000 m³ | 8,000 m³ |
| VS% destruction | 45% | 54% | 58% |
| DS% feed | 5% | 10% | 8.2% |
| DS% of digested sludge cake | 25% | 30% | 33% |
| Tonnes cake per day | 120 | 90 | 60 |
| Faecal coliforms per 100 ml | Typically 1,000,000 | >1,000 | 15-150 |

Final product in piles and front lifter *(courtesy Simon Hartley-Cambi)*

Dublin is undergoing commissioning during spring and summer 2002. Aberdeen was commissioned in September 2001. Since then the plant has operated automatically and reliably with no major problems and has met or exceeded all the claims made by Simon Hartley Cambi and has set a new standard for the digestion process and the quality of product that can be made.

The cake product from Nigg STC is being spread on both grassland and arable crops in the Aberdeen area.

All sites in the Aberdeen Wastewater Project were in full operation by September 2001 with the exception of the Stonehaven pipeline which will commence construction in January 2004 and complete commissioning in `December 2004. ■

(For a fuller description of the Aberdeen Wastewater Project please refer to UK Water Projects 2001 page 203).

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