Annex 6:

Low Temperature Gasification of Low Cost Biomass and Waste Fractions

DONG Energy A/S

PYRONEER, Biomass gasification

www.pyroneer.com

LOW TEMPERATURE GASIFICATION
OF LOW COST BIOMASS AND WASTE FRACTIONS

DONG Energy is developing a technology that can convert low cost biomass and waste fractions into a combustible gas that can be used to replace fossil fuels such as coal and natural gas.

The concept

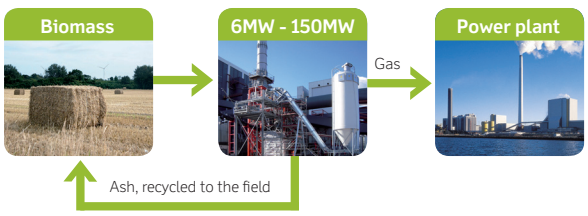
The low temperature gasification technology enables utilisation of high-alkali fuels such as straw, mischanthus and willow in state of the art power generation technologies, such as ultra supercritical steam boilers operating with electrical efficiencies in the range of +47%.

Normally the combustion of biomass, eg straw is associated with corrosion problems due to alkaline species, eg KCl, and hence power plants operates with reduced steam temperature and thus reduced efficiency, compared to what can be obtained when operating on coal.

Other kinds of waste fractions such as manure fibres are so troublesome that we with present technologies cannot convert them at all. If biomass and waste are, however, converted into gas (gasified), at a suitable low temperature, the troublesome alkaline species can be maintained in a solid state.

Through a cyclone, the ashes can be separated from the created gas, and instead of causing corrosion in the boiler, it can be reused as a fertiliser product.

Efficient utilisation of agri residues



Examples of alkaline containing fuels suitable for the Pyroneer gasifier

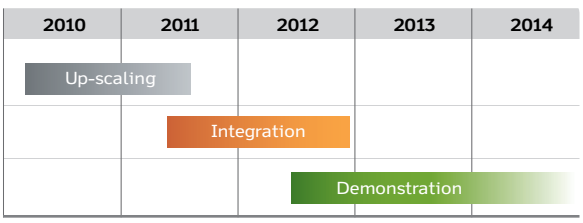
- Straw
- Mischanthus
- Willow
- Fibre

6MW demonstration plant

Features

- Fuel: straw, manure fibres, local residues etc.
- Operating temperature is around 650°C
- Efficiency is ~ 95% (LHV in the fuel that enters the boiler)
- Capacity: 6MW/1.5 tonnes straw per hour
- Location: Asnæs Power Station unit 2, Kalundborg
- Commissioning during spring 2011.

Schedule



Up-scaling: The produced gas is combusted in the flare.

Integration: The gasifier is integrated with unit 2 boiler at Asnæs Power Station. The gas is combusted with coal, and electricity is produced.

Demonstration: Long time testing of various fuels.

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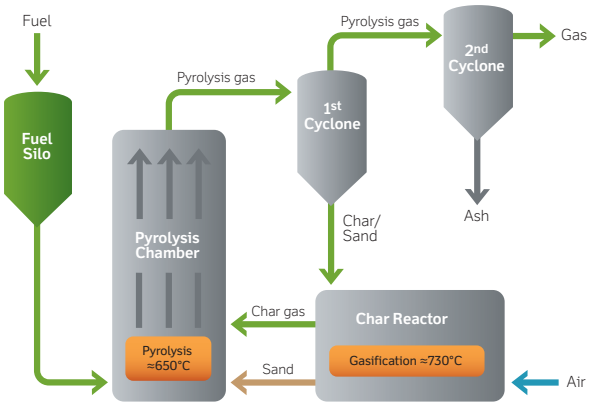
Pyroneer Biomass Gasification

Process description



The Pyroneer gasifier typically consists of three main components; a pyrolysis chamber, a char reactor and a recirculating cyclone. A second cyclone is installed to remove particles from the produced gas.

Pyrolysis chamber
Fuel enters the pyrolysis chamber where the fuel particles are pyrolysed at approximately 650°C upon contact with sand and ash particles. The pyrolysis chamber is a circulating fluidised bed gasifier. The low pyrolysis temperature and retention time result in the formation of only light tars.

1st cyclone
The residual char and the pyrolysis gasses are blown upwards to the 1st cyclone. This cyclone separates the sand and char particles to a char reactor from which mainly the sand and ash are recirculated to the pyrolysis chamber.

Char reactor
The char reactor is a bubbling bed reactor where the char is gasified at approximately 730°C using mainly air.

Efficient char gasification at this low temperature is possible due to a high char retention time which is facilitated by re-circulating mainly sand and ash particles from the bottom of the char reactor to the pyrolysis chamber.

The mentioned stream of mainly sand and ash carries heat from the char reactor to the pyrolysis chamber. Hence, no internal heat transfer surfaces are necessary to provide the heat required for pyrolysing the added fuel.

2nd cyclone
From the 1st cyclone the pyrolysis gasses continue to the 2nd cyclone. This cyclone is more efficient than the 1st cyclone and therefore most of the finest ash particles are separated here. In this way, it is possible to retain 95% of the ash.

Unique selling points

- High efficiency, 95% of the energy in the feedstock can be extracted from the gas. The gas can at preset be co-fired in coal boilers, without reducing steam data.
- Very fuel flexible, able to convert high ash and high alkaline fuels, also at 95% efficiency. Successfully tested straw, manure fibre, chicken litter and various waste fractions from the industry.
- Due to the low temperature, the alkaline and phosphor is maintained in the ash, and can be reused as a fertiliser product.

Advantages compared to direct co-firing of straw and coal

Maintain high steam data
- High efficiency
- Reduced corrosion

High percentage Co-firing
- Large CO_2 reduction
- Reuse of fly ash & bio ash

Performance of high dust DeNOx
- Less physical destruction
- Less chemical deactivation

Funding
The 6MW demonstration plant is partly funded by DONG Energy and partly by Public Service Obligations from Energinet.dk.

Energinet.dk has supported the demonstration project with approximately DKK 35 million. Public Service Obligations are given to projects that have the potential to benefit the Danish society and power sector. Energinet.dk's funds are financed through transport tariffs imposed on power transmission.

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