

Frank S. Lund of Aalborg Energie Teknik a/s sheds a light on biomass boiler retrofitting and fuel conversion at plants in Denmark and Germany

Retrofitting and biomass fuel conversion

The green trend has been present in Europe for many years, driven particularly by the United Nations Framework Convention on Climate Change. We are excited to see that the transition to green energy and more efficient energy production is a priority in many countries.

There are, however, big differences across Europe. Denmark has one of the highest percentages of energy from renewable sources¹. With the rapid increase of carbon dioxide (CO₂) in the atmosphere, Denmark has set a new ambitious goal: a 70% reduction of greenhouse gasses (GHGs) by 2030. The result of reducing emissions is that we can keep the globe as it is and for us as individuals it is important to maintain sea levels, air quality, and air and water temperature.

Frank Scholdann Lund, head of strategy and marketing at Aalborg Energie Teknik a/s (AET), said: “We are happy to live in Denmark as it is among the top countries carrying out green transformations. The transition away from fossil fuels in Denmark has primarily been towards wind and biomass.”

The green trend has also reached many district heating plants and process industries, which are converting into biomass-fired plants. The process industries have the advantage of supplying continuous steam and power 24/7, regardless of whether the wind is blowing, or the sun is shining.

Optimisation of conceptual design within a biomass-fired plant can be done in many ways. The most cost-effective way is to analyse whether an existing fossil-fired boiler installation can

be converted to burning biomass – typically at a cost of 20-50% of a new biomass-fired boiler plant. In this article, I am going to present some examples of where and how fuel conversions have been successfully carried out.

Fuel conversion from coal to clean wood biomass and coal

On the island of Bornholm in Denmark, a heavy fuel oil and coal-fired boiler (up to 106 MWt) and a steam turbine (37 MWe) was built in 1995. The plant, called Østkraft, is owned by the regional municipality of Bornholm and supplies up to 35 MW district heating to the city of Rønne, which has 16,000 citizens.

The base load for power and district heating to the city of Rønne is supplied by burning coal (74 MWt). During normal operations, the power to Bornholm will partly come through a subsea cable from Sweden. If interrupted, the combined heat and power (CHP) plant can switch to burn heavy fuel oil and boost the fuel heat input to 106 MWt.

With the intention of producing green energy and minimising emissions, the boiler was converted to use biomass in 2016. Any mix of biomass, coal and oil can be used in the boiler. The coal and heavy-oil firing systems are maintained as a back-up.

The installation in 2016 included biomass handling, changes to the boiler and the introduction of a flue gas condensation system. AET was responsible for the fuel conversion and among other things, supplying the

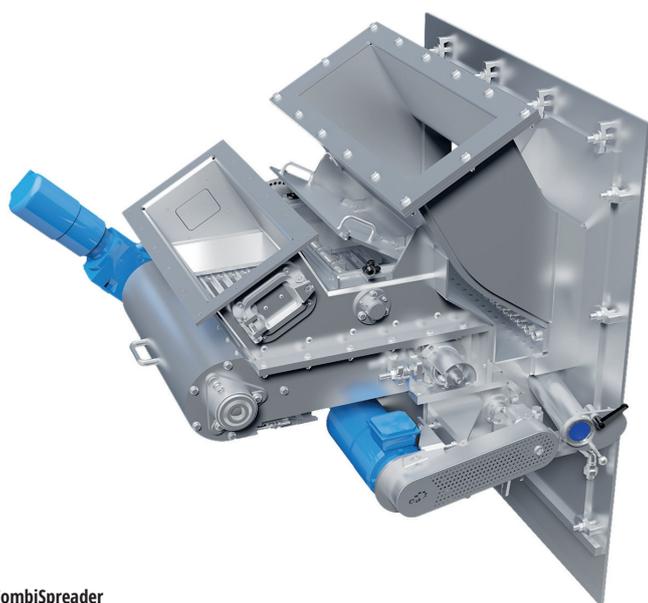
AET Combustion System, including the AET Combi Spreader Stoker to secure a flexible fuel mix between coal and biomass. The AET Combi Spreader Stoker creates a uniform fuel injection into the furnace through an adjustable distribution plate, pulsating air supply and adjusting spreader air pressure. The advantage is a better fuel distribution on the grate (a fully covered grate surface), which ensures a high degree of fuel burnout and lower emissions.

The motivation for converting the Østkraft facility to green energy was primarily to reduce the carbon footprint. AET was the natural choice to undertake Østkraft’s conversion, as the company has the full design of boiler, heating surfaces and the fuel dosing system with the AET Dosing Bin and AET Combi Spreader. All in all, the AET Combustion System was competitive and a perfect match for Østkraft, due to the long-term experience of the AET Combi Spreaders.

Fuel conversion from coal to clean wood biomass, dust and coal

In the city of Randers in Denmark, a district heating plant was built in 1982, consisting of two coal-fired steam boilers (2 x 95 MWt) and one common steam turbine (52 MWe). The advantage of this setup is that part-load operation of the boilers is easier in spring, summer and autumn.

The CHP plant supplies



CombiSpreader

electricity and hot water to Randers, a city of about 60,000 citizens. In the early 2000s, an idea was developed to re-use some of the industrial waste in the surrounding areas, such as meat and bone meal, olive stones, shea nuts, sunflower pellets and bio pellets. In 2002-2003, AET retrofitted the cogeneration plant with the AET Dust Firing System. The plant was then able to operate in co-firing mode with minimum 50% coal and maximum 50% biomass or 100% coal in single mode – or any combination in between. The AET Dust Firing System was added to the existing boilers for even greater fuel flexibility.

In 2008-2009 a further substantial retrofit was carried out, enabling 100% biomass usage and introducing flue gas condensation. A

new separate wood-firing system was implemented and the option to fire coal was maintained. AET enabled the plant to fire using 100% biomass or 100% coal, or any combination in between, for example 70% biomass and 30% coal.

While the first co-firing project in 2002-2003 did not involve major modifications to the furnace and heating surfaces, the conversion to 100% biomass required an extension of the furnace to keep full load on the boilers. Some of the existing heating surfaces were re-designed and a new economiser tube-bank added. The existing grates were relocated accordingly, and the air system was further extended with additional injection levels. The CHP plant is now able to burn wood chips, as well as dusty fuels, using the AET Dust Firing System.

A transition from coal to biomass can be challenging, as biomass can cause corrosion and potentially build-up slag. CFD modelling was used to replicate the combustion, furnace and heating surfaces to identify temperature profiles and the concentration of potassium chloride. After the modelling, it was decided to change the material for the hanging superheaters (SH2 and SH3) to stainless steel.

The two retrofits have given Verdo Production a large fuel flexibility to utilise what fuel is available on the market at a low price. Verdo's modified boilers in 2008-2009, made by AET, are functioning to Verdo's full satisfaction.

What is the secret?

Since its founding in 1996, the full design of the biomass boiler and combustion

components has taken place in-house at AET. "With more than 100 dedicated people and the well-proven AET Combustion System, we see the retrofit and fuel conversions as a core supply and competence of AET," said service director Nicolai Møller. "We are pleased that Østkraft entrusted us to convert their plant. The fuel conversion utilises our extensive 30 years' experience with different fuels. The fuel conversion at Boehringer Ingelheim (Germany) is also a good example of making use of AET's knowledge about boiler design from different boiler manufactures and combustion systems." ●

References:

1. https://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics

For more information:

Visit: www.aet-biomass.com

Aalborg Energie Teknik a/s



AET is a leading independent engineering and contracting company which design, deliver, service, operate and retrofit biomass fired plants in the size from 25 -to 170 MWth. Our plants are characterised by exceptionally high boiler and plant efficiency, high availability, high fuel flexibility and low emissions.



Biomass Fired Boiler Plants



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Plant Improvements, Retrofit, Fuel Conversion

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