Reactor for producing a product gas from a fuel

Field of the invention

The present invention relates to a method for producing a product gas from a fuel, comprising inputting the fuel into a pyrolysis chamber and executing a pyrolysis process for obtaining a product gas, and recirculating parts of the fuel exiting from the pyrolysis chamber to a combustion chamber. In a further aspect, a reactor for producing a product gas from a fuel is provided, comprising a pyrolysis chamber connected to a fuel input, a first process fluid input, and a product gas output, a combustion chamber connected to a flue output, and a feedback channel connecting the pyrolysis chamber and the combustion chamber.

Prior art

International patent publication WO2014/070001 discloses a reactor for producing a product gas from a fuel having a housing with a combustion part accommodating a fluidized bed in operation, a riser extending along a longitudinal direction of the reactor, and a downcomer positioned coaxially around the riser and extending into the fluidized bed. One or more feed channels for providing the fuel to the riser are provided.

Summary

The present disclosure seeks to provide an improved reactor for processing fuels, such as biomass, waste or coal.

According to an embodiment of the present invention, a method according to the preamble defined above is provided, further comprising in the combustion chamber executing a gasification process in a fluidized bed using a primary process fluid, followed by a combustion process in an area above the fluidized bed using a secondary process fluid. The primary and secondary process fluids are e.g. air comprising oxygen. By creating a pyrolysis process, gasification process and combustion process separately several benefits can be achieved, including a more efficient operation and more ability to adapt to a specific fuel.

Accordingly, one aspect relates to a method for producing a product gas from a fuel, comprising inputting the fuel into a pyrolysis chamber and executing a pyrolysis process for obtaining a product gas, recirculating parts of the fuel exiting from the pyrolysis chamber to a combustion chamber, and in the combustion chamber executing a gasification process in a fluidized bed using a primary process fluid, followed by a combustion process in an area above the fluidized bed using a secondary process fluid, the gasification process being controlled by controlling the velocity and oxygen content of the primary process fluid, and the combustion process being controlled by controlling the velocity and oxygen content of the secondary process fluid, wherein the gasification process is operated with an equivalence ratio ER between 0.9 and 0.99, e.g. 0.95, the equivalence ratio ER being defined as the ratio of the amount of oxygen supplied divided by the amount of oxygen needed for complete combustion of the fuel.

Another embodiment relates to a reactor for producing a product gas from a fuel, comprising a pyrolysis chamber connected to a fuel input, a first process fluid input, and a product gas output; a combustion chamber connected to a flue output; a feedback channel connecting the pyrolysis chamber and the combustion chamber; wherein the combustion chamber comprises a gasification zone accommodating a fluidized bed, and a combustion zone above the fluidized bed, wherein the reactor further comprises a primary process fluid input in communication with the gasification zone, and a secondary process fluid input in communication with the combustion zone.

The present disclosure relates to a reactor as defined in the preamble above, wherein the combustion chamber comprises a gasification zone accommodating a fluidized bed, and a combustion zone above the fluidized bed, wherein the reactor further comprises a primary process fluid input in communication with the gasification zone, and a secondary process fluid input in communication with the combustion zone. This allows to control the gasification process and combustion process separately, and more in particular the temperatures in several parts of the reactor, in order to achieve a more efficient all over operation and control of the reactor.

Short description of drawings

The present invention will be discussed in more detail below, using a number of exemplary embodiments, with reference to the attached drawings, in which

Fig. 1 shows a schematic view of a prior art reactor for producing a product gas from a fuel;

Fig. 2 shows a schematic view of a reactor according to an embodiment of the present invention; and

Fig. 3 shows a schematic view of a reactor according to a further embodiment of the present invention

Detailed description of exemplary embodiments

A device for producing a product gas from a fuel, such as biomass, is known in the prior art, see e.g. international patent publication WO2014/070001 of the same applicant as the present application. Fuel (e.g. biomass, waste or (low quality) coal) is supplied to a riser in a reactor and e.g. comprises 80% by weight of volatile constituents and 20% by weight of substantially solid carbon or char. Heating said fuel supplied to the riser to a suitable temperature in a low-oxygen, i.e. a substoichiometric amount of oxygen, or oxygen-free environment, results in gasification or pyrolysis in the riser. Said suitable temperature in the riser is usually higher than 800°C, such as between 850-900°C.

The pyrolysis of the volatile constituents results in the creation of a product gas. The product gas is, for example, a gas mixture which comprises CO, H_2, CH_4 and optionally higher hydrocarbons. After further treatment, said combustible product gas

CLAIMS

1. Method for producing a product gas from a fuel, comprising

- inputting the fuel into a pyrolysis chamber (6) and executing a pyrolysis process for obtaining a product gas,
- recirculating parts of the fuel exiting from the pyrolysis chamber (6) to a combustion chamber (20, 23), and

in the combustion chamber (20, 23) executing a gasification process in a fluidized bed (20) using a primary process fluid, followed by a combustion process in an area (23) above the fluidized bed (20) using a secondary process fluid , the gasification process being controlled by controlling the velocity and oxygen content of the primary process fluid, and the combustion process being controlled by controlling the velocity and oxygen content of the secondary process fluid,

wherein the gasification process is operated with an equivalence ratio ER between 0.9 and 0.99, e.g. 0.95,
the equivalence ratio ER being defined as the ratio of the amount of oxygen supplied divided by the amount of oxygen needed for complete combustion of the fuel.

2. Method according to claim 1, wherein the fluidized bed 20 is operated with an equivalence ratio ER of at least 1, e.g. equal to 1.05 or equal to 1.1,
the equivalence ratio ER being defined as the ratio of the amount of oxygen supplied divided by the amount of oxygen needed for complete combustion of the fuel.

3. Method according to claim 1 or 2, wherein the primary process fluid is used for controlling the temperature in the fluidized bed (20).

4. Method according to any one of claims 1-3, wherein the equivalence ratio is controlled by one or more of:
reducing supply of the primary process fluid, reducing oxygen content in the primary process fluid, adding an inert gas to the primary process fluid, and/or adding flue gas to the primary process fluid.

5. Method according to claim 4, wherein the equivalence ratio is controlled based on measurement of a temperature in the product gas, and/or a temperature in the flue

gas from the combustion process, and/or an oxygen content in the flue gas from the combustion process.

5