

GPP In practice

Issue no. 43
July 2014

Waterschapsbedrijf Limburg, the Netherlands

Background

The Waterschapsbedrijf Limburg (WBL) is the public utility company responsible for the transport and treatment of municipal and industrial wastewater and treatment of sludge in the province of Limburg, Netherlands. The company operates 18 sewage treatment plants altogether. The targets of WBL are to meet both the effluent demands of the waste water treatment plant (WWTP) and their energy saving goals, at the lowest cost possible.

In this example, a new type of thermal hydrolysis process was installed at the WWTP in Venlo, which increased biogas production, reduced sludge generation and speeded up the process – leading to both energy savings and cost reductions.



Procurement objectives

The WWTP in Venlo had been established many years previously, but in January 2011, WBL released an invitation to tender for the design, construction, operation and maintenance of a new sludge hydrolysis plant on the site.

WBL opted for a two-stage tender procedure using pre-qualification to ensure capacity and capability, followed by a competitive dialogue procedure based on functional specifications to allow for innovative proposals that would lead to the optimum hydrolysis technology for the WWTP.

After the pre-selection phase, two rounds of dialogue took place with those who were eligible to bid for the tender at which all candidates were present. Any questions which were raised at these meetings were subsequently submitted in writing and were answered in written format, with all bidders receiving the same information to ensure fairness and transparency.

The contract included design, construction, maintenance and operation - so bidders were encouraged to offer the lowest total cost of ownership.

Functional specifications were used to ensure that bidders had more freedom to come up with innovative solutions in the design phase.

Following the pre-selection phase, a competitive dialogue procedure was used in order to draw out the most efficient solution.

Subject matter of the contract: Design, construction, operation and maintenance a full scale hydrolysis-digestion plant for a period of 6 years at the WWTP in Venlo (with the option to extend to 10 years).

Technical specifications:

Applicants were required to submit a detailed technical proposal based on the functional specifications issued by WBL, the scope of which included; thickening, hydrolysis, digestion, biogas utilisation and dewatering, in addition to operating and maintaining the plant for a period of 6 years. The total investment allowed was 5,500,000 euro.

Award criteria:

The contract was awarded on the basis of total costs i.e. the financial gains/benefits from energy generation and reduced sludge, minus the associated capital costs and operating costs. A more detailed idea of how and why the following cost factors are assessed, as an annual cash flow over the time period of the contract, is given below:

Cost aspect included	Reason for inclusion in award criteria	Cost calculation/ units
% Dry Solids (DS) degradation (assuming an organic matter content of 70.7%)	A higher % of DS degradation means more biogas (and therefore energy) is produced and less sludge remains at the end of the process (reducing disposal costs).	sludge disposal (€) = tonnes dewatered sludge x sludge disposal cost (€/tonne).
% Dry matter content of dewatered sludge (minimum 28.5%)	A higher % dry matter content after the process of sludge dewatering (using thermal hydrolysis and fermentation) means less dewatered sludge to dispose of and less associated costs.	sludge disposal (€) = tonnes dewatered sludge x sludge disposal cost (€/tonne).
Energy yield (from biogas production, converted to heat and electricity through a combined heat and power (CHP) system	The thermal hydrolysis sludge digestion plant both generates and consumes energy. The surplus of generated electricity is used directly on the WWTP for operating aeration compressors, pumps, mixers, etc. Each net produced kWh of electricity leads to a lower net energy purchase by WBL.	The bidder provides a figure for energy generation of kWh/year. WBL's energy purchase rate is used (± € 0,10/kWh) in order to monetise this criterion.
Energy consumption (of electricity and natural gas)	This is split into electricity (used for electric motors) and gas (for steam boiler for heating of the sludge in the plant). Normally however biogas from the digestion plant is used instead of natural gas.	The bidder provides a figure for natural gas consumption in Nm3 and electricity consumption in kWh/year.
Water consumption (Figures for different qualities of water used on the plant must be provided, including effluent and drinking water)	Effluent is mainly used for cleaning activities and can be used for polymer preparation. This comes free of charge for WBL as it produces effluent from the sewage treatment plant. Drinking water is used mainly for steam preparation (after softening) and can be used for cleaning and polymer preparation too.	Bidders provide figures for m3 of effluent and drinking (quality) water consumption per tonne of dry solid. The latter is then monetised by multiplying it by a standard rate for tap water (€/m³).

In addition to the above factors, a number of other costs were added to the total cost used in the award criteria phase to score bidders. These included the cost of: polymers used per year to neutralise electric charges in watery sludge, chemicals used per year in order to operate the thermal hydrolysis plant (THP), the necessary measurements and analysis performed during operation and any other operation and maintenance costs not so far included in the above categories, including labour and spare parts. Bidders were also required to provide energy consumption and water consumption figures for existing parts of the waste water treatment plant because the existing consumption levels could be affected by the introduction of a new process component (hydrolysed and digested sludge has different viscosity/ dewatering properties than raw untreated sludge).

This results in a positive cash flow each year, which is discounted by dividing it by a discount factor per year.

All the discounted cash flows are totalised into one total cash flow value, which then is subtracted by the investment (the cost of the design, construction, materials etc.). This eventually results in a 'net present value'.

The higher the reduction of sludge disposal costs or the higher the amount of generated electricity, the higher the net present value will be. Alternatively: the lower the investment, the lower the annual costs for energy, the lower the labour or spare parts, the higher the net present value will be. The supplier with the highest net present value has the best business case (although there were restrictions including a maximum amount allowed for investment).

Results:

The tender was published in January 2011. After the pre-selection phase 2 bids were received, with the contract awarded in May the same year. Installation work began in late 2011, and the hydrolysis plant entered operation in autumn 2012.

The winning bidder developed a technology which significantly improves the efficiency of sludge treatment, and is affordable in smaller WWTPs (7,000 tonnes per year in this case). It increases the amount of biogas production, reduces the quantity of sludge produced, reduces the anaerobic digestion time and increases the dewatering. As a result the technology is an affordable thermal hydrolysis sludge treatment technology that lowers the costs and the CO₂ emissions of sludge treatment.

The sludge of the WWTP is first mechanically thickened, then heated to a temperature of 140°C and pressurised to 4 bar. This thickened sludge is hydrolysed in the reactor, subsequently cooled and anaerobic digested in the "agro digesters". At the end of the process, the sludge is dewatered.

The winning bidder developed the technology in-house and WBL was the launching customer. The winning bidder is responsible for the exploitation of this new technology. It has a period of six years to do so with an option to extend to 10 years. The technology will be developed further in this period.

Lessons learned

The project at WBL is the first of its kind. It took more time to solve the technical problems that arose in the scaling up from pilot to full scale installation than was expected. This has meant that the financial gains were not realised until 1.5 years after the start of the contract.

There is a good working relationship between WBL and the winning bidder, who have to date proven very effective at solving specific technical problems. WBL feels that such a positive working relationship is essential for such a development.

Additionally the contract stimulates further improvements. The contract is monitored by measuring the gains (the amount of electricity produced and sludge reduced) and the cost of the operation. Better financial results than those presented in the tender (in net present value) are rewarded with additional bonus payments.

A second full scale WWTP will be built using the same technology in Apeldoorn, the Netherlands by the Waterschap Veluwe. This plant will begin operating later in 2014.

For more information, please see technical background criteria and EU GPP criteria for Waste Water Infrastructure.

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Environmental impacts

The installed technology resulted in a series of positive environmental impacts:

- Production of sustainable energy: The combination of hydrolysis and digestion results in an enhanced degradation of sludge in comparison with conventional digestion. The biogas production is increased by 15-50% compared to conventional digestion. The produced biogas is used for the generation of heat and electricity for use on site. The generated electricity amounts to 4 million kWh/year, equal to 40% of the electricity demand of the WWTP in Venlo. This equates to a saving of 2,700 tonnes CO₂ per year.
- Reduction of sludge disposal: The amount of sludge is reduced by 50%. As well as the additional sludge degradation, the sludge can be dewatered so that it has a higher dry solids content. The reduction of the amount of sludge and the higher dewatering means that the amount of transportation required is halved (in comparison to a traditional process).
- Recovery of nutrients: The high degradation causes increased concentrations of nitrogen and phosphorus in the sludge. This makes the nutrients in the sludge suitable for recovery. At the moment, further research is being carried out by the winning bidder in order to make it possible to recover the sludge.