

Straw-fired district heating plants: **Clean the smoke and economise on the straw**

A new type of scrubber facility can clean the smoke from straw-fired district heating plants efficiently and increase the efficiency of the boiler by approx. 10 percent. In Øster Toreby on Lolland, Denmark, this has resulted in savings of approx. DKK 320,000 a year for purchasing of fuel.

By Jens Dall Bentzen

Today, approximately 60 district heating plants in Denmark are using straw as primary fuel. The efficiency of these facilities is usually 85 – 90 percent, which is approximately 10 percent lower than the efficiency of wood chips-fired plants, where the energy content of the exhaust gas is utilised more efficiently.

Biomass has a water content that varies between 10 – 20 percent for straw and 40 – 50 percent for wood chips. When the biomass is burned in district heating boilers, the water content is transformed into steam, and if the energy of the steam is not utilised, significant amounts of energy go out through the chimney. Therefore, many facilities have been equipped with systems for exhaust gas condensation, where the smoke is cooled down below the dewpoint. This makes the steam start to condense, and the heat is released into the condensation water, which means that it can be used in the district heating system afterwards.

Today, practically all wood chips-fired district heating plants are equipped with exhaust gas condensation, as it is a relatively simple technology that results in significant improvement of the operating economy. In theory, it is also possible to install exhaust gas condensation in the straw-fired plants, but in practice, it has turned out to give rise to a lot of problems. When it has been attempted, there have usually been problems with corrosion, and the facilities have not been able to comply with current environmental requirements.



The district heating plant in Øster Toreby, where they have installed a condensation system for the largest of the two straw-burning boilers.

Hals Fjernvarme

One of the most successful projects with exhaust gas condensation in a straw-fired district heating plant is a facility at Hals Fjernvarme, east of Aalborg, Denmark. Here, the exhaust gases are first led through a multi-cyclone, which sorts out the coarsest impurities, after which the smoke is led into a so-called scrubber tower. Basically, it works like a large shower booth that cleans the smoke while the energy from the exhaust gas is transferred to the wash water and then on to the district heating water.

However, the system from Hals Fjernvarme cannot be transferred directly to the other straw-fired district heating plants in the country. The problem is that the particle content is higher than allowed according to the regulations of the Danish Environmental Protection Agency, and therefore, the district heating plant has had to be exempted from the regulations to be able to use the facility. This has been granted with reference to the fact that a large part of the particles consist of harmless salts, but it is uncertain whether other plants would be granted the same exemption.

EDDP is to replace ERP

New research programme focused on demonstration projects is to replace the old Energy Research Programme.

The world is full of abbreviations, and in that area, energy research is certainly no exemption. As follow-up on the government's new energy plan, ERP is to be replaced by EDDP, or more accurately: The Energy Research Programme, ERP, (EFP = Energiforskningsprogrammet) is to be replaced by a new Energy-technological Development and Demonstration Programme, EDDP (EUDP = Energiteknologisk Udviklings- og Demonstrationsprogram).

The most important task for the new programme will be to reduce the gap between research and demonstration. The objective is to make it easier to transform promising research results into commercial use. This means that the new

programme will have some similarities with the old UVE programme that was discontinued in 2002.

In February, a legislative proposal about the new EDDP programme was submitted for hearing, and the proposal is currently included in the negotiations on energy policy that are taking place between the Minister of Transport and Energy and the spokesmen for energy policy of the Danish Parliament.

The legislative proposal proposes giving the EDDP a central role with its own independent board. The Minister is to appoint the seven members of the board on the basis of their individual qualifications. The chairman is to have a business-oriented background. The board is to be supported by an independent secretariat placed in the Danish Energy Authority.

According to the administrative head of department Hans Jürgen Stehr from the

Danish Energy Authority, the EDDP is mainly supposed to give grants for establishment of pilot plants and implementation of demonstration projects, but the programme can also support actual research activities.

A secretariat will be established for the programme that, among other things, will be given the task of inspiring public and private companies to cooperate and establish concrete project consortiums. The secretariat is also supposed to help develop strategies for the research work and point out areas where a special Danish effort can make new and environmentally friendly technologies more cost-effective.

In connection with the establishment of the new EDDP programme, the Consulting Energy Research Committee (REFU = Rådgivende Energiforskningsudvalg) will be discontinued before the end of 2007.

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Øster Toreby

At the district heating plant in Øster Toreby Varmeværk on Lolland, Denmark, a new system for exhaust gas cleaning was to be installed in 2004, but instead of buying two new bag filters for the two straw-burning boilers, a decision was made to install a condensation system for the largest of the two straw-burning boilers.

The system is based on the experiences from the district heating plant in Hals with a scrubber tower, but in two significant areas, it is a completely new concept: Before the scrubber, there is a bag filter that removes salts from the exhaust gas, and a system has also been installed that neutralises the water in the scrubber. Thus, it is not necessary to clean the scrubber water and the content of hydrochloric and sulphuric acid in the exhaust gas is removed.

In the fall of 2006, a measuring programme was carried out on the facility, which documented that it is living up to the expectations. The smoke is efficiently cleaned for particles, hydrochloric and sulphuric acid, and the condensate from the scrubber is clean and neutralised.

Last but not least, the efficiency of the straw-burning boiler has been increased by approx. ten percent, and thus, the plant can expect to save a bit more than DKK 320,000 on fuel a year.



photo: jens dall bentzen/cowi

The plant manager at the district heating plant in Øster Toreby with a sample of the water from the scrubber tower.

Perspectives

Experience from the district heating plant in Øster Toreby has shown that it is possible to install systems for exhaust gas condensation on straw-burning district heating systems that can ensure efficient cleaning of the smoke and increase the efficiency by about ten percent at the same time.

However, a precondition for installing this type of system is that the return temperature of the district heating water is low. In Øster Toreby, the temperature is all the way down to 38 °C, and therefore, it has been possible to cool down the exhaust gas to about 43 °C. If the temperature of the return water is between 40 °C

and 50 °C, it is usually necessary to install a system for humidifying the combustion air to be able to install a system like the one in Øster Toreby.

Apart from the savings on fuel, the facility may be able to prevent expenses for sulphur charges amounting to 150,000 a year. However, it is still not certain whether this would be possible in practice, as the authorities require installation of equipment that can continuously measure the sulphur content of the smoke, which could turn out to be a significant expense for the district heating plant.

The project regarding exhaust gas condensation in Øster Toreby receives support from the Danish District Heating Association and the Energy Research Programme, which is administered by the Danish Energy Authority.

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