Decentralized generation of energy out of biomass using enhanced technologies

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Introduction

In a cooperation between companies and institutes from the Netherlands and Germany a fixed bed gasification hot gas generator for applications with waste wood is developed. A special feature of the hot gas generator developed in this project in comparison to former wood and biomass gasifiers is the immediate incineration of the produced gas.

The project is a cooperation between companies and institutes from the Netherlands and Germany: Fachhochschule (University of Applied Sciences) Münster, BTG Biomass Technology Group BV, Enschede, Saxion Hogeschool Enschede (University of Applied Sciences) and ECOS GmbH, Osnabrück where build a partnership.

The project is supported by the European Union (within the INTERREG IIIa programme) by the European structure funds for regional economic developments as well as by the ministries for economic affairs of the Netherlands and the German federal states of Lower Saxony and North Rhine Westphalia (NRW).

Process description

Within the project a fixed bed gasification hot gas generator of the type VGH 15 is being developed, constructed and tested. Tar problems, which lead to problems when using a combustion engine, are avoided by direct combustion of the hot gas. The hot flue gases are utilised in a Stirling engine for electricity production. The already developed and tested Stirling engine SOLO Stirling 161 is equipped with a heat exchanger (providing warm water for heating purposes) and all necessary process control. The engine, particularly it's heater head and the process control equipment are adapted to the gasification hot gas generator and optimized for further operation. The maximum electrical performance is 9 kW. The produced electricity can either be used by the end-user or fed into the public grid.

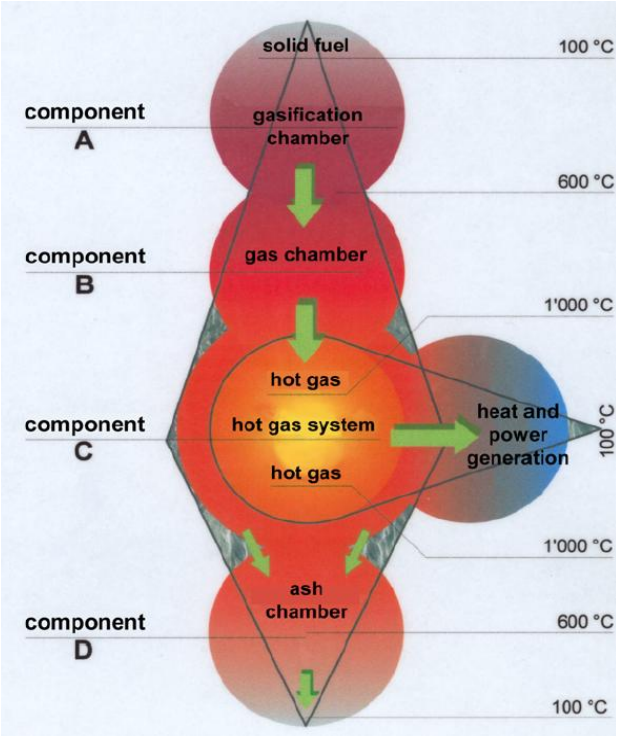

figure 1: flow chart of gasification process

The crushed fuel is supplied at the top through a sluice system. In the gasification chamber (A), water vapour is released. Supplied with preheated air at temperatures up to 600 °C the fuel is dried and transformed to methane, hydrogen and carbon monoxide. The hot gas is lead to the gas chamber (B) where the gasification reaction is completed. In the following combustion chamber (C) the combustible compounds are burned while the oxidation heat is directly used for the gasification process. The hot flue gas is used for driving the Stirling engine as well as for the production of hot air, hot water and steam in a heat exchanger. The remaining ash falls into the ash chamber (D). Melting of the remaining ash is avoided since temperatures above 600 °C do not appear in the gas chamber.

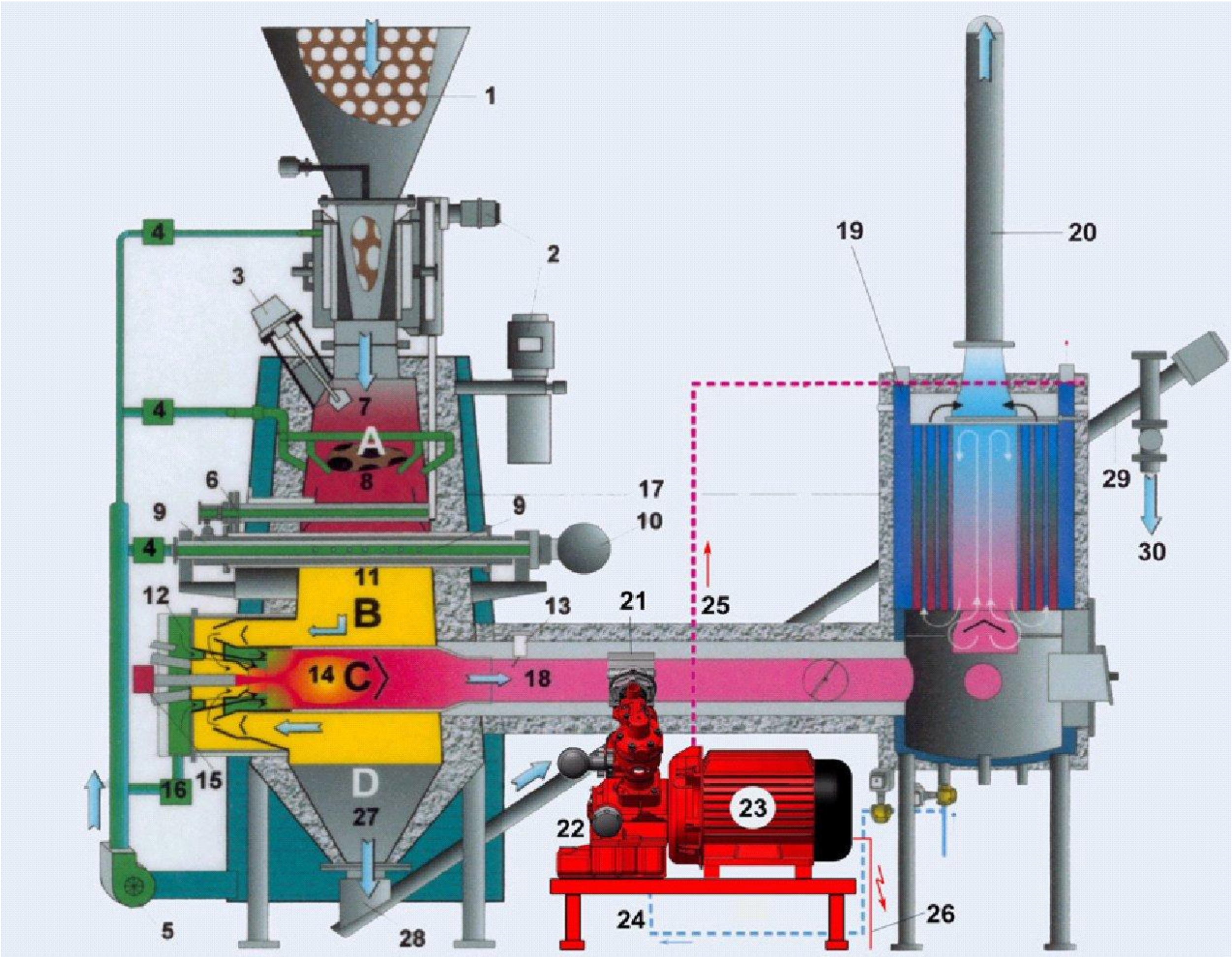

figure 2: system components

Single component A: Gasification chamber

1 Product input
2 Stoker storage
3 Level controller
4 Air supply (Gasification)
5 Fan
6 Electrical heating rod
7 Drying zone
8 Gasification zone
9 Twin floor unit
10 Vibrating unit

Single component B: Gas chamber / Gas feeding

11Gas feeding tube

Single component C: Gas burner, Hot gas feeding

12 Hot gas generator
13 Lambda sensor
14 Hot gas chamber
15 Gas pilot burner
16 Air supply (Hot gas generator)
17 Isolation

Option electricity and heat

18 Hot gas feeding
19 Tube chiller
20 Flue gas pipe
21 Boiler head
22 Stirling engine
23 Electrical generator
24 Cooling water, inlet
25 Cooling water, outlet
26 Current output

Single component D:
Ash chamber, Ash discharge

27 Ash chamber
28 Deashing unit
29 Deashing tube with discharge screw
30 Ash discharge to container

Application potential

The Stirling cogeneration system stands for a versatility of the used fuels and for local application with high energy efficiency. However the fuel has to be sized into small pieces and must have a dry content of approximately 70 - 80 %.

The following fuels can be used:

Solid waste from wood: Wood chips, sawdust and loggings.

Solid waste from agriculture: Chicken litter, straw, hay, energy crops and solid waste of biomass from oil plants.

Municipal and industrial solid waste: solid waste from compost, solids from liquid manure, residues from the paper industry.

Homepage DeBiT-project: http://www.fh-muenster.de/FB1/Koenig