CLAIMS

1. A method for gasifying biomass by water vapor, the method using a high temperature superheated water vapor as an oxidant and an energy carrier to transform the biomass into a crude synthetic gas in a gasifier, quenching the crude synthetic gas in a spray tower, and finally producing a clean synthetic gas; the method comprising the steps as follows:

    a) grinding the biomass, feeding the biomass into the gasifier, adopting a plasma torch heater to prepare high temperature superheated water vapor, at the same time spraying ~~a~~ the high temperature superheated water vapor into the gasifier, controlling the gasifier at an operating temperature of 1200-1600°C, fully contacting the biomass with the high temperature superheated water vapor to carry out desiccation, separation of volatile matters, pyrolysis, gasification, and producing the crude synthetic gas and an ash; wherein an input speed of the high temperature superheated water vapor into the gasifier is 35-50 m/s, a retention time of the crude synthetic gas in the gasifier is 15-20 s, and an output speed of the crude synthetic gas from the gasifier is 15-20 m/s;

    b) transporting the crude synthetic gas into the spray tower, quenching the crude synthetic gas by spraying water to cool down the crude synthetic gas to a temperature of 650-800°C, condensing a slag and a tar, dissolving alkali metal oxides and part of acid gases, and acquiring a primary synthetic gas; and

    c) carrying out cooling, dust removal, deacidification, and desiccation to transform the primary synthetic gas into the clean synthetic gas.

2. The method of claim 1, **characterized in that** the grinded biomass in step a) has a particle size of 50 mm × 50 mm below and a water content of 40% below.

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

4. The method of claim 1 or 2, **characterized in that** the operating temperature of the gasifier in step a) is controlled at 1200-1400°C, and an operating pressure of the gasifier is controlled at 105-109 kPa.

~~5. The method of claim 4, **characterized in that** in step a), an input speed of the high temperature superheated water vapor into the gasifier is 35-50 m/s, a retention time of the crude synthetic gas in the gasifier is 15-20 s, and an output speed of the crude synthetic gas from the gasifier is 15-20 m/s.~~

~~6.~~5. The method of claim 1 or 2, **characterized in that** in step b) the crude synthetic gas is quenched by water and cooled down to a temperature of 750-800°C.

~~7.~~6. The method of claim 1 or 2, **characterized in that** in step c) the primary synthetic gas is cooled down to a temperature of 260-320°C.

~~8.~~7. A system for gasifying biomass by water vapor according to the method of claim 1, comprising:

a water storage tank (10);

a water pump (9);

a heat exchanger (12);

a plasma torch heater (5);

the gasifier (6); and

the spray tower (11);

characterized in that

the water storage tank (10) is connected to a water inlet of the heat exchanger (12) via the water pump (9);

a vapor outlet of the heat exchanger (12) is connected to a vapor inlet of the plasma torch heater (5);

a vapor outlet of the plasma torch heater (5) is connected to a vapor nozzle of the gasifier (6);

an ash outlet of the gasifier (6) is connected to an inlet of an ash cooler (7);

a gas outlet of the gasifier (6) is connected to a gas inlet of the spray tower (11);

a gas outlet of the spray tower (11) is connected to a gas inlet of the heat exchanger (12); and

a gas outlet of the heat exchanger (12) is connected to a dust collector (13), a deacidification tower (14), and a desiccator (15) in series.

~~9.~~8. The system of claim ~~8~~7, **characterized in that** a nitrogen protecting device (4) is connected to a feed inlet of the gasifier (6).

~~10.~~9. The system of claim 7 or 8, **characterized in that** a plurality of the vapor nozzles are arranged on the gasifier (6) and grouped into 3-4 height levels, and the vapor nozzles of each level are evenly and tangentially arranged along a circumferential direction.