

PROCESS- AND TECHNOLOGY- DESCRIPTION

**LMSV –
AIR MULTI STAGE
GASIFIER**

LMSV – Air multi-stage gasification

The VER Verfahrenstechnik Dresden GmbH developed in cooperation with Lehmann Maschinenbau GmbH a multi-stage method for gasification of biogenic residues since 2007.

For this system was a pilot plant planned at 2008. The construction and further developments at this pilot plant are realized at the site of Lehmann Ltd. in Jocketa/Germany. Furthermore tests are planned, to use this new technology for difficult feedstocks, e.g. digestate materials or sewage sludges.

Description of the technology:

The pilot plant, with 200 kW fuel power, is divided in the following process stages:

- **Module 1:** Fuel pre-heating
- **Module 2:** Gassing
- **Module 3:** Gasification
- **Module 4:** Fuel gas cooling
- **Module 5:** Residue material combustion with energetic recovery of the combustion heat (for pre-heating of the gasification air)

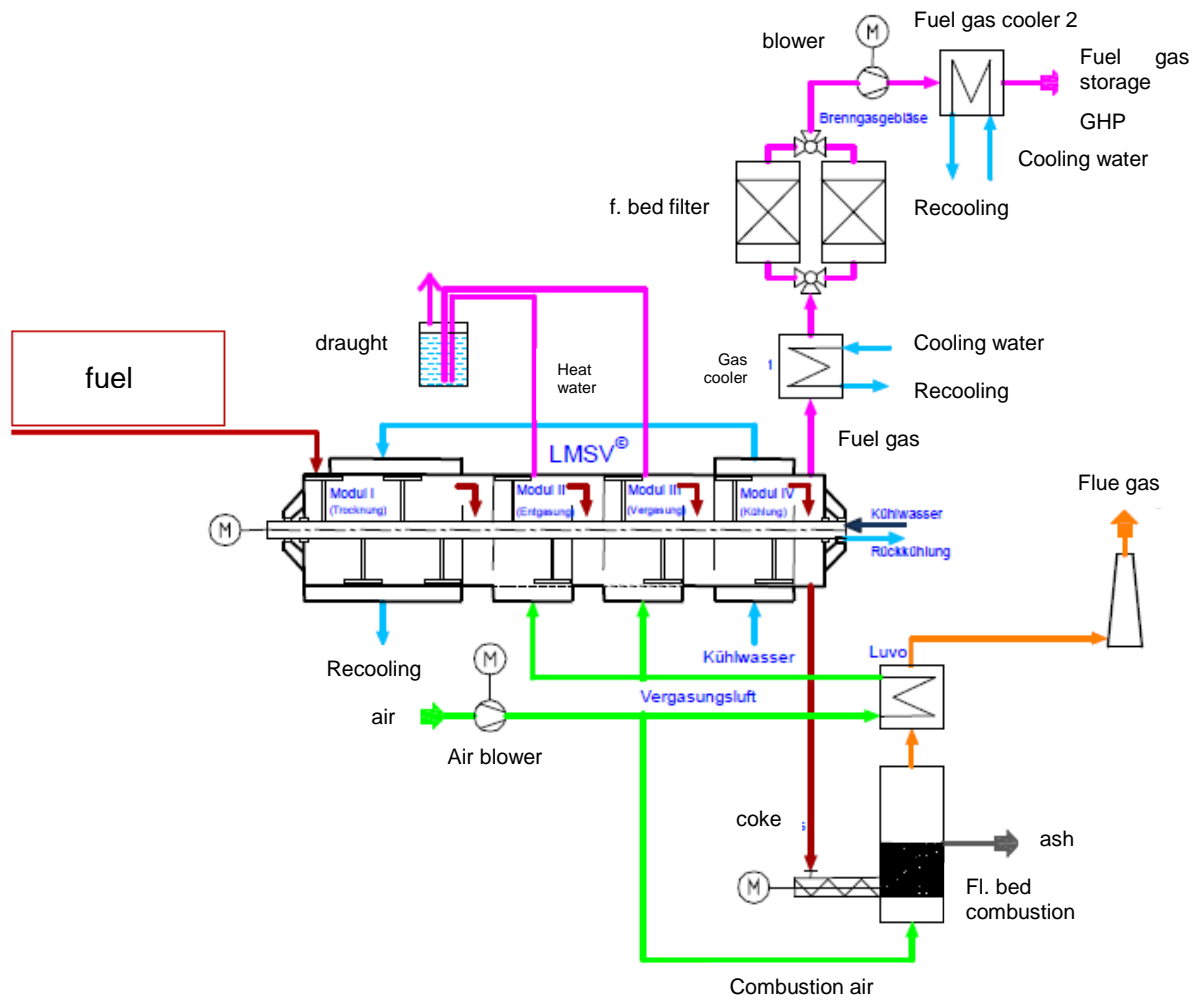
With exception of the combustion, are all the other modules (1 to 4) at a thermal apparatus. This is a horizontal cylinder with agitator.

The apparatus has an inside diameter of 0.8 m and a length of 4 m.

Each of these modules contains a overflow to keep the charge level constant. With a gas lock was short circuit avoided.

Characterize of the modules:

- **Module 1:** Fuel pre-heating
 - Pre-heating and after drying of the fuel on app. 100°C with pre-heated water from module 4.
- **Module 2:** Gassing
 - The fuel gassing with low amount of pre-heated air occurs on 400 – 500°C.
- The processed energy-containing low-temperature carbonization gas leads with the fuel overflow to gasification module 3.
- **Module 3:** Gasification
 - The gasification of the low temperature carbonization coke and the thermal conversion of the low-temperature carbonization gas on 600 – 700°C.
 - As gasification medium, air is blowing through nozzles on the floor of the gasification module.
- **Module 4:** Fuel gas cooling
 - The residual coke from gasification and fuel gas were cooled to temperatures around 100°C. During the cooling of fuel gas condense tar components, which were take up by the residual coke and together with the residual coke burned in module 5.
 - The shell of the cooling module 4 is cooled with water. The obtained heat is used for the fuel pre-heating at the double shell of module 1, over a closed pipe line system.
- **Module 5:** Combustion
 - The combustion of the residual carbon of module 4 occurs at oxidizing atmosphere at temperatures app. 900°C in the module 5, fluidized bed combustion.
 - Entry the combustion occurs preferably by screw.
 - The flue gas is used for the modules 2 and 3.
- Fuel gas cleaning and compression
 - The fuel gas cleaning is processed enclosed to the gasifier.
 - To clean the fuel gas from tar and other compounds, a gas cooling (40 °C) is occurred
 - After the fuel gas filter follows a blower to passes the gas for the following using (CHP/thermal use).



Picture 1: Process scheme of LMSV



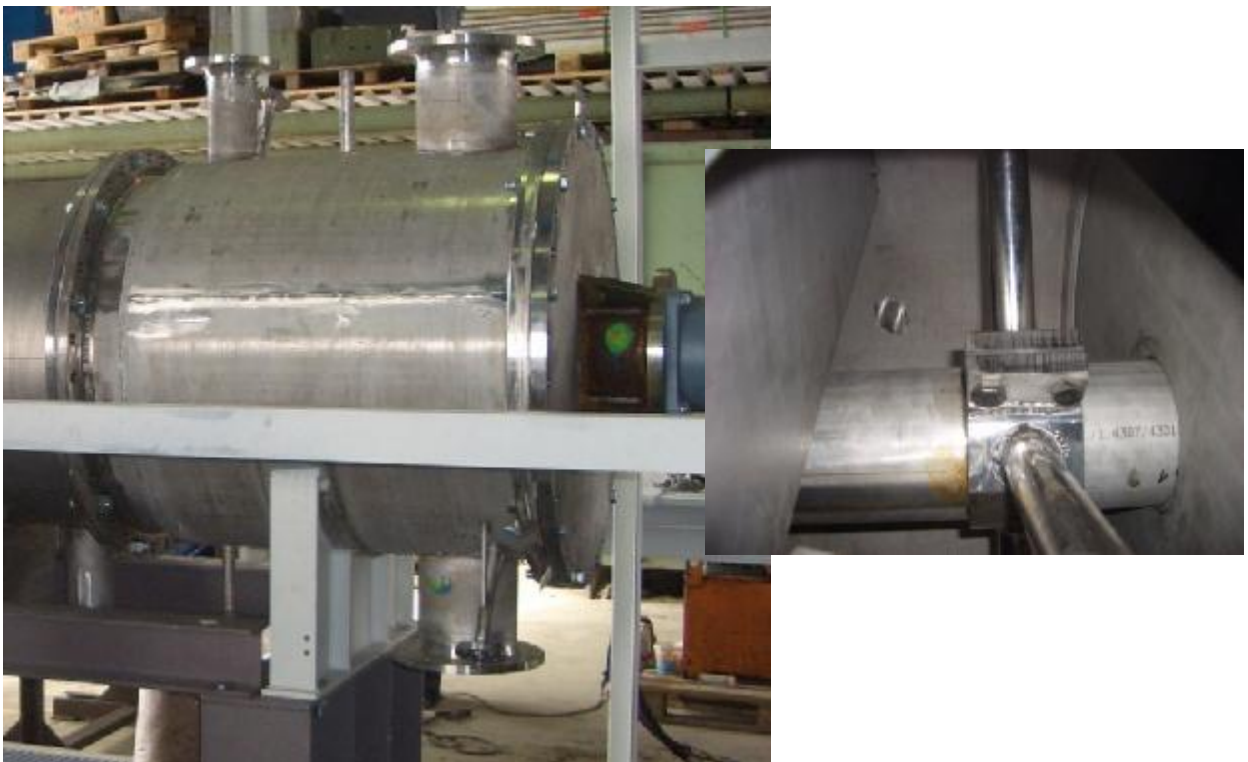
Picture 2: Module 1 to 4 – installation of LMSV



Picture 3: Module 1 – entry with heating zone for fuels (LMSV)



Picture 4: Module 2 + 3 – gassing and gasification zone (LMSV)



Picture 5: Module 4 – cooling module: solid and fuel gas cooling (LMSV)

Stage of work: March 2012