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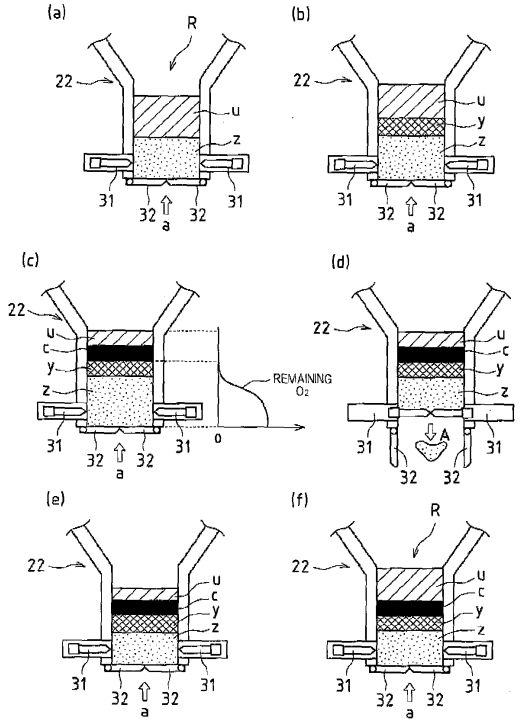
(54) METHOD FOR SUPPLYING COMBUSTION AIR IN VERTICAL WASTE INCINERATOR, AND VERTICAL WASTE INCINERATOR

(57) A method for supplying combustion air in a vertical incinerator according to one embodiment of the present invention is such that during incineration treatment by the vertical incinerator 1, a supplied amount of combustion air a is controlled in such a manner as to be 0.2 to 0.8 times as much as a theoretical air amount that is necessary to completely combust waste R in deposit layers, and the combustion air a is supplied in such a manner as to reduce oxygen in the combustion air a from a lower portion to an upper portion of the deposit layers.

FIG.4



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Description

Technical Field

[0001] The present invention relates to a method for supplying combustion air in a vertical incinerator, and the vertical incinerator in which waste is charged in a sequence into a vertical furnace so as to combust the waste while the combustion air is supplied to deposit layers formed by the waste charged into the furnace, and incineration ash that results after completion of the combustion is discharged in a sequence from a bottom portion of the furnace to outside of the furnace so as to implement incineration treatment for the waste.

Background Art

[0002] Waste such as industrial waste, general waste includes various characteristics, such as a solid, a liquid, and a viscous body, and flammable materials, nonflammable materials, and incombustible materials are mixed, variation in characteristics of wastes is great. In particular, industrial waste associated with medical services includes a large quantity of high moisture waste such as a paper diaper in addition to meltable glass and disposable plastic containers having a high calorific value. Further, it is necessary to dispose sharp-edged materials such as an injection needle, and infectious waste that are packed in a specific package, which makes it difficult to implement pre-treatment to homogenize the characteristics of wastes by agitating and the like.

[0003] When the incineration treatment of the waste in which there is great variation in characteristics of wastes is implemented, it is difficult to maintain a stable combustion condition. Also, the local temperature rise is likely to occur due to combustion of flammable materials having a high calorific value, and fused incombustible materials are adhered to the walls of the furnace so as to form a clinker. There occurs a problem in that the progressed, enlarged clinker causes a hindrance at the time of incineration and incineration ash discharge.

[0004] There have been generally used furnaces including a method of combusting waste while rotating or agitating the waste, such as a rotary kiln type, an inclined rotary hearth type, a horizontal rotary hearth type equipped with an agitating means, in order to implement the incineration treatment of the waste having great variation in characteristics of wastes. However, in these methods, the deposition thickness of the waste in the furnaces becomes thin, so that it is more likely to generate so-called combustion irregularity in which only flammable materials such as paper, plastic, are incinerated first, nonflammable materials are remained. Accordingly, it is necessary to increase hearth areas in order to ensure a combustion time for nonflammable materials and prevent the decrease of the life of refractory materials due to a blow-by and, which causes a problem in that installation areas are increased.

[0005] Incidentally, these days, there has been developed a vertical incinerator to implement the incineration treatment in such a manner that the waste disposed at the lower portion of a vertical furnace is thickly deposited, and the deposited waste are combusted, gas generated through the combustion is combusted at an upper portion of the furnace (for example, see Patent Documents 1 and 2).

[0006] That is, the conventional vertical incinerator shown in Patent Documents 1 and 2 is such that an incineration method is adopted, wherein the installation area is reduced by making its furnace vertical, and waste disposed at the lower portion in the vertical furnace is thickly deposited so as to ensure the deposition thickness of waste, and during the incineration treatment, the deposited waste is piled up in the order of "refining layer", "combustion layer", and "ash layer" from the top thereof and combusted while the combustion condition is controlled, and gaseous flammable materials generated by the combustion are re-combusted at the upper portion of the furnace.

[0007] Incidentally, "the refining layer" is a layer mainly to dry the characteristics of wastes so as to homogenize the waste to be charged. "The combustion layer" is a layer to combust the waste while ensuring a plenty of combustion time. "The ash layer" is a layer to combust remaining unburned materials and deposit incineration ash that results after completion of the combustion.

Related Art Documents

Patent Documents

[0008]

Patent Document 1: Japanese Unexamined Patent Application Publication No. 4-158110.
Patent Document 2: Japanese Examined Utility Model Registration Publication No. 5-31383.

Summary of the Invention

Problems to be Solved by the Invention

[0009] However, with respect to the conventional vertical incinerator shown in Patent Documents 1 and 2, there has been the case where many of flammable materials included in the waste charged at the time of waste injection are immediately combusted in the refining layer, and the temperature in the furnace instantaneously rises, which makes the combustion condition unstable.

[0010] When many of flammable materials are combusted in the refining layer, the content of the flammable materials having a high calorific value is reduced in the waste that transfers to the combustion layer and a percentage of the nonflammable materials is relatively increased. This phenomenon reduces combustion calorie in the combustion layer and causes an increase in ignition

loss of the incineration ash.

[0011] The present invention has been achieved in view of the above circumstances to solve the technical problems, and it is an object of the present invention to provide a method for supplying combustion air in a new vertical incinerator, and the vertical incinerator that maintain a stable combustion condition and possibly accomplish the reduction of ignition loss.

Means of Solving the Problems

[0012] According to one aspect of the present invention, a method for supplying combustion air in a vertical incinerator (hereinafter referred to as "a method of the present invention") may be a method for supplying combustion air in a vertical incinerator in which waste is charged in a sequence into a vertical furnace so as to combust the waste while the combustion air is supplied to deposit layers that are formed by the waste charged into the furnace, and incineration treatment for the waste is implemented by sequentially discharging incineration ash that results after completion of the combustion from a bottom portion to outside of the furnace.

[0013] That is, the method of the present invention targets an incinerator based on the technical concept that the incineration treatment is implemented in such a manner that waste is deposited at the bottom portion of the furnace while the combustion air is supplied to the deposit layers formed by the deposited waste. In particular, other additional structure is not limited as long as the incinerator is based on the technical concept.

[0014] The method of the present invention is characterized most in that during the incineration treatment, the supplied amount of the combustion air is controlled in such a manner as to be 0.2 to 0.8 times as much as a theoretical air amount that is necessary to completely combust the waste in the deposit layers, and the combustion air is supplied in such a manner as to reduce oxygen from a lower portion to an upper portion of the deposit layers.

[0015] Incidentally, "theoretical air amount" means the necessary amount of air to completely combust a combustion object.

[0016] In an ordinary incinerator, the supplied amount of the combustion air is determined in accordance with the quantity of waste charged into a furnace per unit time, a calorific value, and the like, but the combustion air is supplied with some surplus with respect to the theoretical air amount in order to completely combust the charged waste. However, when a surplus amount of air, which is more than necessary, is supplied, there is the case where a temperature in the furnace decreases. Accordingly, the combustion air that is about 1.1 to 1.4 times as much as the theoretical air amount is commonly supplied in the ordinary incinerator

[0017] Also, a conventional vertical incinerator is often configured such that waste deposited at the lower portion of the furnace is combusted, and gaseous flammable materials generated through the combustion are re-combusted at the upper portion of the furnace. The amount of combustion air supplied to the deposit layers formed by the deposited waste is usually about 0.8 to 1.3 times as much as the theoretical air amount.

[0018] However, when incineration treatment for waste in which flammable materials and nonflammable materials are mixed is implemented in the vertical incinerator, and the combustion air that is about 0.8 to 1.3 times as much as the theoretical air amount is supplied to the deposit layers, there has been the case where flammable materials in the waste charged, in particular, at the time of waste injection, are instantaneously, immediately combusted due to the sufficient amount of oxygen left in the upper portion of the deposit layers so as to make the combustion condition unstable.

[0019] Accordingly, the inventors have thoroughly examined the vertical incinerator of this type in order to maintain the stable combustion condition and has obtained the knowledge that the supplied amount of the combustion air is controlled in such a manner as to be 0.2 to 0.8 times as much as the theoretical air amount that is necessary to completely combust the waste in the deposit layers during the incineration treatment, and the combustion air is supplied in such a manner as to reduce oxygen in the combustion air from a lower portion to an upper portion of the deposit layers, and accordingly, in the deposit layers during the incineration treatment, unburned materials in the incineration ash (ash layer) existed in the bottom portion of the furnace and waste in a layer at the time of combustion (combustion layer) existed on the incineration ash are aerobically combusted so as to consume the oxygen in the deposit layers, and there is formed, above the combustion layer, a char layer (reduction layer) in which the pyrolysis (reduction) of waste is facilitated under a high temperature in the substantially absence of oxygen where oxygen is hardly supplied.

[0020] There has been obtained the knowledge that when the char layer in the substantially absence of oxygen is formed above the combustion layer in the deposit layers, an instantaneous temperature rise, which is caused by immediate combustion of flammable materials in a layer (refining layer) above the char layer, is restrained, and combustion condition becomes greatly stable.

[0021] Also, there has been obtained the knowledge that the flammable materials having a high calorific value are not immediately combusted in the refining layer but transferred from the refining layer to the char layer, and then from the char layer to the combustion layer while a large amount of the flammable materials is contained in the waste, so that combustion calorie in the combustion layer is kept.

[0022] Furthermore, the char layer receives heat generated from the combustion layer so as to be in a high temperature state. Accordingly, in the char layer, the waste is exposed in the high temperature in a state where oxygen is insufficient for a relatively long period of time

to implement suppressed combustion, so that the non-flammable materials in the waste sufficiently pyrolyzed. As a result, there has been obtained the knowledge that homogeneous incineration treatment of the waste is facilitated, and the combustion calorie in the combustion layer is maintained, so that the remaining of unburned materials in the incineration ash discharged in the end is remarkably minimized so as to greatly reduce ignition loss.

[0023] When the supplied amount of combustion air is 0.2 times less than the theoretical air amount that is necessary to completely combust the waste in the deposit layers, the combustion layer in the deposit layers is not sufficiently formed due to the low amount of the combustion air. On the other hand, when the supplied amount of combustion air is 0.8 times higher than the theoretical air amount that is necessary to completely combust the waste in the deposit layers, the char layer in the deposit layers is not sufficiently formed due to the too much amount of the combustion air. Accordingly, in the method of the present invention, the supplied amount of combustion air is set in a range of from 0.2 to 0.8 times as much as the theoretical air amount that is necessary to completely combust the waste in the deposit layers. It is preferable that the supplied amount of combustion air be set in a range of 0.3 to 0.7 times as much as the theoretical air amount, and more preferably, in a range of 0.4 to 0.6 times as much as the theoretical air amount

[0024] Incidentally, in the conventional vertical incinerator, there have been disposed a plurality of air intake nozzles along the upper-and-lower direction of a wall of the furnace in order to supply the combustion air to the deposit layers, which allows the combustion air to be supplied from a plurality of portions.

[0025] However, in the method of the present invention, it is necessary to gradually reduce the density of oxygen from the lower portion to the upper portion of the deposit layers formed by the waste charged into the furnace and positively form the char layer in the substantially absence of oxygen on the combustion layer in the deposit layers. Accordingly it is not preferable that a large amount of combustion air be supplied to positions that correspond with the range of from a middle portion to the upper portion in the deposit layers.

[0026] That is, it is extremely difficult to form the stable char layer on the combustion layer in the deposit layers just in the way that the combustion air supplied to the deposit layers is merely 0.2 to 0.8 times as much as the theoretical air amount that is necessary to completely combust the waste in the deposit layers during the incineration treatment.

[0027] In view of this point, in the method of the present invention, the supplied amount of the combustion air is controlled in such a manner as to be 0.2 to 0.8 times as much as the theoretical air amount that is necessary to completely combust the waste in the deposit layers during the incineration treatment, and the combustion air is supplied in such a manner as to reduce oxygen from the lower portion to the upper portion of the deposit layers, so that the char layer in the substantially absence of oxygen is stably formed on the combustion layer in the deposit layers.

[0028] When the combustion air is supplied in such a manner as to reduce oxygen in the combustion air from the lower portion to the upper portion of the deposit layers, it is necessary to supply a large percentage of the total amount of combustion air supplied to the deposit layers from the lower portion (preferably, bottom portion) of the deposit layers. More specifically, it is preferable that 60 percent or more of the total amount of combustion air supplied to the deposit layers be supplied from the lower portion of the deposit layers, or more preferably, 70 percent or more of the total amount be supplied, and further more preferably, 90 percent or more ofthe total amount be supplied.

[0029] That is, in the method of the present invention, it is preferable that most of the combustion air supplied to the deposit layers be supplied from the lower portion of the deposit layers. Accordingly, in the method of the present invention, it is preferable that the combustion air be supplied only from the lower portion of the deposit layers.

[0030] Subsequently, a vertical incinerator of the present invention (hereinafter referred to as "the incinerator of the present invention") will be described. The aforementioned description regarding the method of the present invention is also applied to the incinerator of the present invention. Therefore, the description will be omitted to avoid repetition.

[0031] The incinerator of the present invention may be characterized in that waste is charged in a sequence into a vertical furnace so as to combust the waste while the combustion air is supplied to deposit layers that are formed by the waste charged into the furnace, and incineration treatment for the waste is implemented by sequentially discharging incineration ash that results after completion of the combustion from an incineration ash discharge plate disposed on a bottom portion of the furnace to outside of the furnace, the vertical incinerator includes a plurality of air blow holes configured to supply the combustion air from a bottom portion of deposit layers to the incineration ash discharge plate, wherein the combustion air is supplied from the air blow holes during the incineration treatment, and further a control mechanism configured to control supplied amount of the combustion air in such a manner as to be 0.2 to 0.8 times as much as a theoretical air amount that is necessary to completely combust the waste in the deposit layers.

[0032] It is noted that the air blow holes provided in the incineration ash discharge plate are not limited to one portion but may separately be arranged at a plurality of portions.

Effects of the Invention

[0033] It is expected that the method of the present

invention and the incinerator of the present invention, which include the above-mentioned configuration, keep the stable combustion condition in the vertical incinerator and further reduce the ignition loss.

[0034] That is, with respect to the method of the present invention and the incinerator of the present invention, the supplied amount of combustion air is controlled in such a manner as to be 0.2 to 0.8 times as much as the theoretical air amount that is necessary to completely combust the waste in the deposit layers during the incineration treatment, and the combustion air is supplied in such a manner as to reduce oxygen from the lower portion to the upper portion of the deposit layers, so that the char layer in the substantially absence of oxygen is formed in the deposit layers during the incineration treatment, and the flammable materials in the refining layer existed above the char layer are immediately combusted so as to restrain an instantaneous temperature increase, which makes the combustion condition stable greatly.

[0035] Also, the flammable materials having a high calorific value are not immediately combusted in the refining layer but transferred from the refining layer to the char layer, and then from the char layer to the combustion layer while a large amount of the flammable materials is contained in the waste, so that combustion calorie in the combustion layer is kept.

[0036] Furthermore, the char layer receives heat generated from the combustion layer so as to be in a high temperature state. Accordingly, in the char layer, the waste is exposed in the high temperature in a state where oxygen is insufficient for a relatively long period of time while containing the flammable materials having a high calorific value to implement the suppressed combustion, so that the nonflammable materials in the combustion layer are sufficiently pyrolyzed. As a result, the homogeneous incineration treatment of the waste is facilitated, and the combustion calorie in the combustion layer is kept, so that the remaining of unburned materials in the incineration ash discharged in the end of the process is remarkably minimized so as to greatly reduce ignition loss.

Brief Description of the Drawings

[0037]

[FIG. 1] FIG. 1 is a schematic cross-sectional view of a structure of a vertical incinerator according to an embodiment of the present invention.

[FIG. 2] FIG. 2 is a plane view of an incineration ash discharge plate of the vertical incinerator according to an embodiment of the present invention.

[FIG. 3] FIGs. 3(a) to 3(f) are explanatory diagrams to explain a combustion condition in deposit layers with respect to the vertical incinerator in which a supplied amount of combustion air is 0.8 to 1.3 times as much as a theoretical air amount.

[FIG. 4] FIGs. 4(a) to 4(f) are explanatory diagrams to explain the combustion condition in the deposit layers with respect to the vertical incinerator in which the supplied amount of combustion air is 0.2 to 0.8 times as much as the theoretical air amount.

Modes for Carrying out the Invention

[0038] Hereinafter, embodiments of the present invention will be described referring to the drawings. However, the present invention is not limited to the present embodiments.

[0039] FIG. 1 is a schematic cross-sectional view of a structure of a vertical incinerator. In FIG. 1, the vertical incinerator 1 includes a furnace 2 made up of a cylindrical portion 21 and a funnel portion 22 that is continuously contacted with a lower portion of the cylindrical portion 21, and an incineration ash discharge mechanism 3 disposed at a bottom portion of the furnace 2. Furthermore, a secondary combustion chamber 5 placed on an upper portion of the furnace 2 via an exhaust gas mixing means 4 is provided for the vertical incinerator 1.

[0040] The furnace 2 is made up of a steel casing (not shown) that is constituted of the covering of the furnace 2, an upper refractory material 23 on the inner side (disposed in the cylindrical portion 21), and a lower refractory material 24 (disposed in the funnel portion 22). A charging chute 6 that charges waste R into a furnace and includes a sealing mechanism such as a double damper provided on the side surface of the furnace 2. Also, on the side surface of the furnace 2, there are provided a plurality of secondary combustion air blow holes 25 that arc used for re-combustion of a gaseous flammable material e that is generated by combusting deposit layers. Secondary combustion air b having a normal temperature is supplied from the secondary combustion air blow holes 25 to the cylindrical portion 21 via a forced draft fan 26.

[0041] The funnel portion 22 to stack the charged waste R in a layer is formed in a funnel shape to be squeezed. A water cooling jacket 8 to cool the lower refractory material 24 with cooling water passing through its inside is provided across the entire circumferential surface of the lower refractory material 24 disposed in the funnel portion 22. The waste R charged into the furnace forms deposit layers in the funnel portion 22.

[0042] The incineration ash discharge mechanism 3 is provided at a lower portion of the funnel portion 22 and includes a pair of retractable waste supporting means 31 that are opposite to each other and disposed on the upper side of the mechanism 3, an incineration ash discharge plate 32 that is openable and closable, disposed on the lower side of the mechanism 3, an ash discharger 33, and a drive mechanism for these components which is not shown in the figure.

[0043] The waste supporting means 31 are usually positioned in a retracted state where the waste supporting means 31 are retracted from the inside of the furnace 2. When incineration ash A is discharged after completion of incineration, the waste supporting means 31 are pro-

jected into the furnace 2 (shown in a dot-dash line in the diagram) and support the weight of the deposit layers disposed above the waste supporting means 31. Incinerated ash A disposed below the waste supporting means 31 is discharged into an ash discharger 33 disposed at a lower portion ofthe incineration ash discharge mechanism 3 in accordance with the rotation of the incineration ash discharge plate 32 (shown in the dashed dotted line in the diagram).

[0044] As shown in FIG. 2, a plurality of air blow holes 28 (28a and 28b) are perforated in a radial pattern in the incineration ash discharge plate 32. In the present embodiment, in the case where the air blow holes 28 are perforated in the radial pattern in the incineration ash discharge plate 32, a plurality of air blow holes 28a having a diameter of about 35 to 45 mm are provided in the vicinity of the center of the incineration ash discharge plate 32, and a plurality of air blow holes 27a having a diameter of about 25 to 35 mm are provided in the periphery of the air blow holes 28a. That is, the air blow holes 28a having a relatively large diameter are provided in the vicinity of the center of the incineration ash discharge plate 32, so that a large amount of combustion air a is supplied to the vicinity of the center of the bottom portion of the deposit layers.

[0045] The combustion air a transmitted from a combustion air supply pipe 7 is supplied to the deposit layers through the air blow holes 28. The combustion air a is heated by a high-temperature air preheater 52 provided in the secondary combustion chamber 5 and supplied via a forced draft fan 27. On the path of the combustion air supply pipe 7, there are provided a flow meter F to monitor the flow mount of the combustion air a and an opening and closing valve (damper) D to change the supplied amount of the combustion air a. The supplied amount of the combustion air a according to the present invention is controlled in such a manner as to increase the supplied amount of the combustion air a by opening the opening and closing valve D in the case when a transmission load of the combustion air a is augmented due to an increase in deposition thickness of the deposit layers so as to reduce the flow amount of the combustion air a. In contrast, when the deposition thickness of the waste R decreases so as to reduce the transmission load of the combustion air a, and the flow amount of the combustion air a increases, it is controlled in such a manner as to decrease the supplied amount of the combustion air a by narrowing down the opening and closing valve D.

[0046] The high-temperature gaseous flammable materials e generated by the combustion of the deposit layers are varied into combustion gas w by heat added by a secondary combustion burner 50, and secondary combustion air b having a normal temperature, which is supplied from a secondary combustion air blow hole 25. The combustion gas w is let into the secondary combustion chamber 5 via the exhaust gas mixing means 4 and varied into re-combustion gas r in which the complete incineration of unreacted gas or suspended carbon particulate matters as well as the pyrolysis and combustion of organic compounds such as dioxin is implemented according to the heat added by a re-heating burner 51. Subsequently, the re-combustion gas r is transmitted to gas treatment equipment located outside furnace.

[0047] Next, a combustion condition of the deposit layers deposited at the lower portion of the furnace according to the vertical incinerator 1 of the above-described configuration will be described.

<Combustion State in Case Where Supplied Amount of Combustion Air a Is 0.8 to 1.3 Times As Much As Theoretical Air Amount>

[0048] At the beginning of operation, the waste R charged into the furnace 2 from the charging chute 6 is deposited on an ash layer z remained at the bottom portion of the funnel portion 22 and varied into a refining layer u so as to form deposit layers at the initial stage (see FIG. 3(a)). As to the deposit layers at the initial stage, the waste R in the refining layer u comes in contact with the high-temperature combustion air a heated through the ash layer z so as to be dried, starts the combustion of flammable materials first while consuming oxygen, and forms a combustion layer y while holding embers along with nonflammable materials (see FIG. 3(b)).

[0049] When the supplied amount of the combustion air a is 0.8 to 1.3 times as much as the theoretical air amount, oxygen is sufficiently supplied to the upper portion of the deposit layers. Accordingly, the combustion layer y is gradually expanded over the upper portion of the refining layer u while consuming oxygen. Also, the incineration ash A in the combustion layer y in which the combustion has completed is deposited on the ash layer 2 (see FIG. 3(c)). A graph illustrated on the right side of the diagram shows a state where oxygen (remaining O_2 amount) is consumed through the combustion from the lower portion to the upper portion of the deposit layers).

[0050] When a constant amount or more of the incineration ash A is deposited on the ash layer z, the waste supporting means 31 and the incineration ash discharge plate 32 are operated in a sequence so as to drop the incineration ash A below with respect to the waste supporting means 31 into the ash discharger 33 (see FIG. 3 (d)).

[0051] After discharging the incineration ash A, the incineration ash discharge plate 32 is returned to the original position, and the waste supporting means 31 are displaced to the outside of the furnace 2. Accordingly, the remaining ash layer z, the combustion layer y, and the refining layer u that are disposed above the waste supporting means 31 are dropped in a sequence on the incineration ash discharge plate 32 (see FIG. 3(e)).

[0052] The air permeability of the ash layer z, the combustion layer y, and the refining layer u is improved by the impact at the time of the dropping. Also, a mass of incineration residue in the combustion layer y and the refining layer u disintegrates, so that air permeates the

inside of the mass. Consequently, combustion is further facilitated by the remaining ember.

[0053] Subsequently, when the waste R is charged in a sequence from the charging chute 6, the waste R charged forms a new refining layer u. Also, the lower portion ofthe refining layer u starts the combustion by heat of the combustion layer y and the combustion air a so as to form a new combustion layer y. The incineration ash A in which the combustion has completed is deposited on the ash layer z (see FIG. 3(f)).

[0054] That is, during incineration treatment, when the supplied amount of the combustion air a supplied to the deposit layers is 0.8 to 1.3 times as much as the theoretical air amount, "refining layer u", "combustion layer y" and "ash layer z" in the order beginning at the top are formed, which provides a steady state, even though the position is transferred in accordance with its combustion condition in the deposit layers.

[0055] However, in the steady state, the refining layer u and the combustion layer y are adjoined with each other, and oxygen is sufficiently supplied to the upper portion of the deposit layers. When the waste R is charged, there is the case where there occurs a phenomenon in which flammable materials in the refining layer u is instantaneously, immediately combusted, so as to make the combustion condition unstable.

<Combustion State in Case Where the Supplied Amount of Combustion Air a Is 0.2 to 0.8 Times As Much As Theoretical Air Amount>

[0056] At the beginning of operation, the waste R charged into the furnace 2 from the charging chute 6 is deposited on the ash layer z remained at the bottom portion of the funnel portion 22 and varied into the refining layer u so as to form the deposit layers at the initial stage (see FIG. 4(a)). As to the deposit layers at the initial stage, the waste R in the refining layer u comes in contact with the high-temperature combustion air a heated through the ash layer z so as to be dried, starts the combustion of flammable materials first while consuming oxygen, and forms the combustion layer y while holding embers along with nonflammable materials (see FIG. 4(b)).

[0057] When the supplied amount of the combustion air a is 0.2 to 4.8 times as much as the theoretical air amount, the combustion layer y is gradually expanded over the refining layer u, but the expansion of the combustion layer y stagnates upon depletion of oxygen in the combustion air a. When the expansion of the combustion layer y stagnates, the refining layer u disposed on the combustion layer y is exposed to heat of the combustion layer y with little oxygen left so as to form a char layer c in which the pyrolysis of the waste R is facilitated in a substantially absence of oxygen under a high temperature. Also, the incineration ash A in the combustion layer y in which the combustion has completed is deposited on the ash layer z (see FIG. 4(c). A graph illustrated on the right side of the diagram shows a state where oxygen (remaining O_2 amount) is consumed through the combustion from the lower portion to the upper portion of the deposit layers.).

[0058] When a certain quantity or more of the incineration ash A is deposited on the ash layer z, the waste supporting means 31 and the incineration ash discharge plate 32 are operated in a sequence so as to drop the incineration ash A below with respect to the waste supporting means 31 into the ash discharger 33 (see FIG. 4 (d)).

[0059] After discharging the incineration ash A, the incineration ash discharge plate 32 is returned to the original position, and the waste supporting means 31 are displaced to the outside of the furnace 2. Accordingly, the remaining ash layer z, the combustion layer y, the char layer c, and the refining layer u that are disposed above the waste supporting means 31 are dropped in a sequence on the incineration ash discharge plate 32 (see FIG. 4(e)).

[0060] The air permeability of the ash layer z, the combustion layer y, the char layer c, and the refining layer u is improved by the impact at the time of the dropping. Also, a mass of incineration residue in the combustion layer y, the char layer c, and the refining layer u disintegrates, so that air permeates the inside of the mass. Consequently, combustion is further facilitated by the remaining ember.

[0061] Subsequently, when the waste R is charged in a sequence from the charging chute 6, the waste R charged forms a new refining layer u. Also, the char layer c, to which the oxygen of combustion air a is supplied due to the dropping, begins to combust and turns into a new combustion layer y. Furthermore, the lower portion of the refining layers u being in deficiency of oxygen is formed as a new char layer c. The incineration ash A in which the combustion has completed is deposited on the ash layer z (see FIG. 4(f)).

[0062] That is, during incineration treatment, when the supplied amount of the combustion air a supplied to the deposit layers is 0.2 to 0.8 times as much as the theoretical air amount, "refining layer u", "char layer c", "combustion layer y" and "ash layer z" in the order beginning at the top are formed, which provides a steady condition, even though the positions of each layer are fluctuated in accordance with its combustion condition in the deposit layers.

[0063] Then, when the char layer c in the substantially absence of oxygen is formed between the refining layer u and the combustion layer y in the deposit layers, the phenomenon in which flammable materials in the refining layer u is instantaneously, immediately combusted is restrained, which makes the combustion condition stable greatly.

[0064] Also, the flammable materials in the refining layer u are not immediately combusted while a large amount of the flammable materials is contained in the waste R and transferred from the refining layer u to the char layer c, and continuously from the char layer c to the combus-

tion layer y. Consequently, combustion calorie in the combustion layer y is kept.

[0065] Furthermore, in the char layer c, the waste R is exposed in a high temperature in a state of oxygen deficiency for a relatively long period of time while containing the flammable materials having a high calorific value to implement the suppressed combustion, so that nonflammable materials in the waste R are sufficiently pyrolyzed. As a result, homogeneous incineration treatment of the waste R is facilitated, and the combustion calorie in the combustion layer y is kept, so that the remaining of unburned materials in the incineration ash A discharged in the end is remarkably minimized so as to greatly reduce ignition loss.

Description of the Reference Numeral

[0066]

1	Vertical incinerator
2	Furnace
3	Incineration ash discharge mechanism
4	Exhaust gas mixing means
5	Secondary combustion chamber
6	Charging chute
7	Combustion air supply pipe
8	Water cooling jacket
28	Air blow hole
32	Incineration ash discharge plate
a	Combustion air
u	Refined layer
c	Char layer
y	Combustion layer
z	Ash layer

Claims

1. A method for supplying combustion air in a vertical incinerator in which waste is charged in a sequence into a vertical furnace to combust the waste while the combustion air is supplied to deposit layers that are formed by the waste charged into the furnace, and incineration treatment for the waste is implemented by sequentially discharging incineration ash that results after completion of the combustion from a bottom portion to outside of the furnace, the method comprising:

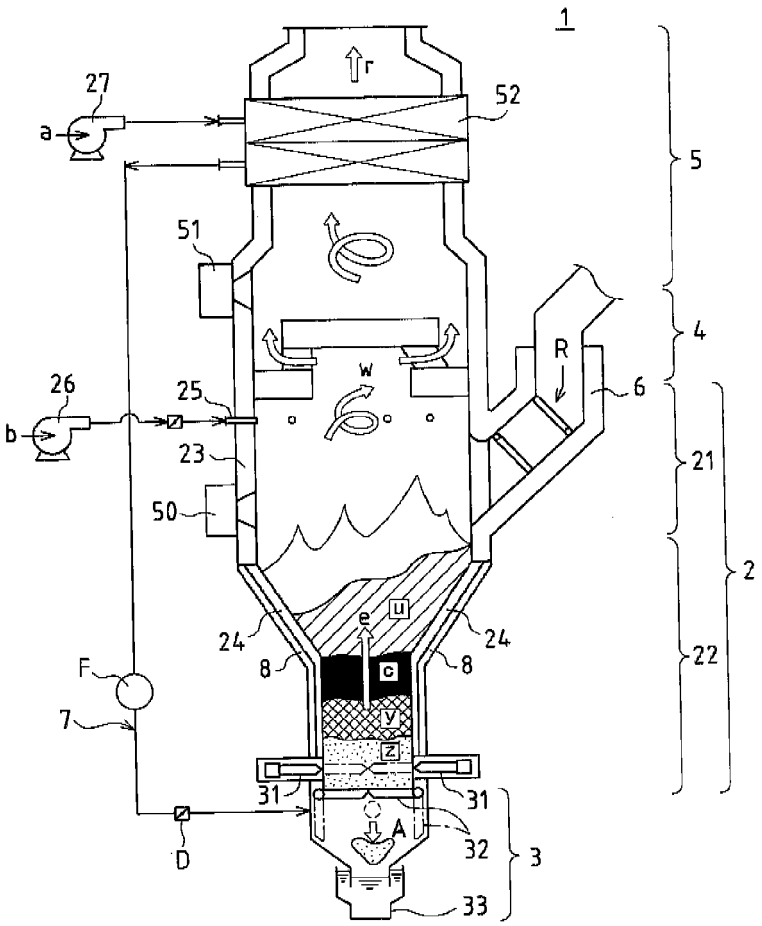
   controlling a supplied amount of the combustion air in such a manner as to be 0.2 to 0.8 times as much as a theoretical air amount that is necessary to completely combust the waste in the deposit layers during the incineration treatment; and
   supplying the combustion air in such a manner as to reduce oxygen in the combustion air from a lower portion to an upper portion of the deposit layers.

2. The method for supplying the combustion air in the vertical incinerator according to claim 1, wherein the combustion air is supplied only from the lower portion of the deposit layers.

3. A vertical incinerator in which waste is charged in a sequence into a vertical furnace to combust the waste while combustion air is supplied to deposit layers that are formed by the waste charged into the furnace, and incineration treatment for the waste is implemented by sequentially discharging incineration ash that results after completion of the combustion from an incineration ash discharge plate disposed on a bottom portion of the furnace to outside of the furnace, the vertical incinerator comprising:

   a plurality of air blow holes provided in the incineration ash discharge plate and configured to supply the combustion air from a bottom portion of the deposit layers,
   wherein the combustion air is supplied from the air blow holes during the incineration treatment; and further
   a control mechanism configured to control a supplied amount of the combustion air in such a manner as to be 0.2 to 0.8 times as much as a theoretical air amount that it is necessary to completely combust the waste in the deposit layers.

FIG.1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r
27
a
52
5
51
4
R
w
26
25
6
b
23
21
50
2
e
u
24
24
8
8
c
F
y
7
z
22
31
31
A
32
3
D
33

FIG.2

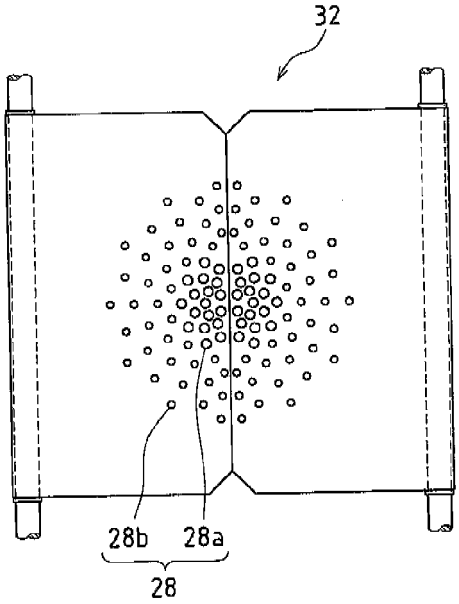
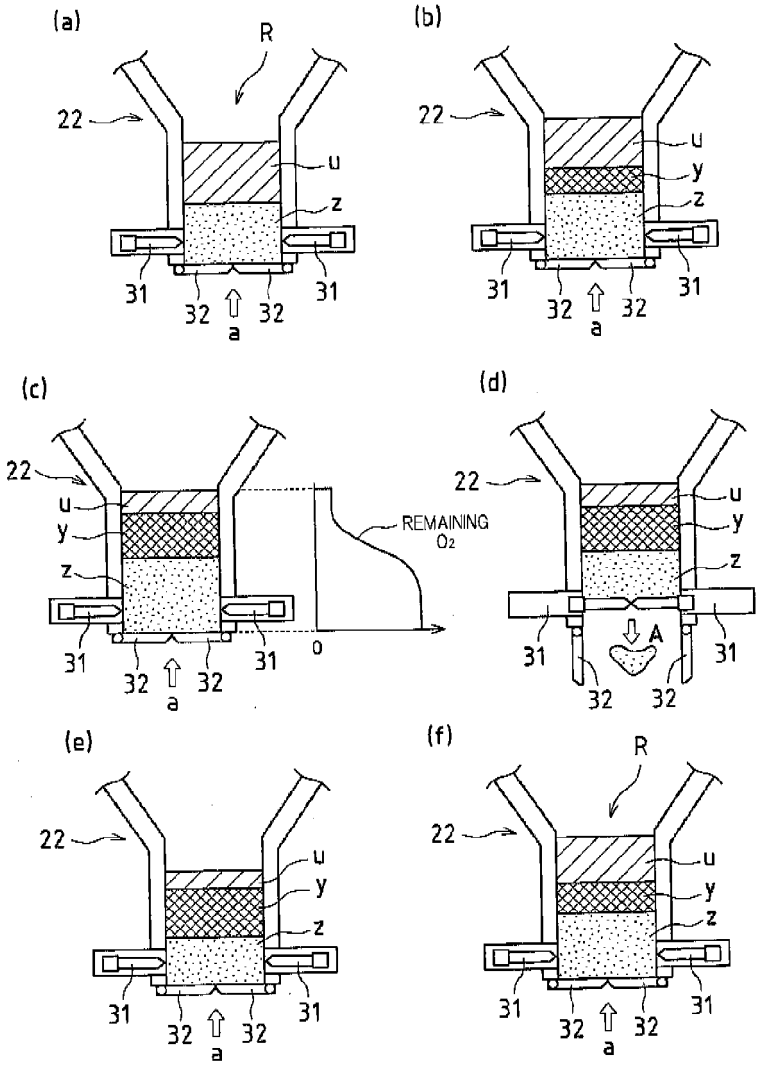


FIG.3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(c)
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z
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(d)
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32
31
(e)
22
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(f)
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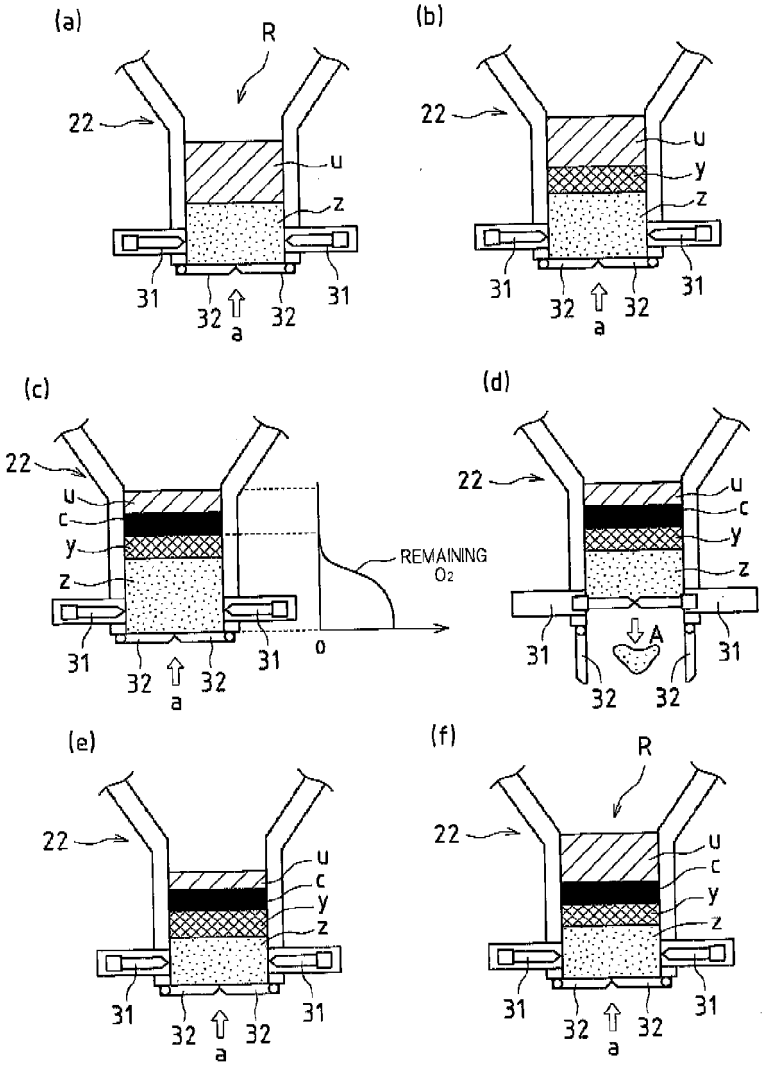
FIG.4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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/052375

A. CLASSIFICATION OF SUBJECT MATTER
F23G5/24(2006.01)i, *F23G5/50*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F23G5/24, F23G5/50

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 51-98171 A (Kubota Tekko Kabushiki Kaisha), 28 August 1976 (28.08.1976), page 1, lower left column, line 17 to column 2, upper right column, line 1; drawings (Family: none)	1-3
Y	JP 2007-57113 A (Plantec Inc.), 08 March 2007 (08.03.2007), page 6, lines 25 to 31 (Family: none)	1-3
Y	JP 2001-289418 A (Hitachi Metals, Ltd.), 19 October 2001 (19.10.2001), column 6, lines 11 to 16 (Family: none)	1-3

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 March, 2011 (08.03.11)	22 March, 2011 (22.03.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/052375

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-233048 A (Kabushiki Kaisha Kinsei Sangyo), 19 August 2004 (19.08.2004), entire text; all drawings (Family: none)	1-3

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4158110 A **[0008]**
- JP 5031383 A **[0008]**