Miscanthus and its issues with combustion and corrosive nature

Calorific value of wood and miscanthus per kg, is almost identical, but due to the density twice the storage and logistics costs.

Ash content 6-7 times higher than in wood with bark

Ash melting point below 1000 ° C and therefore problems with clinker development.

Nitrogen (N) is almost completely converted to NOx; as it is not bound in the ash.

Fraction of potassium (K) reduces the ash melting point and promotes the release of very fine dust particles (<0.1 microns).

The sulphur (S) is converted to SO 2, causing corrosion.

Chlorine (Cl) is involved in the formation of hydrogen chloride (HCl), dioxins and furans. This results in interaction with other substances creating highly corrosive conditions.

	Density kg/m³	Calorific Value MJ/kg	Ash Content [%]	Ash Melting Temperture [℃]	N [%]	K [%]	S [%]	Cl [%]
Spruce with bark	**220-250**	**18,8**	**0,5-1**	**~1400**	**0,13**	**0,13**	**0,015**	**0,005**
Poplar	**200-225**	**18,5**	**1,8**	**~ 1335**	**0,42**	**0,35**	**0,031**	**0,004**
Miscanthus	**80-120**	**17,6**	**3,9**	**~ 950**	**0,73**	**0,7**	**0,15**	**0,22**
Straw	**70-110**	**17,2**	**5,7**	**~ 800**	**0,48**	**1,0**	**0,082**	**0,19**
Rape seed cake	**---**	**21,2**	**6,2**	**k.A.**	**4,97**	**1,60**	**0,55**	**0,019**

The chemical and physical properties and their effect on combustion

In combustion nitrogen oxides (NOx) are formed and carbon (CO).

Carbon dioxide (CO2), sulphur dioxide (SO2) and chlorine (Cl 2).

The two substances sulphur dioxide (SO2) and chlorine (Cl 2) when in the gaseous state are not a problem at high flue gas temperatures, as condensation does not form.

These two substances, if not in the gaseous state but on the liquid state - in other words in the condensation, is where the problem arrives. The dew point of sulphur is around 80 ° C. When linked with water which is formed by the condensation, the result is of sulphuric acid (H2SO4).

Sulphuric acid is acidic and works aggressively to steel and partially on stainless steel.

The condensation point for chlorine is about 55 ° C. In the gaseous state it is referred to as chloride (CI2), which at condensation point is combined with Hydrogen. From this combination creates hydrochloric acid (HCl). Hydrochloric acid is more aggressive than sulphuric acid, and can corrode high quality stainless steel.

It is therefore the life of the entire heating and chimney system which is of importance.

If miscanthus is burnt the following procedures are very important

Condensation is prevented at all times both in the boiler and chimney.

Under no circumstances must rain water enter the chimney system as it will mix with the dust and create corrosive conditions.

The boiler is very well maintained. IE flue ways and chimney cleaned very regularly.

The life of the HDG boiler and the connecting flue will be greatly reduced when burning miscanthus and other non wood products

So can an HDG boiler burn Miscanthus

YES, taking into account the higher maintenance and service costs and the increased wear and tear it is technically possible.

However HDG have decided that the potential of poorly maintained boilers which will result in early product failure is unacceptable and could damage HDG`s reputation as a quality manufacturer. As a result HDG will not support the burning of Miscanthus in one of their boilers. If such conditions occur the damage is easy to identify and will void the warranty.

In conclusion the issues you may experience burning miscanthus

- Bulk density of miscanthus needs to be taken and the storage area required
- The increased amount of dust when handling miscanthus fuel
- Practice has shown that the ash content is at least 4 times as higher than with wood chips
- Increased requirement for cleaning the combustion chamber, grate and heat exchanger
- Miscanthus is prone to bridging in the hopper area and may cause fuel starvation issues and excessive wear to the rotary sluice
- Reduced combustion temperature will result in a power loss expected to be at least 25%;
- Significant risk of corrosion due to the ingredients sulphur and chlorine
- The boiler is not type tested for such fuels and as such has no EN testing approval for heat output or emission levels.

Boiler flue way coated in corrosive material

Boiler flue way after cleaning showing extreme rusting issues

Heat exchanger flue way, heavily coated with corrosive material left over from burning miscanthus

Boiler de-ashing auger having difficulty removing excessive ash content

Excessive ash levels in combustion chamber