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(54) Title: MECHANISM FOR PRODUCTION OF HYDROCARBON BY PYROLYSIS OF WASTE PLASTICS AND PRODUCTION METHOD THEREOF

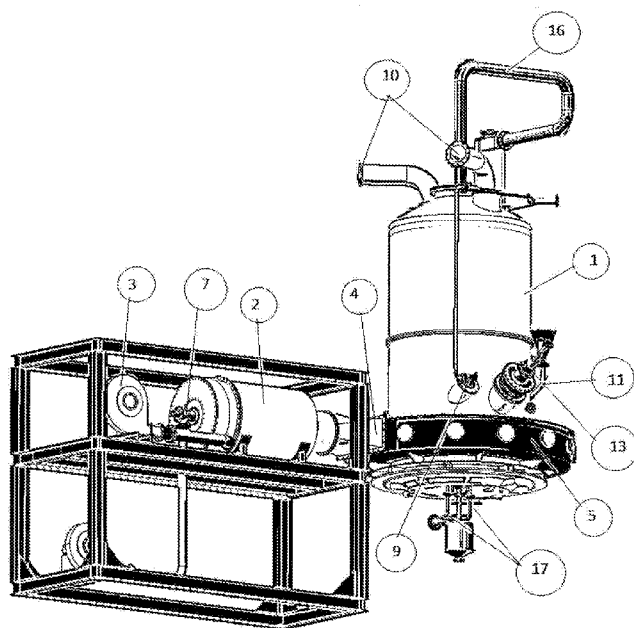


Figure 1

(57) Abstract: The present invention is relate to environment and energy areas and ultimately lead to the production of liquid fuel from the thermochemical recycling of plastic materials, based on a new fast pyrolysis process. The invention consists of an external reactor (1), an internal reactor (12), two gas burners (9) located in the walls of the external reactor (1), an external furnace (2) is located where the main burner (7), a circular distribution box (5), a heat exchanger (13), a gas compressor and a cooling system by water. A novelty is the use of two concentric and circular reactors, wherein the external reactor (1) provides the heat for the pyrolysis process. Besides the mechanism, it is also intended patenting operation method thereof.

Description

Mechanism for production of hydrocarbon by pyrolysis of waste plastics and production method thereof

Brief introduction of the invention

The concept of sustainability is emperor in the twenty-first century, with the international community increasingly aware of the need to reduce environmental problems and, therefore, committed to attaining ambitious objectives in the environmental area.

A key objective is related to the gradual and significant reduction of gas emissions. These environmental issues are particularly relevant in the energy sector, where there is an increasingly strong demand for alternative energy, clean and at a lower cost, allowing also decrease the dependency on oil and its direct derivatives (diesel and petrol).

Thus, the waste recycling for the production of fuels plays an extremely important role, insofar as competing simultaneously for the purposes of environment and energy production.

The present invention is relate to environment and energy areas and ultimately lead to production of a liquid fuel (diesel) from the thermochemical recycling of plastic materials, based on a new fast pyrolysis process.

The same provides a new and improved form of plastic recycling through its transformation into hydrocarbons, which can be used as oil substitutes.

A major advantage of this method for production of hydrocarbons is that it proposes an alternative use for direct burning waste plastics, which is not limited only

to the recycling thereof, thereby contributing to reduction of environmental problems.

Besides the waste pyrolysis process contributes to a rational use of oil as an energy source. Through this process, the heavier hydrocarbons are converted to hydrocarbons of lower molecular weight (liquid or gas), in the absence of oxygen gasification and condensation by cooling.

Thus, it can be said that this invention provides a new way of recycling plastic waste with a view to obtaining hydrocarbons, which can be used in particular in the oil and petrochemical industries.

In addition, this plastic transformation process is self-sufficient from an energy point of view, because some of the generated gases are burned to provide the heat necessary for pyrolysis reactions.

State of the art

In search of the prior art the invention, which was performed in order to assess if it had already been designed or implemented by a third party, the following patent documents were identified, of which we highlight the distinction with the present invention;

- Yoshioka, T. at al, Pyrolysis of poly (ethylene terephthalate) in a fluidised bed plant 2004, Elsevier - discloses pyrolysis in a fluidized bed system comprising a fluidized bed reactor, a cyclone, electrostatic precipitator one, a compressor a pre-heater and a cooler. However, as discussed below, this system does not comprise all the components of the present invention, being different embodiment of the invention.
- US20140027265A1 - This invention describes a method for producing hydrocarbons from carbon-containing

materials, using a fluidized bed pyrolysis reactor and a solid catalyst. However, this patent only describes a method, not claimed any product, unlike the present invention which is a product and method. Moreover the analysis of the mentioned patent application the two separate reactors used, there being one inside and one outside as will be described herein.

- CN202359074U - the present invention describes a mechanism in which to produce the hydrocarbon pyrolysis of plastics through it involves two fluidized beds, one low temperature and one high temperature. However, in the case of the mechanism claimed herein is just a fluidized bed which is being cooled during the process.
- Garforth, A. et al, Production of hydrocarbons by catalytic degradation of high density polyethylene in a laboratory fluidized-bed reactor, 1998, Elsevier - this article only describes a reactor and not two as in the invention now claimed.
- EP0008169A1 - also in the case of this invention a reactor is used only in addition the production method is quite diverse.

Description of the figures

Figure 1 - overall view of the mechanism in which the various components are identified;

Figure 2 - vertical section of the mechanism, on which are marked the various internal and external components of the invention; and

Figure 3 - a view of the underside of the invention, in which are described the various components thereof.

Description of the invention

The present invention relates to a hydrocarbon pyrolysis mechanism of production of waste plastics in a fluidized bed consisting of an external reactor, an internal reactor, two gas burners located in the walls of the external reactor, an external furnace where is located the main burner a circular distribution box, a heat exchanger, a gas compressor and a cooling system by water.

Besides the mechanism, it is also intended patenting operation method thereof.

As to the mechanism it should be noted that a new feature is the use of two concentric and circular reactors, wherein the external reactor (1) provides the heat for the pyrolysis process, and part of the pyrolysis gas is combusted in an external furnace (2) to produce hot gases which are mixed with outdoor air through the fan (3) reaching about 600 ° C. These gases are then used to fluidize the sand bed in the external reactor (1).

The produced gas is transported via a connection (4) to a circular distribution box (5) of the external furnace around the external reactor (1). This circular distribution box (5) there are micro-perforated tubes (6) which conveys the gas to the external reactor (1) where injected into the sand. The external furnace (2), the external reactor, the circular distribution box (5) and the connecting piece (4) are made of carbon steel, covered with a refractory lining (18).

The external furnace (2) is located on the main burner (7). This burner produces gas at 1200 ° C, which are then cooled to 600 ° C using a secondary air introduced into it over the fan (3). This mixture is introduced into the reactor through the external circular distribution box (5).

The external reactor (1) is constructed of carbon steel coated with a refractory lining (18). Here, laterally, there are two gas burners (9) which are located in the

external reactor (1) wall to raise the temperature of the external reactor (1) to 850°C.

The hot gases leaving the external reactor (1) from the top through two outlets (10). The sand level of the external reactor (1) is maintained at the desired level through the sand supplying it through a sand supply (11) throughout the time of use of the invention.

The internal reactor (12) is where the pyrolysis reactions occur. The internal reactor (12) there is no oxygen present, and the sand is fluidized in the reactor with a part of the gaseous product obtained previously compressed in the process gas compressor and introduced into the sand by means of two tubes (17) which are connected to the distributor (19) micro-perforated tube. This gas was preheated to 400 ° C taking advantage of heat of exhaust gas outside the reactor to the chimney through the exchanger (13) with an internal temperature of the reactor (12) is held at maximum 500°C. This reactor domestic (12) is constructed of high temperature resistant steel to withstand the high temperatures. The height of the reactor (12) is calculated to ensure that the residence time is sufficient and the heat transfer is desired.

The supply of plastic to the internal reactor (12) is conducted through a pneumatic conveying mechanism (21).

The mechanism consists of a heat exchanger (13) in which the outer annular part circulates cold water (14) and the inside of passing a process gas stream mixed with the plastic feed to the reactor. The cooling water is necessary to prevent softening of the plastic before it enters the internal reactor (12).

There is still a tube (15) inserted into the internal reactor (12) at the level corresponding to the top of the fluidized bed for measuring pressure across the fluidized bed.

Thus, the plastics are pyrolyzed essentially converted to a gaseous product exiting the internal reactor (12) for an extraction tube (16) which is directed to the cooling and condensation system.

The pyrolysis process involves heating the internal reactor (12) via the external reactor (1) so that the internal temperature in the reactor reaches a temperature range of 475-500°C. Once reached this temperature is reached, starts the engine power with plastic, which then enter the internal reactor (12) mostly vaporize to produce a cloud of hydrocarbons which leave the internal reactor (12) and undergo a cyclone, in which all the particles are carried out.

From the cyclone, the hydrocarbon stream through a tube which is insulated from the outside by a heat exchanger that lowers the temperature of gases to 250 ° C, this being a yet sufficiently high temperature to avoid condensation of any hydrocarbon.

From this heat exchanger the gases pass to the condenser in which the diesel fuel is used to cool the hydrocarbon gases to about 30 ° C. At this temperature, the condensing part is mixed with the diesel and is separated from non-condensable part.

The uncondensed gases then pass through a cyclone to recover the hydrocarbon vapors and then will flow through a heat exchanger in which the gases are cooled to 10 ° C to ensure complete condensation occurs. After passing through another heat exchanger (W106), the gases pass through a compressor in which the pressure is increased to 350 Mbar.

The produced gas will be used for three purposes:

- 1) To fluidize the sand the internal reactor (12) in order to increase the efficiency of heat transfer.

2) To be used in the external burners to heat the reactor to about 850 ° C; and

3) the remainder gas will be used to generate electricity for own consumption.

In the liquefaction system exists a fixed volume of produced hydrocarbons that will circulate in a closed circuit through a cooling exchanger to maintain its temperature at about 15 ° C and will serve to extract heat from the process gases to condense.

Finally, it should be noted that the excess amount to the fixed volume outstanding in the liquefaction system will be sent to the storage of fuel produced.

Lisboa, November 30, 2015

Claims

1. A mechanism for production of hydrocarbon by pyrolysis of waste plastic in a fluidized bed comprising:

- an external reactor (1);
- two gas burners (9) located on the external wall of the external reactor (1);
- an external furnace (2) where is located the main burner (7);
- a distribution of cash flows (5) with micro perforated tube (6);
- an internal reactor (12);
- a heat exchanger (13) at a part where the cold water circulates (14):
- a gas compressor;
- a fan (3);
- a cooling water system; and
- a pipe water pressure gauge inserted into the internal reactor (12) which measures the pressure across the bed

wherein the external reactor (1) and the internal reactor (12) are concentric and circular, and the internal reactor (12) in which pyrolysis takes place, heated by the external reactor (1).

2. Mechanism according to claim 1, wherein the external furnace (2), the external reactor (12), the circular distribution box (5) and the connecting piece (4) are of carbon steel, covered with a refractory lining (18).

3. Mechanism according to claim 1, wherein the feed of plastic for the internal reactor (12) takes place through a pneumatic conveying mechanism (21), which consists of a heat exchanger (13) ring in which the outer part circulates cold water (14) and the inside of passing a

process gas stream mixed with the plastic feed to the reactor.

4. Method of operation of the invention described in claim 1, wherein:

- the external reactor (1) generate heat for the pyrolysis process and part of the pyrolysis gas burned in an external furnace (2) which produces hot gas that will be mixed with outdoor air through the fan (3) reaching about 600 ° C, which are used to fluidize the sand in the external reactor (1);
- the gases are transported via a connection (4) to the circular distribution box (5) of the furnace around the external reactor (1);
- the micro-perforated tubes (6) of the circular distribution box (5) carrying the gas to the external reactor (1) where the gas is injected into the sand;
- the level of the sand bed in the external reactor (1) is maintained at the desired level through the sand supplying it through a sand supply (11) throughout the hydrocarbon production time;
- the main burner (7) located in the external furnace (2) produces gas at 1200 ° C, which are cooled to 600 ° C using a secondary air introduced into the external furnace (2) through the fan (3);
- the two gas burners (9) located in the external reactor increase the temperature of the external reactor (1) to 850 ° C;
- the gas is preheated to about 400 ° C taking advantage of heat from outside the reactor gas (12) evacuated to the chimney through the exchanger (13) and the temperature of the internal reactor (12) maintained at maximum 500 ° C ;

- pyrolysis reaction occurs in the internal reactor (12) in which there is no oxygen present, and the sand is fluidized with a part of the gaseous product obtained previously compressed in the process gas compressor and introduced into the sand by means of two tubes (17) that are connected to the distributor (19) through the micro-perforated pipes;
- feeding the plastic for the internal reactor (12) is conducted through a pneumatic conveying mechanism further described in claim 3;
- powered internal reactor (12), the pyrolyzed plastic vaporize to produce a cloud of hydrocarbons exiting the internal reactor (12) for an extraction tube (16) which is directed for cooling / cyclone and condensation ;
- from the cyclone, hydrocarbon flow through a tube isolated from the outside by a heat exchanger in which the low temperature of the gases to 250 ° C;
- from this heat exchanger the gases pass to the condenser in which the diesel fuel is used to cool the hydrocarbon gases to about 30 ° C;
- reaches the temperature of 30 ° C, the condensing part is mixed with the diesel and is separated from non-condensable part;
- the uncondensed gases then pass through a cyclone to recover the hydrocarbon vapors and then will flow through a heat exchanger in which the gases are cooled to 10 ° C to ensure complete condensation occurs;
- after passing through another heat exchanger (W106), the gases pass through a compressor in which the pressure is increased to 350 Mbar.

5. Method of operation of the invention according to claim 4, wherein in the liquefaction system exists a fixed volume of produced hydrocarbons that will circulate in a closed circuit through a cooling exchanger to maintain its temperature at about 15 ° C and will serve to extracting heat from the process gases to condense.

6. Mechanism according to claim 1, wherein the gas produced according to the method described in claim 4 is used to fluidize the sand the internal reactor, is used in the external burners to heat the reactor to about 850 ° C and being used to generate electricity for own consumption.

Lisboa, November 30th, 2015

Drawings

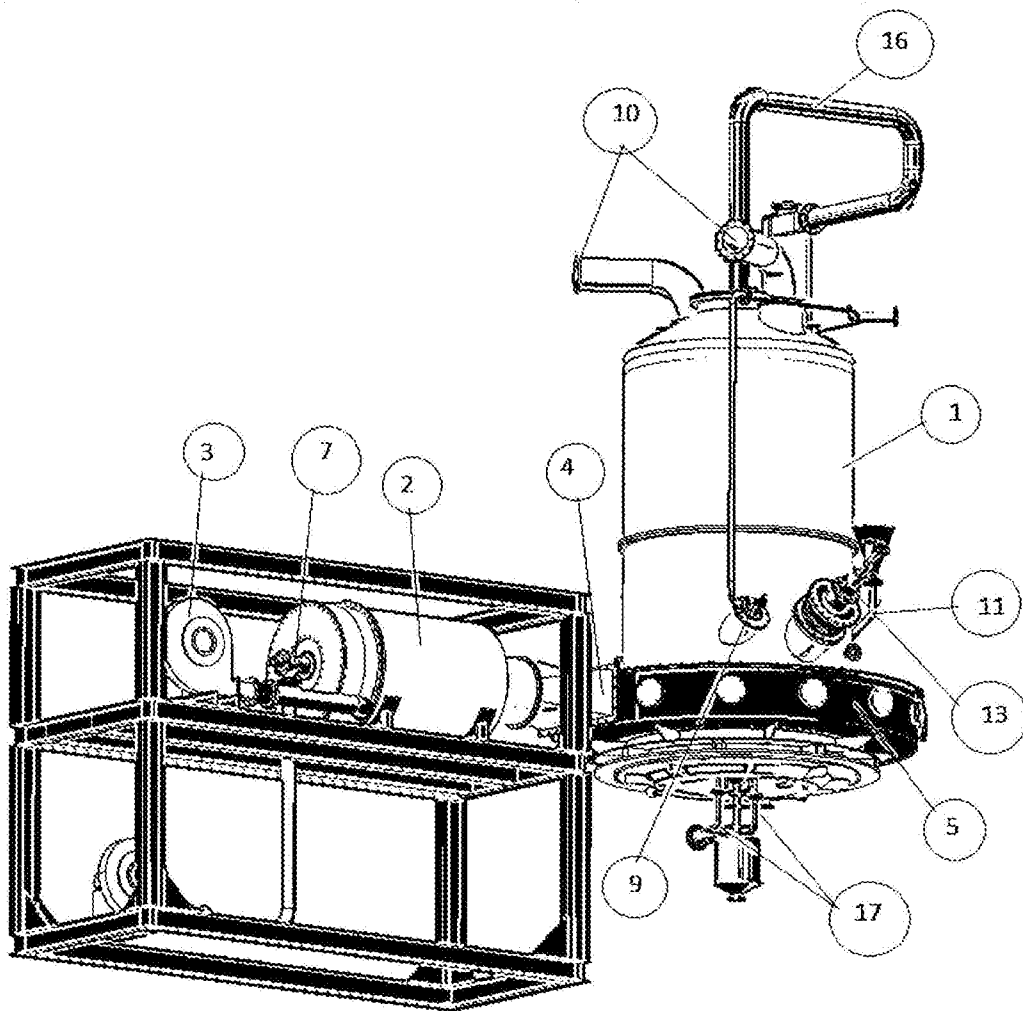


Figure 1

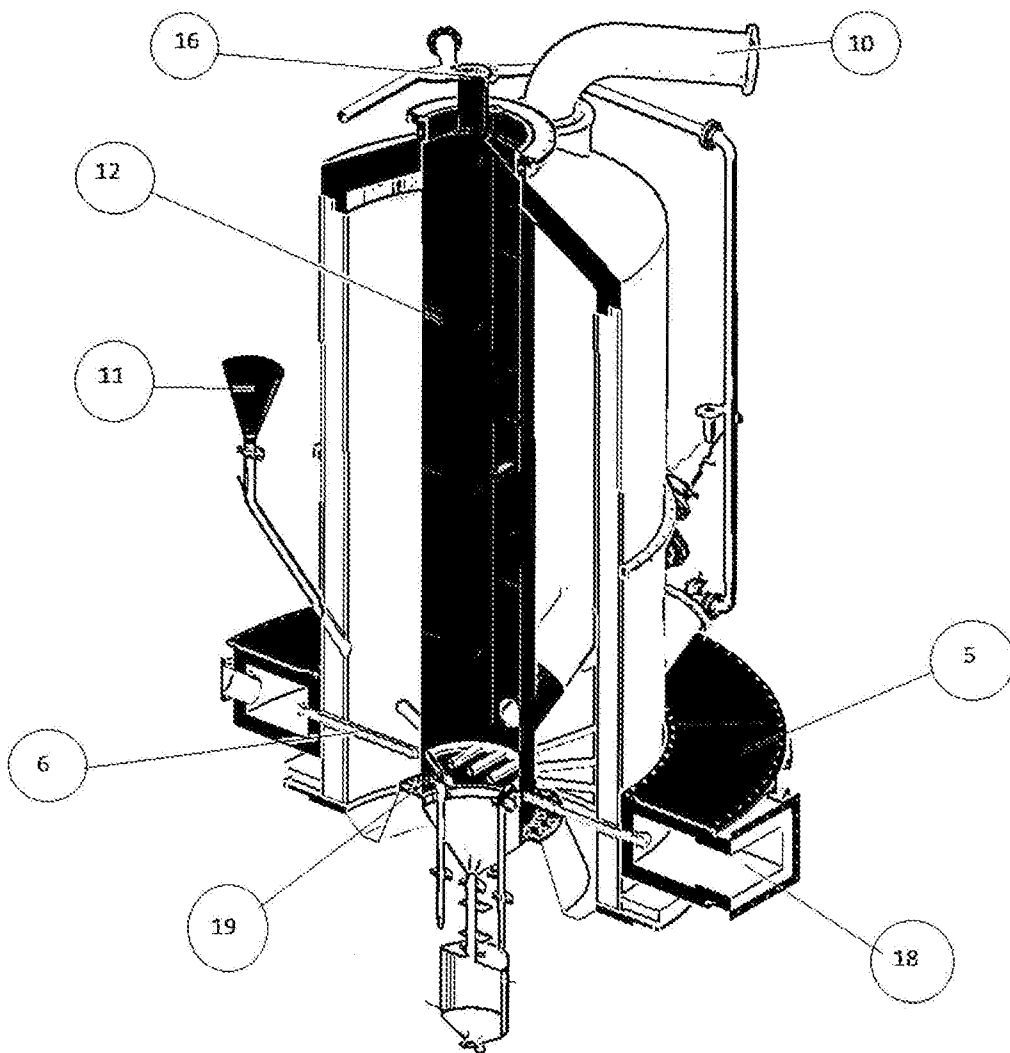


Figure 2

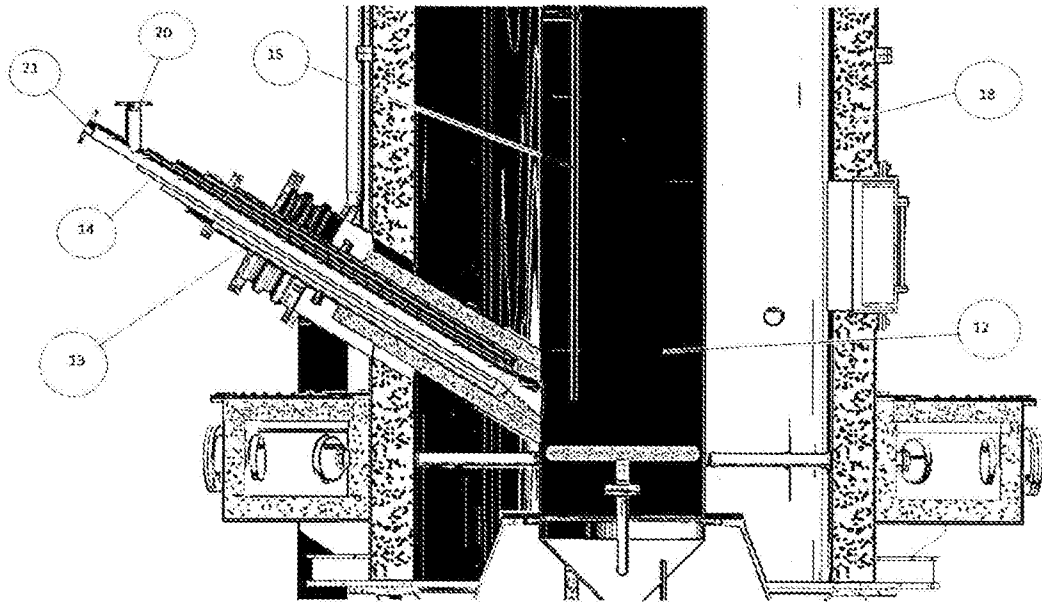


Figure 3