

An open-and-shut case

From organic waste to CO₂-neutral energy

Lemvig Biogas a.m.b.a. is the largest biogas plant in Denmark, generating both heat and electricity with unparalleled efficiency. The inputs consist of raw manure slurries (9–12% dry solids) from approx. 75 local farms, along with other organic waste and residual products (up to 30% dry solids) from industrial activities of many different kinds – including slaughterhouses, pharmaceutical set-ups and breweries.



The plant's annual production is about 8.5 million cubic metres of biogas, along with about 5.6 million cubic metres of methane. This biogas is used to generate more than 21 million kWh of electricity annually.

Recovered heat means more revenue

The Lemvig Biogas production process is based on thermophilic fermentation, using bacteria that have to be kept as close as possible to 52.5°C. Achieving this with constantly circulating biomass in the four digester/fermenter tanks (total volume 14,300 cubic metres) requires about 9,000 MWh of energy – corresponding to about 16% of the facility's total output.

According to Managing Director Lars Kristensen, of Lemvig Biogas, "if we had to use the heat we produce to maintain the required operating temperature, we'd have much less to sell!" Generating this heat would involve big installations involving undesirable financial and operational uncertainties, and would have a big impact on revenue.

Big benefits from pre-heating

Instead, Lemvig Biogas installed 4 Alfa Laval spiral heat exchangers to draw heat from the digested manure flows that cool from 52°C to 29°C in order to pre-heat the incoming undigested organic waste from 15°C to 44°C. The hot media is therefore the digested sludge, with about 3.5% dry solids.

This input corresponds to approx. 6,000 MWh of heat, which means only about 7.5% of the biogas is used for heating – with big improvements in overall revenue.

Rolling replacement

Heat transfer at Lemvig Biogas has been based on Alfa Laval spiral heat exchangers since 1992. Two units were replaced in 2003 and 2005, having withstood about 11 years of 24/7 running, and manual cleaning with inhibited hydrochloric acid.

In 2010, two units are being replaced by larger Alfa Laval systems, to provide a 45% increase in capacity.

Blockages and struvite deposits

The Lemvig Biogas facility operates efficiently round the clock. The major practical challenge stems from inappropriate detritus – such as sand and plastic remnants – in the flows of organic waste. This can rapidly result in blockages.

The other main problem is the constant build-up of magnesium ammonium phosphate. Also known as struvite, this mineral is a natural product of organic decay in putrescent matter, and of bacterial action on organic compounds. Struvite accumulates rapidly as highly resilient deposits in pipes, valves and heat exchangers.

Constant cleaning

Most processes at Lemvig Biogas are highly automated – except cleaning and inspection. According to Maintenance Manager Dan Grummesgaard, this is because deposits inside the system

build up by about 1 mm every 24 hours, making effective, reliable cleaning at regular intervals a must.

Struvite is readily soluble in acid, so the Alfa Laval spiral heat exchangers are normally cleaned 2–3 times a week using inhibited hydrochloric acid. Each cleaning session takes 2 hours, but is essential for maintaining heat transfer efficiency.

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Lars Kristensen, Managing Director of Lemvig Biogas

Degassed slurry is being tanked at Lemvig Biogas in northern Denmark.



The customer

Lemvig Biogas a.m.b.a. is the largest biogas plant in Denmark. The company is a front-runner in its field, processing farm slurry and other organic waste from about 75 local farms that are part-owners of the plant.

The challenge

The thermophilic fermentation requires that the bacteria are kept as close as possible to 52.5°C at all times. This requires substantial amounts of reliable thermal energy. But to ensure profitability, the price of this energy must be predictable and relatively consistent – regardless of market conditions and geo-political disruptions.

The equipment

Alfa Laval has supplied Lemvig Biogas with

- STS, sludge to sludge, for heat recovery by using sludge on both sides.

In 2010, two units are being replaced by larger Alfa Laval Spiral Heat Exchangers, to provide a 45% increase in capacity.

The benefits

- Turbulent self-cleaning flow pattern prevents fouling and struvite deposits.
- Single-channel, wide-gap design prevents blockages and unplanned downtime.
- Reliable, round-the-clock operation does away with unpleasant surprises.
- Safe and reliable due to welded, gasket-free design.
- Very little maintenance required, saving on manpower and costs.

The inspection advantage

Dan Grummesgaard points out that the Lemvig Biogas staff consider it vital to have a hands-on overview of the internal state of the facility's heat exchangers – these units are absolutely crucial for operating efficiency. Rather than automated CIP procedures and closed systems that they can't see inside, the staff therefore prefer using their expert eyes to monitor the state of key surfaces.

The Alfa Laval spiral heat exchangers provide big advantages because they are easy to open for visual inspection – the hinged covers give full access to both sides of the heat transfer surfaces. This makes it quick, easy and inexpensive to remove any deposits and other blockages whenever necessary. The units are normally opened approximately 6 times a year, and the whole inspection process takes about 4 hours.

Strongest link in the chain

According to Dan Grummesgaard, there are hardly ever problems associated with the Alfa Laval heat exchangers. The struvite build-ups usually occur in the ancillary equipment.

In his opinion, the heat exchanger channels still look as good as new after 7 years of hard use and extremely frequent acid cleaning. "You simply can't see they've been cleaned so often with an acid solution," he points out.

Survival of the fittest

According to Lars Kristensen, "we run our equipment hard. Nevertheless, these Alfa Laval heat exchangers run 100% as intended – which is great for us. They've ensured us maximum efficiency, and we're satisfied enough to order more – even larger – units to help us increase the production capacity at Lemvig Biogas."



4 of 5 Alfa Laval spiral heat exchangers installed in the pre-heating section.

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Dan Grummesgaard, Maintenance Manager at Lemvig Biogas



Contact Alfa Laval

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