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(54) **RAPID HEATING DEVICE AND HEATING METHOD FOR ORGANIC SOLID WASTE**

SCHNELLAUFWÄRMVORRICHTUNG UND VERFAHREN ZUM AUFWÄRMEN VON ORGANISCHEN FESTEN ABFÄLLEN

DISPOSITIF DE CHAUFFAGE RAPIDE ET PROCÉDÉ DE CHAUFFAGE POUR DÉCHETS SOLIDES ORGANIQUES

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Description

TECHNICAL FIELD

[0001] The invention belongs to the technical field of energy and resource utilization of organic solid waste, and specifically relates to a device for rapid heating and high-efficiency heat preservation of organic solid waste.

[0002] The invention also relates to a rapid heating method using the device.

BACKGROUND

[0003] The organic solid waste production all over the world is large, with an annual output of 5 billion tons in China, but the reduction and resource utilization rate is low, which seriously affects the urban living environment. Pyrolysis technology can realize the reduction and resource utilization of organic solid waste, it can convert biomass energy into resource products such as fuel gas, bio-oil, and biochar. With the construction of Zero-waste City, organic solid waste pyrolysis technology has attracted more and more attention. At present, the research on pyrolysis technology mainly focuses on the optimization of pyrolysis system, exhaust gas emission standards, etc. The existing organic solid waste pyrolysis technology and equipment have the disadvantages of long heating time, long start-up time, and low heat energy conversion efficiency. And the slow heating speed leads to the generation of dioxins in the pyrolysis process, which increases the back-end disposal cost and greatly limits the promotion of organic solid waste pyrolysis technology. There is an urgent need to design a rapid heating method for pyrolysis equipment, improve the heat energy conversion efficiency of pyrolysis equipment, and effectively suppress the production of dioxins.

[0004] US 2012/073197 A1 discloses a gasifier including a combustion chamber and a pressure vessel surrounding the combustion chamber, wherein the pressure vessel includes an inner surface. A controller adjusts a pressure inside the pressure vessel so that a dew point temperature of corrosive compounds produced in the combustion chamber is less than a temperature of the inner surface of the pressure vessel.

[0005] WO 03/040619 A1 discloses a carbonizing apparatus using a far infrared rays heater that can extremely heighten an operation efficiency by shortening a temperature rise time necessary for a carbonizing operation through a direct heating method using a cartridge heater of far infrared rays, and thus by preventing an unnecessary loss of power. The carbonizing apparatus includes a body case that has a door on one side face thereof, and has a far infrared rays heater and a carbonizing receptacle thereinside; the inner side wall faces of the body case are constructed of insulation bricks.

[0006] JP 2002-129165 A discloses a carbonization tank comprising electric heaters which are arranged on the exterior of a far infrared ray radiating type ceramic layer formed in the inner wall of said tank. The ceramic layer is formed by coating a ceramic paint having far infrared ray radiation properties.

SUMMARY OF THE INVENTION

[0007] The purpose of the present invention is to solve at least one of the technical problems existing in the prior art, and to provide a device for rapid heating and high-efficiency heat preservation of organic solid waste as defined in claim 1.

[0008] Another object of the present invention is to provide a rapid heating method as defined in claim 6 using the above-mentioned device.

[0009] To achieve the above purposes, the present invention provides a device as defined in claim 1 for rapid heating and efficient heat preservation of organic solid waste, including an infrared heater, a heating furnace, a pyrolysis furnace and an automatic control unit.

[0010] The pyrolysis furnace is embedded in the heating furnace, the infrared heater is located on the outer side wall of the heating furnace, the outer wall of the pyrolysis furnace is coated with infrared absorbing paint, and the inner wall is covered with an insulating layer.

[0011] In the described device, the heating furnace and the pyrolysis furnace have uniform shapes, which can be oval, circular, rectangular or other shapes, preferably cylindrical, to ensure uniform heating. In the described device, the infrared heater is uniformly arranged on the outer wall of the heating furnace for heating the pyrolysis furnace, and the heating rate is in the range of 75-125°C/s,

preferably 90~110°C/s, most preferably 100°C/s. More than one infrared heaters can be set as required, and the wavelengths of the infrared rays emitted by the infrared heaters are all different. In the described device, the outer wall of the pyrolysis furnace is uniformly coated with the infrared absorbing paint, and the inner wall is covered with the insulating layer.

[0012] In the described device, the infrared absorbing paint is semiconductor titanium oxide, and the material of the insulation layer on the inner wall of the pyrolysis furnace is ceramic fiber.

[0013] In the described device, the material of the pyrolysis furnace is silicon carbide and other materials with high temperature resistance and small specific heat capacity.

[0014] The invention provides a method for rapid heating using the above-mentioned device, including the following steps:

According to the type and feed amount of organic solid waste, the rapid heating of the pyrolysis furnace is realized, and the pyrolysis temperature of the pyrolysis furnace is maintained, so as to realize the high-efficiency pyrolysis of the organic solid waste.

[0015] In the described method, the heating rate of the pyrolysis heating device is controlled by the automatic control unit, and the automatic control unit performs au-

tomatic control according to the feed amount of the material and the pyrolysis temperature. When the device is started, the temperature of the pyrolysis furnace can rise to 1000°C within 1 minute, which greatly reduces the start-up time of the equipment. When the temperature is higher than 1000°C, the infrared heater is turned off and the insulation layer is used to maintain the pyrolysis temperature in the pyrolysis furnace. When the pyrolysis temperature in the pyrolysis furnace is lower than 900°C, the infrared heater is turned on again to realize the rapid heating of the pyrolysis furnace.

[0016] Based on the above technical solutions, it can be known that the present invention has the following beneficial effects:

In view of the disadvantages of the pyrolysis technology and equipment of organic solid waste, such as long start-up time and low heat energy conversion efficiency, which lead to the generation of dioxins in the pyrolysis process and increase the back-end disposal cost, a fast heating and efficient insulation device for organic solid waste was designed. The heat radiation of the infrared heater of the heating furnace realizes the rapid heating of the pyrolysis furnace, the pyrolysis furnace uses the insulation layer on the inner wall to prevent heat loss and maintain the pyrolysis temperature of the material, thereby realizing the rapid heating and efficient insulation of the material, and shortening the pyrolysis heating time, improving the pyrolysis efficiency of organic solid waste and effectively reduce the production of dioxin.

DESCRIPTION OF THE DRAWINGS

[0017] Fig. 1 is a schematic diagram of the component structure of the organic solid waste rapid heating device of the present invention.

[0018] Description of the logo in the figure

1 feed port, 2 pyrolysis furnace, 3 insulation layer, 4 paint, 5 heating furnace, 6 discharge port, 7 infrared heater.

MODE OF CARRYING OUT THE INVENTION

[0019] In order to make the objectives, technical solutions and advantages of the present invention clearer, the present invention will be further described in detail below in conjunction with specific embodiments and with reference to the accompanying drawings.

[0020] A specific implementation of the present invention will be described in detail below with reference to the accompanying drawings.

[0021] Fig. 1 is a schematic diagram of a device for rapid heating and high-efficiency heat preservation of organic solid waste according to an embodiment of the present invention. The device of the present invention includes: an infrared heater 7, a heating furnace 5, a pyrolysis furnace 2 and an automatic control unit.

[0022] Specifically, in the device of the present invention, the pyrolysis furnace 2 is embedded in the heating furnace 5, both ends of the pyrolysis furnace 2 are provided with a feed port 1 and a discharge port 6 respectively, and the infrared heater 7 is located on the outer side wall of the heating furnace 5, the outer wall of the pyrolysis furnace 2 is coated with infrared absorbing paint 4, and the inner wall is covered with an insulating layer 3.

[0023] In a specific embodiment, the number of infrared heaters can be one or more, preferably three. Wherein, the pyrolysis furnace and the heating furnace can be elliptical, circular, rectangular or other uniform shapes, and preferably circular, with a temperature probe provided on the inner wall. Wherein, the wave-absorbing paint coated on the outer wall of the pyrolysis furnace is semiconductor titanium oxide, and the inner wall insulation layer is made of ceramic fiber.

[0024] Wherein, the material of the pyrolysis furnace is materials with high temperature resistance and small specific heat capacity, such as silicon carbide.

[0025] Wherein, the pyrolysis furnace is nested in the heating furnace, and the solid waste processing capacity of the pyrolysis furnace is 0.1-2 tons/day. According to the processing needs, select the number of working infrared heaters. Turn on the infrared heater to heat the pyrolysis furnace. Under the action of the infrared absorbing material on the outer wall of the pyrolysis furnace, the temperature of the pyrolysis furnace rises to 1000°C within 10s. At this time, the feed port is opened, and the solid waste is rapidly pyrolyzed in the pyrolysis furnace, shortening the heating process and reducing the generation of dioxins. The pyrolysis furnace maintains the pyrolysis temperature above 900°C under the action of the insulation layer, and the solid waste after pyrolysis is discharged from the discharge port.

[0026] Wherein, the pyrolysis furnace is controlled by an automatic control unit, which is connected with a temperature probe of the pyrolysis furnace (known technology), and the use time of the infrared heater is controlled by analyzing the temperature in the furnace. In the control process, when the temperature in the pyrolysis furnace is lower than 850°C, the infrared heater is turned on for heating, and when the temperature is higher than 1000°C, the infrared heater is turned off to maintain the temperature in the pyrolysis furnace continuously above 850°C.

[0027] After testing, the dioxin outlet content is below 0.05ngTEQ/Nm3, which meets the EU waste incineration pollutant emission standard (DIRECTIVE 2010). Compared with the existing domestic organic solid waste pyrolysis incinerator, the dioxin content is 1.0ngTEQ/Nm3, The concentration of dioxins treated by the device of the invention is reduced by more than 95%.

[0028] The specific embodiments described above further describe the objectives, technical solutions and beneficial effects of the present invention in detail. It should be understood that the above are only specific embodiments of the present invention and are not intended to limit the present invention as defined by the appended claims.

Claims

1. A rapid heating device for pyrolysis of organic solid waste, includes an infrared heater, a heating furnace, a pyrolysis furnace and an automatic control unit; the pyrolysis furnace is embedded in the heating furnace, the infrared heater is uniformly arranged on the outer side wall of the heating furnace, the outer wall of the pyrolysis furnace is uniformly coated with infrared absorbing paint for absorbing infrared wavelengths of heat radiation from the infrared heater, wherein under the action of the infrared absorbing paint, rapid heating of the pyrolysis furnace is realized, and the inner wall of the pyrolysis furnace is covered with an insulating layer, wherein the automatic control unit is configured to control the heating rate of the pyrolysis furnace according to pyrolysis temperature, wherein when the pyrolysis temperature in the pyrolysis furnace is lower than a first preset temperature, the automatic control unit turns on the infrared heater to realize the rapid heating of the pyrolysis furnace, and when the pyrolysis temperature is higher than a second preset temperature, the automatic control unit turns off the infrared heater to maintain the pyrolysis temperature in the pyrolysis furnace by relying on the insulating layer, wherein the heating rate of the rapid heating device is in the range of 75~125°C/s, preferably 90~110°C/s, most preferably 100°C/s.

2. The device according to claim 1, wherein the heating furnace and the pyrolysis furnace have uniform shapes, such as oval, circular, rectangular or other shapes, to ensure uniform heating.

3. The device according to claim 1, wherein the infrared heaters are uniformly arranged on the outer wall of the heating furnace, and multiple infrared heaters can be set as required, and the wavelengths of the infrared rays emitted by the infrared heaters are all different.

4. The device according to claim 1, wherein the infrared absorbing paint coated on the outer wall of the pyrolysis furnace is semiconductor titanium oxide, and the material of the insulation layer on the inner wall of the pyrolysis furnace is ceramic fiber.

5. The device according to claim 1, wherein the material of the pyrolysis furnace is silicon carbide.

6. A rapid heating method using the device according to any one of claims 1 to 5, comprising the following steps:
   The heating rate of the pyrolysis furnace is controlled by the automatic control unit, which automatically controls according to feed amount of materials and pyrolysis temperature, when the pyrolysis temperature in the pyrolysis furnace is lower than a first preset temperature, the infrared heater is turned on to realize the rapid heating of the pyrolysis furnace, when the pyrolysis temperature is higher than a second preset temperature, the infrared heater is turned off to maintain the pyrolysis temperature in the pyrolysis furnace by relying on the insulation layer.

7. The rapid heating method according to claim 6, wherein the infrared heater is turned on when the pyrolysis temperature in the pyrolysis furnace is lower than 900°C, and the infrared heater is turned off when the temperature is higher than 1000°C.

Patentansprüche

1. Schnellaufwärmvorrichtung zur Pyrolyse von organischen festen Abfällen, darin eingeschlossen eine Infrarot-Heizvorrichtung, ein Heizofen, ein Pyrolyseofen und eine automatische Steuereinheit, der Pyrolyseofen ist in den Heizofen eingebettet, die Infrarot-Heizvorrichtung ist gleichförmig auf der äußeren Seitenwand des Heizofens angeordnet, die äußere Wand des Pyrolyseofens ist gleichförmig mit Infrarot-Absorptionsfarbe beschichtet, um Infrarot-Wellenlängen der Wärmestrahlung von der Infrarot-Heizvorrichtung zu absorbieren, wobei unter der Einwirkung der Infrarot-Absorptionsfarbe eine schnelle Aufwärmung des Pyrolyseofens durchgeführt wird, und die innere Wand des Pyrolyseofens ist mit einer isolierenden Schicht bedeckt, wobei die automatische Steuereinheit konfiguriert ist, um die Aufwärmungsrate des Pyrolyseofens gemäß der Pyrolysetemperatur zu steuern, wobei, wenn die Pyrolysetemperatur im Pyrolyseofen niedriger als die erste voreingestellte Temperatur ist, die automatische Steuereinheit die Infrarot-Heizvorrichtung einschaltet, um die schnelle Aufwärmung des Pyrolyseofens durchzuführen, und wenn die Pyrolysetemperatur höher als eine zweite voreingestellte Temperatur ist, die automatische Steuereinheit die Infrarot-Heizvorrichtung abschaltet, um die Pyrolysetemperatur im Pyrolyseofen durch Vertrauen auf die isolierende Schicht beizubehalten, wobei die Aufwärmungsrate der schnellen Aufwärmungsvorrichtung im Bereich von 75 - 125 °C/s, vorzugsweise 90 - 110 °C/s, insbesondere 100 °C/s liegt.

2. Vorrichtung nach Anspruch 1, wobei der Heizofen und der Pyrolyseofen gleichmäßige Formen aufweisen, wie z. B. oval, rechtwinklig oder andere Formen, um die gleichmäßige Aufwärmung sicherzustellen.

3. Vorrichtung nach Anspruch 1, wobei die Infrarot-Heizvorrichtungen gleichmäßig auf der äußeren Wand des Heizofens angeordnet sind und zahlreiche Infrarot-Heizvorrichtungen wie erforderlich ein-

gestellt werden können und die Wellenlängen der Infrarotstrahlen, die von den Infrarot-Heizvorrichtungen emittiert werden, alle verschieden sind.

4. Vorrichtung nach Anspruch 1, wobei die Infrarot-Absorptionsfarbe, die auf der äußeren Wand des Pyrolyseofens beschichtet ist, Halbleiter-Titanoxid ist und das Material der isolierenden Schicht auf der inneren Wand des Pyrolyseofens Keramikfaser ist.

5. Vorrichtung nach Anspruch 1, wobei das Material des Pyrolyseofens Siliciumcarbid ist.

6. Schnellaufwärmverfahren unter Verwendung der Vorrichtung nach einem der Ansprüche 1 bis 5, umfassend die folgenden Schritte:
Steuern der Aufwärmungsrate des Pyrolyseofens durch die automatische Steuereinheit, die automatisch gemäß der Zufuhrmenge von Materialien und der Pyrolysetemperatur steuert, wenn die Pyrolysetemperatur im Pyrolyseofen niedriger als eine erste voreingestellte Temperatur ist, wird die Infrarot-Heizvorrichtung eingeschaltet, um die schnelle Aufwärmung des Pyrolyseofens durchzuführen, wenn die Pyrolysetemperatur höher als eine zweite voreingestellte Temperatur ist, wird die Infrarot-Heizvorrichtung abgeschaltet, um die Pyrolysetemperatur im Pyrolyseofen durch Vertrauen auf die isolierende Schicht beizubehalten.

7. Schnellaufwärmverfahren nach Anspruch 6, wobei die Infrarot-Heizvorrichtung eingeschaltet wird, wenn die Pyrolysetemperatur im Pyrolyseofen niedriger als 900 °C ist, und die Infrarot-Heizvorrichtung abgeschaltet wird, wenn die Temperatur höher als 1000 °C ist.

Revendications

1. Dispositif de chauffage rapide pour la pyrolyse de déchets solides organiques, qui comprend un dispositif de chauffage à infrarouge, un four de chauffage, un four de pyrolyse et une unité de commande automatique ; le four de pyrolyse est intégré dans le four de chauffage, le dispositif de chauffage à infrarouge est agencé uniformément sur la paroi côté externe du four de chauffage, la paroi externe du four de pyrolyse est revêtue uniformément avec une peinture absorbant l'infrarouge pour absorber les longueurs d'onde infrarouges de rayonnement thermique provenant du dispositif de chauffage à infrarouge, dans lequel, sous l'action de la peinture absorbant l'infrarouge, le chauffage rapide du four de pyrolyse est réalisé, et la paroi interne du four de pyrolyse est recouverte avec une couche isolante, dans lequel l'unité de commande automatique est configurée pour réguler la vitesse de chauffage du four de pyrolyse en fonction de la température de pyrolyse, dans lequel, lorsque la température de pyrolyse dans le four de pyrolyse est inférieure à une première température prédéfinie, l'unité de commande automatique active le dispositif de chauffage à infrarouge pour réaliser le chauffage rapide du four de pyrolyse, et lorsque la température de pyrolyse est supérieure à une deuxième température prédéfinie, l'unité de commande automatique désactive le dispositif de chauffage à infrarouge pour maintenir la température de pyrolyse dans le four de pyrolyse en s'appuyant sur la couche isolante, dans lequel la vitesse de chauffage du dispositif de chauffage rapide est dans la plage de 75 à 125 °C/s, de préférence de 90 à 110 °C/s, de manière préférée entre toutes de 100 °C/s.

2. Dispositif selon la revendication 1, dans lequel le four de chauffage et le four de pyrolyse ont des formes uniformes, telles que des formes ovale, circulaire, rectangulaire ou autres, pour assurer un chauffage uniforme.

3. Dispositif selon la revendication 1, dans lequel les dispositifs de chauffage à infrarouge sont agencés uniformément sur la paroi externe du four de chauffage, et des dispositifs de chauffage à infrarouge multiples peuvent être installés comme requis, et les longueurs d'onde des rayons infrarouges émis par les dispositifs de chauffage à infrarouge sont toutes différentes.

4. Dispositif selon la revendication 1, dans lequel la peinture absorbant l'infrarouge revêtue sur la paroi externe du four de pyrolyse est de l'oxyde de titane semiconducteur, et le matériau de la couche d'isolation sur la paroi interne du four de pyrolyse est une fibre céramique.

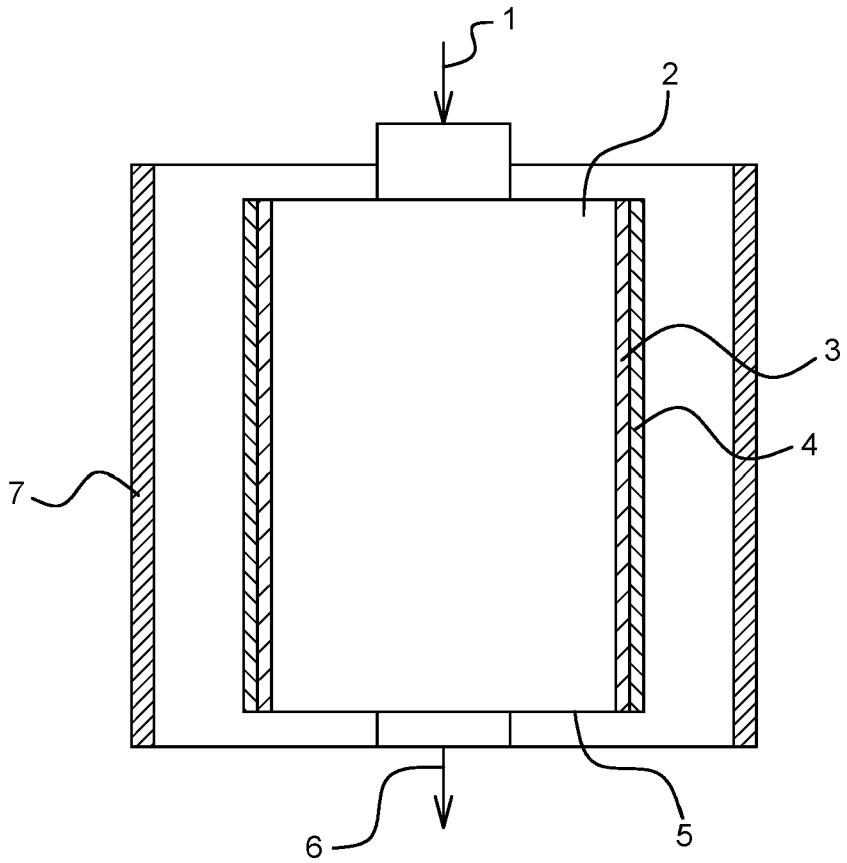
5. Dispositif selon la revendication 1, dans lequel le matériau du four de pyrolyse est le carbure de silicium.

6. Procédé de chauffage rapide utilisant le dispositif selon l'une quelconque des revendications 1 à 5, comprenant les étapes suivantes :
la vitesse de chauffage du four de pyrolyse est régulée par l'unité de commande automatique, qui commande automatiquement en fonction de la quantité d'alimentation de matériaux et la température de pyrolyse, lorsque la température de pyrolyse dans le four de pyrolyse est inférieure à une première température prédéfinie, le dispositif de chauffage à infrarouge est activé pour réaliser le chauffage rapide du four de pyrolyse, lorsque la température de pyrolyse est supérieure à une deuxième température prédéfinie, le dispositif de chauffage à infrarouge est désactivé pour maintenir la température de pyrolyse dans le four de pyrolyse en s'appuyant sur la

couche d'isolation.

7. Procédé de chauffage rapide selon la revendication 6, dans lequel le dispositif de chauffage à infrarouge est activé lorsque la température de pyrolyse dans le four de pyrolyse est inférieure à 900 °C, et le dispositif de chauffage à infrarouge est désactivé lorsque la température est supérieure à 1000 °C.

Fig. 1



REFERENCES CITED IN THE DESCRIPTION

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