STRAW TO ENERGY

Status, Technologies and Innovation

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Straw as a Source of Energy

Only a few decades ago, straw was considered to be a problem waste product, which should be disposed of as quickly as possible. The part of the straw that could not be used for feed and bedding was typically burnt on the fields after harvest. However, in 1991, field burning became illegal, and since then there has been a greater focus on using straw for energy purposes.

The biggest advantage of using straw in the energy sector is that it is a CO_2 neutral fuel, which does not contribute to an increase of the atmosphere's content of greenhouse gasses. Today, straw is primarily used as fuel at individual farm plants, at district heating plants and in large power plants, but in the future, straw will probably also be used for production of gas and bioethanol. DONG Energy has spent a considerable amount of money on developing new technologies for energy production from straw, and has established a pilot plant for production of bioethanol, and is currently working on a plant for thermal gasification of straw. The advantage of converting straw to gas is that it provides better opportunities for utilising the fuel at existing coal boiler plants.

STRAW AS FUEL

Straw normally contains 14-20% water, which vaporises during combustion. The dry matter contains of about 50% Carbon, 6% Hydrogen, 42% Oxygen as well as small amounts of Nitrogen, Sulphur, Silicium, Alkali, Chloride and other.

When straw is used as fuel, the water content must not exceed 20%. If the water content is higher, there is a risk that the bales of straw become too hard and compact. Similarly, a high water content increases the risk of formation of condensation and corrosion.

The presence of Chlorine and Alkali in the flue gas can be a problem at combustion, leading to the development of Sodium Chloride and Potassium Chloride, which are highly aggressive and cause corrosion in boilers and pipes – particularly at high temperatures. The aim is to use straw with a low content of harmful matter, and here the weather plays a significant role. Straw, which has been exposed to a lot of rain after maturing - especially after harvest, and has turned grey, is far less aggressive than yellow straw, which only has been exposed to a limited amount of rain.

The ash content can vary between 2-10%, although the average is 4%. Straw from crops that have been cultivated on sandy soil normally has the lowest content of ash, while straw from lowland soils usually has the highest ash content. The heating value is highest with the lowest ash content, so it can be an advantage to use straw from sandy soil for heating purposes.

The ash from straw burning can become viscid already at 600 degrees, and this is important for the power plants, where a high steam temperature is envisaged in order to obtain high electricity efficiency. New boiler types and better steel alloys have reduced the problem over time, but power plants still consider straw as a more troublesome fuel than wood.

RESOURCES

Over the years, a number of analyses have been completed concerning the available straw resources in Denmark as well as abroad. Even though there can be great differences in the individual studies, the general consensus is that resources are far greater than current consumption.

However, handling and transport of straw can be very expensive, so even though resources are plentiful, there may not be an economical benefit from utilising the straw. While energy wood today has become an international commodity, straw is still primarily traded locally. In principle nothing prevents straw pellets from being sold across borders; it just has not happened yet.

Parametres of importance for the fuel value of straw, wood chips and coal. Yellow straw is collected immediately after it has been harvested, while grey straw has been subjected to rain before collection.

	Yellow straw	Grey straw	Wood chips	Coal
Water content	10-20%	10-20%	40-50%	12%
Ash	4%	3%	1%	12%
Carbon	42%	43%	50%	59%
Hydrogen	5%	5%	6%	4%
Oxygen	37%	38%	38%	7%
Chloride	0.75%	0.20%	0.02%	0.08%
Nitrogen	0.35%	0.41%	0.30%	1.00%
Sulphur	0.16%	0.13%	0.05%	0.80%
Heating value	14.4 MJ/kg	15.0 MJ/kg	10.4 MJ/kg	25.0 MJ/kg