CLAIMS

1. A method for producing synthetic gas from biomass by low temperature pyrolysis and high temperature gasification, the method using a superheated water vapor as an oxidant and an energy carrier, conducting biomass pyrolysis and gasification at different temperature ranges, and finally producing clean synthetic gas; and the method comprising the following steps:

    a) grinding the biomass, feeding the biomass into a pyrolysis furnace while spraying a low temperature superheated water vapor generated by a low-temperature plasma torch heater into the pyrolysis furnace, controlling the pyrolysis furnace at an operating temperature ~~of 500-800°C~~, contacting the biomass with the low temperature superheated water vapor for a pyrolysis reaction to yield crude synthetic gas and an ash comprising a coke;

    b) cooling the ash, and separating the coke from the ash;

    c) transporting the crude synthetic gas and the coke into a gasifier, spraying a high temperature superheated water vapor generated by a high temperature plasma torch heater into the gasifier, controlling the gasifier at an operating temperature of 1200-1600°C, contacting the biomass with the high temperature superheated water vapor for conducting a gasification reaction to yield primary synthetic gas; and

    d) cooling, dust removing, deacidifying, and desiccating the primary synthetic gas to obtain clean synthetic gas;

    wherein:

the operating temperature of the pyrolysis furnace in step a) is controlled at 500-650°C, an operating pressure of the pyrolysis furnace is controlled at 105-109 kPa;

an input speed of the low temperature superheated water vapor into the pyrolysis furnace is 35-50 m/s; and

a retention time of the crude synthetic gas in the pyrolysis furnace is 15-20 s, and an output speed of the crude synthetic gas from the pyrolysis furnace is 15-20 m/s..

2. The method of claim 1, **characterized in that** ground biomass in step a) has a particle size of 20 mm × 20 mm below and a water content of 40 wt. % below.

3. The method of claim 1 or 2, **characterized in that** in step a) a nitrogen atmosphere is provided at a feed inlet of the pyrolysis furnace.

~~4. The method of claim 1 or 2, **characterized in that**~~

~~the operating temperature of the pyrolysis furnace in step a) is controlled at 500-650°C, an operating pressure of the pyrolysis furnace is controlled at 105-109 kPa;~~

~~an input speed of the low temperature superheated water vapor into the pyrolysis furnace is 35-50 m/s; and~~

~~a retention time of the crude synthetic gas in the pyrolysis furnace is 15-20 s, and an output speed of the crude synthetic gas from the pyrolysis furnace is 15-20 m/s.~~

~~5.~~4. The method of claim 1 or 2, **characterized in that**

the operating temperature of the gasifier in step c) is controlled at 1200-1400°C, and an operating pressure of the gasifier is controlled at 105-109 kPa;

an input speed of the high temperature superheated water vapor into the gasifier is 35-50 m/s; and

a retention time of the crude synthetic gas in the gasifier is 15-20 s, and an output speed of the primary synthetic gas from the gasifier is 15-20 m/s.

~~6.~~5. The method of claim 1 or 2, **characterized in that** in step d) the primary synthetic gas is cooled down to a temperature of 260-320°C.

~~7.~~6. A system for producing synthetic gas from biomass by low temperature pyrolysis and high temperature gasification according to the method of claim 1, the system comprising:

the pyrolysis furnace (5);

the gasifier (9);

a low temperature plasma torch heater (8);

a high temperature plasma torch heater (10);

a water storage tank (17);

a water pump (16); and

a heat exchanger (11);

characterized in that

the water storage tank (17) is connected to a water inlet of the heat exchanger (11) via the water pump (16);

a vapor outlet of the heat exchanger (11) is connected to a vapor inlet of the low temperature plasma torch heater (8) and a vapor inlet of the high temperature plasma torch heater (10);

a vapor outlet of the low temperature torch heater (8) is connected to a vapor nozzle of the pyrolysis furnace (5);

a vapor outlet of the high temperature plasma torch heater (10) is connected to a vapor nozzle of the gasifier (9);

a gas outlet of the pyrolysis furnace (5) is connected to a gas inlet of the gasifier (9), an ash outlet of the pyrolysis furnace (5) is connected to an ash inlet of an ash cooler (6), an ash outlet of the ash cooler (6) is connected to a feed inlet of an ash-coke separator (7);

a gas outlet of the gasifier (9) is connected to a gas inlet of the heat exchanger (11); and

a gas outlet of the heat exchanger (11) is connected to a dust collector (12), a deacidification tower (13), and a desiccator (14) in series.

~~8.~~7. The system of claim ~~7~~6, **characterized in that** a nitrogen protecting device (4) is connected to a feed inlet of the pyrolysis furnace (5).

9.8. The system of claim 7.6 or 87, **characterized in that** a coke outlet of the ash-coke separator (7) is connected to a coke inlet of the gasifier (9) via a coke transporter (19).

10.9. The system of claim 7.6 or 87, **characterized in that** the vapor nozzles arranged on the pyrolysis furnace (5) and the gasifier (9) are grouped into 2-4 height levels, respectively, and the vapor nozzles of each level are evenly and tangentially arranged along a circumferential direction.