Process- and Technology-Description

Air Cross Flow-Gasification

1 Description of the technology:

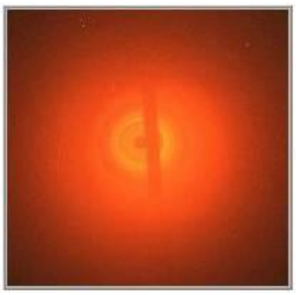
1.01 Development of the Air cross flow gasification-process

The VER Ltd. began in 1993 with the development of a new gasification process for energy recovery of organic products. In the fall of 1994 a Pilot plant in Freital near Dresden, which works according to this method, was put into operation.

The plant has a capacity of 15 to 30 kg/h and is useful for testing the suitability of different gasifier feedstock in terms of their composition and processing to determine the design data for the design and construction of major gasification plants, based on specific materials used, and data for any to develop necessary approval process for such facilities.

In 1995, an operating license after BImSchG for the examination of about 100 types of waste was granted. Since February 1996, on behalf of customers order, studies carried out with treated waste, dried sewage sludge and with the standard fuel SGF in the LQV pilot plant.

For this new technology of air cross-flow gasification, the VER GmbH 1996 has received a German patent.



Picture 1: LQV-pilot plant in Freital

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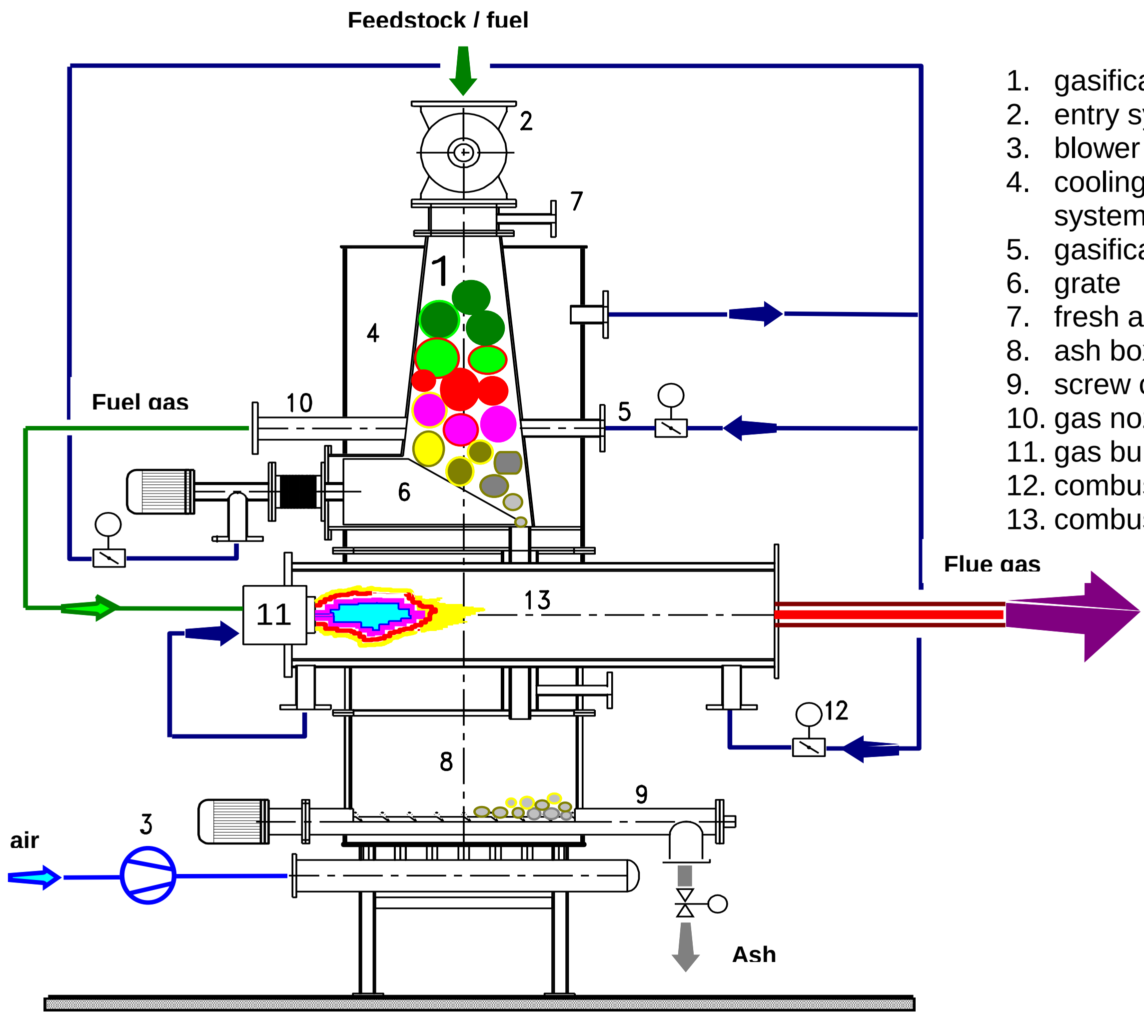
2 Description of the LQV-pilot plant

The pilot plant consists of the main components:

- Gasification unit with a combustion chamber and ash collector unit
- Flue gas heat changer
- Flue gas cleaning

The processing of the used fuels is outside the system. The feeding and metering of the fuels is in regard to the low mass flow rates (up to 40 kg/h) presently carried out manually.



1. gasification chamber
2. entry system
3. blower
4. cooling-isolation-system
5. gasification air supply
6. grate
7. fresh air supply
8. ash box
9. screw conveyor
10. gas nozzle
11. gas burner
12. combustion air supply
13. combustion chamber

Picture 2: Schematic structure of the LQV-pilot plant

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2.01 Gasification unit

2.01.1 Structure oft he gasification unit

The gasification unit consists of 3 moduls:

Gasification chamber / chamber / ash collector

The modular design makes it possible to set up and operate the gasifier with and without integrated combustion chamber unit. This possibility is of interest if, for example the fuel gas from several gasification units in a common combustion chamber is burned, or if otherwise the gas from one or more gasification units, e.g. in a gas engine, will be used.

2.01.2 Function of the gasification unit

Gasification chamber

The gasification chamber is a conically downwardly widening shaft with a volume of 130 l (VA 130). The upper end forming a chamber lock through which the charge is to be gasified with the feeds. At the bottom of the gasifier is the grate. This is designed as a movable grate steps and has two tasks: on the one hand, promoted by the shear movement, the ashes of the fuel to the side-mounted ash discharge channel, on the other hand is the rust of the lower supply air gasification.

The feeding of the gasification air or of the gasification agent is at two different locations. The majority, about 90% of the gasification air is blown laterally, whereby a so-called cross-flow is realized.

The second lower portion of the gasification air is supplied through the grate. The purpose of this so-called rust air is to ensure especially for a widespread or almost complete combustion of the fuel to be gasified.

The outlet of the gasification gas is located on the side of the air supply opposite side.

The cooling of the gasifier is carried by a two-layer heat-isolating system. Through this system, the total air (gasification and combustion air) is directly warms. In this way, the heat losses are reduced.

The commissioning of the plant is carried via a hot air blower, which ignites the fuel in the gasifier bed. Thereafter, no further supply of auxiliary power occurs in the gasification chamber, the process is auto-thermal.

Combustion chamber unit

The combustion chamber unit is disposed below the gasifier unit. The gas leaving the gasifier is supplied to a specific lean gas burner. The combustion air is used first to cool the combustion chamber and is thereby further heated before they also the burner is supplied. The combustion chamber is dimensioned such that at an average fuel flow rate, the residence time of the flue gas is 2 s, was in the use of contaminated fuels according to the 17. BImSchV is required.

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In the event that the combustion chamber temperature drops below 850 ° C (during start-up or shut-down and in case of malfunctions), is supporting a burner that runs on propane, which ensures reliable ignition of the lean gas.

Through the combustion chamber unit extends the ash chute through which falls the fuel ash from the gasifier into the ash collection container, without however exists between them a connection.

Ash collection container

The lowermost third part of the gasification apparatus is the ash collection container. This is collected from the gasifier through the ash slot of the combustion chamber unit falling fuel ash. The ash collector is tapered down and has a screw in the bottom tray for ash discharge.

Through a double jacket of the ash collector is cooled by means of the total air. The ash screw is closed by a slide which is cyclically opened for discharging the ash.

2.02 Heat exchanger

The combustion gas from the combustion chamber passes into the heat exchanger where the hot gas the sensible heat is extracted. As a cooling medium, the return of the heating system is used at the plant site. The flue gas exits the heat exchanger at about 100 ° C. Outside the heating season the heat is dissipated through an air heat exchanger to the environment.

Downstream of the heat exchanger is an induced draft blower, which causes the heat exchanger, the combustion chamber and the gasifier, the total gas flow and promotes the flue gas through the downstream gas cleaning.

2.03 Flue gas cleaning

The LQV pilot plant has a two-stage flue gas cleaning. This is necessary in order to comply the energy recovery from waste, the requirements of the 17th BImSchV. When using an unloaded wood is a flue gas cleaning generally not necessary.

The first cleaning step is an activated coke filter with integrated dust filter. In this purification stage, the dust and contaminants bound thereto, as well as a number of other contaminants from the flue gas can be largely removed. Consumed activated carbon, which is loaded with pollutants, is fed to the gasifier as fuel, so this will not normally be disposed of as waste. The adsorbed organic pollutants are destroyed by the gasification and subsequent combustion of the gas and the largely inorganic pollutants are involved in the fuel ash. Only in cases where the used fuel contains greater amounts of volatile heavy metals mercury and arsenic, which are involved only in an insufficient amount in the fuel ash, a waste of the loaded activated coke is required.

The second flue gas cleaning stage is an alkaline scrubber. During the processing of chlorine-containing feedstocks leads to the formation of hydrogen chloride. Since the activated carbon adsorber is not in a position to reduce the hydrogen chloride content in the flue gas to the 17th BImSchV to prescribed limit, the activated carbon filters, is a wet washing downstream. In this wet washing by means of an approximately 5 -% sodium bicarbonate solution removed in the flue gas contains hydrogen chloride. Sulfur dioxide is also removed by this wash. This creates a sodium chloride-/-sulfate solution, which is not a pollutant.

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3 Messurement- and control concept

The LQV pilot plant is operated by a small control system mostly automatically. By appropriate sensors, all relevant process parameters are recorded, such as temperatures in the gasification chamber, air flow rates, levels, pressures and switching states of valves. Thus, the energy and materials accounting for the overall process is possible.

The visualization of process data and archiving of these data takes place with a downstream PC.

Apart from a few simple procedures and manual feeding of the carburetor with fuel is the starting of the pilot plant automatically. The startup program establishes the process parameters that characterize the normal operation of the plant. In normal operation, various control loops respond to internal and external disturbances. During the entire period of operation parameters on critical limit is exceeded and the condition of aggregates can be monitored. If faults occur, depending on the severity and duration of triggered fault either alarm or left the system automatically and made a safe condition.

The following control loops are active during normal operation:

Reaction temperature in the gasifier

The temperature measurement in the gasifier via a temperature probe (12 measuring planes). This allows the temperature profile shown on the gasifier and the location of the reaction zone can be determined. Via the variation of the gasification agent or by varying the oxygen concentration, the reaction temperature in the vicinity of the desired value is maintained.

Gasifier pressure

The internal pressure in the gasifier is measured, adherence to the desired pressure set point in the gasifier via the setting of the induced draft fan speed of the flue gas cleaning. A nominal value of 5 mm water head prevents the escape of carbonization gas of the fuel sheath.

Lean gas combustion

The determination of the concentration of oxygen in the flue gas from lean gas combustion and the corresponding variation of the quantity of combustion air in the combustion chamber optimal combustion conditions with regard CO concentration and temperature of combustion are produced.

Fill levels in the gasifier and the ash pit

The above levels are recorded and displayed. As already mentioned, made the fuel metering and the ash discharge current manually. These processes can be automated by adding the corresponding aggregates.

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Grate movement

The control of the ash discharge or the burnout is done by varying the grating movement. The control of the grate movement is time dependent.

Grate air flow

In order to optimize the burnout is supplied through the grate secondary gasification air. The volume of air is driven in fixed relation to the main air gasification.

Heating control

The lean gas in the combustion released heat energy is fed through the flue gas heat exchanger in the heating system of the plant site. The flow temperature is in the range of 80 to 90°C kept constant in order to prevent condensation in the flue gas after the heat exchanger.

Based on this concept, it is usually possible to realize a unattended operation of a large-scale LQV system.

The raw gas flows from the bottom of the WSK apparatus and passes a nozzle floor and / or a different type raw gas distribution chamber. The gas distribution chamber causes a uniform flow of the fluidized bed apparatus, and thus the fluidized bed.

Stage of work: February 2012

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