

SPECIFICATION

METHOD AND FACILITY OF REFUSE INCINERATION

FIELD OF THE INVENTION

The present invention relates to a method and facility of refuse incineration in a refuse disposal system.

BACKGROUND OF THE INVENTION

Conventionally, a refuse incineration facility for incinerating urban refuse for disposal is generally provided with a fire grate type refuse incinerator. Sometimes, there is provided a fluid bed incinerator. In addition, an ash fusion furnace is often installed together for reducing volume of incineration ash discharged from the refuse incinerator and for rendering it harmless.

Recent urban refuse is characterized by increase of plastics volume contained in the refuse and increase of amount of refuse as a whole.

The fire grate type refuse incinerator is very effective because refuse other than bulky refuse can be fed into the incinerator as they are without being broken. However, when refuse containing plastics of 30 wt.% or more in combustible is incinerated, there is possibility that molten plastics flows down under the fire grate to damage it or to cause fire accident. Thus, the fire grate type refuse incinerator has a problem that it cannot accommodate recent

refuse containing much plastics. Furthermore, it is demanded to make the incinerator larger so as to accommodate increasing amount of refuse. However, in a flat bed combustion system in which combustion takes place on the surface of a fire grate, when a large volume of refuse is fed, the fire grate is difficult to support such large volume because it is bent, so that there is limit in disposing a large volume of refuse. Thus, the volume of refuse which can be incinerated in a typical refuse incinerator is said to be limited to 1000 tons a day.

On the other hand, the fluid bed incinerator is suitable for incineration of refuse containing large amount of plastics because material to be incinerated is incinerated through suspended combustion while the material is caused to float and flow in a fluid layer. However, since the fluid bed incinerator requires much power for breaking and fluidizing refuse, the volume to be incinerated is generally limited to 200 tons a day, and it is difficult to increase the volume anymore.

DISCLOSURE OF THE INVENTION

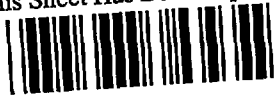
The present invention is intended to provide a method and a facility for refuse incineration which can efficiently incinerate refuse containing a large volume of plastics with a fire grate incinerator, and which can dispose a large volume of refuse.

To attain such object, a method for incinerating



refuse according to the present invention comprises a preprocessing process for preprocessing combustible, said preprocessing process comprising a first breaking step for primarily breaking combustible; a separation step for separating metal and noncombustible from the broken combustible; a second breaking step for secondarily breaking the separated broken noncombustible; and a classification step for classifying the broken combustible into coarse combustible and fine combustible; wherein the preprocessed and formed coarse combustible is fed onto a fire grate of a refuse incinerator for combustion in a primary combustion chamber, the preprocessed and produced fine combustible being supplied as fuel to a combustion burner for a secondary combustion chamber which is provided above the primary combustion chamber of the refuse incinerator.

A refuse incineration facility according to the present invention comprises a preprocessing facility comprising a first breaker for primarily breaking combustible, a metal sorter for sorting metal from the broken combustible, a noncombustible separator for separating noncombustible from the broken combustible, a secondary breaker for breaking coarse combustible after the separation, and a classifier for classifying the secondarily broken combustible into coarse combustible and fine combustible; a refuse incinerator formed with a primary combustion chamber on a fire grate for incinerating the combustible processed in the preprocessing facility, and with a secondary combustion chamber thereabove;



a coarse combustible supply line for supplying the coarse combustible separated by said classifier to the primary combustion chamber of the refuse incinerator; and a fine combustible incineration supply line for supplying as fuel said fine combustible to a combustion burner mounted in the second combustion chamber of the refuse incinerator.

With the above arrangement, the coarse combustible is flat bed burnt on the fire grate in the primary combustion chamber, and the fine combustible is burnt in suspended combustion by combustion burner in the secondary combustion chamber, whereby most of plastics easily broken can be burnt in suspended combustion in the secondary combustion chamber, and, thus, refuse even with plastics content of 30 wt.% or more can be sufficiently burnt. In addition, since the refuse can be incinerated in both the primary and secondary combustion chambers, the volume of refuse being incinerated can be significantly increased than that by a refuse incinerator which performs flat bed combustion only on the fire grate.

In addition, it is possible to stabilize flame, and to improve combustion efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is the arrangement of a refuse incineration facility in an embodiment according to the present invention;

Fig. 2 is a longitudinal sectional view showing a second embodiment of a refuse incinerator applied to the

refuse incineration facility;

Fig. 3 is a longitudinal sectional view of a combustion fluff burner for the refuse incinerator;

Fig. 4 is a graph showing CO concentration in the refuse incinerator;

Fig. 5 is a longitudinal sectional view showing a third embodiment of a refuse incinerator applied to the refuse incineration facility;

Fig. 6 is a longitudinal sectional view showing a secondary air nozzle of the refuse incinerator;

Fig. 7 is a longitudinal sectional view showing a fourth embodiment of a refuse incinerator applied to the refuse incineration facility; and

Fig. 8 is a graph showing NO_x and CO concentration in the refuse incinerator.

DESCRIPTION OF THE EMBODIMENTS

Referring to Fig. 1, a refuse incinerator 1 comprises a primary combustion chamber 4 for flat bed combustion on a plurality of fire grates 2 of coarse combustible fed from a hopper 3, and a secondary combustion chamber 7 for suspended combustion of fine combustible with a combustion fluff burner 5 and a secondary air nozzle 6 above the primary combustion chamber 4.

An ash fusion furnace 8 installed together with the refuse incinerator 1 is provided with a fusion fluff burner 9 and a slag cooling chamber 10. The fusion fluff burner 9

heats and melts incineration residue discharged from the refuse incinerator 1, and the generated molten slag is water cooled in the slag cooling chamber 10 to form granulated slag for reducing its volume and rendering it harmless.

An electric power generation facility 41 installed together with the refuse incinerator 1 is to recover exhaust gas exhausted from the refuse incinerator 1 and to generate electric power. The electric power generation facility 41 comprises a superheater 42 which is a boiler for recovering heat from the exhaust gas exhausted from the refuse incinerator 1, an independent superheater 43 for obtaining high power by superheating the steam obtained by the superheater 42, a steam turbine 44 rotatably driven by the high temperature steam from the independent superheater 43, a generator 45 being started by the steam turbine 44, and an exhaust heat recovery unit 46. Then, the independent superheater 43 is provided with a superheating fluff burner 43a which is a superheating burner.

A preprocessing facility 11 for preprocessing collected refuse before feeding into the refuse incinerator 1 comprises a first breaker 12a for performing a first breaking process 12 in which combustible are broken into about 50 - 80 mm, a magnetic selector 13a and an aluminum selector 13b for performing a metal selection process 13 in which metal is removed from the combustible broken by the first breaker 12, a dryer 14a for performing a drying process 14 in which the combustible after selection is dried, an air gravitation

separator 15a for performing a non-combustible separation process 15 in which non-combustible is separated from the dried combustible, a second breaker 16a for performing a second breaking process 16 in which combustible after separation is further broken, and a classifying sieve 17a for performing a classification process 17 in which the broken combustible is classified into fine combustible of 5 mm or less (hereinafter called "fluff") and coarse combustible larger than 5 mm.

Between the preprocessing facility 11, and the refuse incinerator 1, the ash fusion furnace 8 and the electric power generation facility 41, there are provided a non-combustible supply line 21 for supplying the non-combustible separated by the non-combustible separation process 15 into the hopper 3 of the refuse incinerator 1; a coarse combustible supply line 22 for supplying the coarse combustible separated by the classification process 17 to the hopper 3 of the refuse incinerator 1; a re-breaking line 23 for sometimes supplying parts of the coarse combustible to the second breaking process 16 again; a fine combustible incineration supply line 24A for supplying the fluff separated by the classification process 17 as fuel to the combustion fluff burner 5 of the refuse incinerator 1; a fine combustible fusion supply line 24B for supplying the fluff separated by the classification process 17 as fuel to the fusion fluff burner 9 of the ash fusion furnace 8; and a fine combustible superheating supply line 24 C for supplying the fluff separated by the classification process 17

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as fuel to the superheating fluff burner 43a of the electric power generation facility 41.

There is an oxygen concentrator 31 for concentrating oxygen concentration in the air to about 30%. The refuse incineration facility comprises a combustion enriched air supply line 32A for supplying oxygen enriched combustion air in which oxygen concentration is concentrated to about 30% as combustion air from the oxygen concentrator 30 to the secondary air nozzle 6 and the combustion fluff burner 5 of the refuse incinerator 1; a fusion enriched air supply line 32B for supplying oxygen enriched air from the oxygen concentrator 31 to the fusion fluff burner 9 of the ash fusion furnace 8; and a superheating enriched air supply line 32C for supplying oxygen enriched air from the oxygen concentrator 31 to the superheating fluff burner 43a of the electric power generation facility 41.

With the above arrangement, combustible collected as combustible refuse of classified and collected urban refuse is primarily broken into size of 50 - 80 mm square in the first breaking process 12. Then, after metal is removed in the metal selection process 13, the combustible is dried in the drying process 14. Subsequently, noncombustible is removed from the combustible in the non-combustible separation process 15. Furthermore, after the combustible is secondarily broken in the second breaking process 16, it is separated into fluff of 5 mm square or less and coarse combustible of more than 5 mm square in the classification process 17.

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Then, the coarse combustible is supplied from the coarse combustible supply line 22 to the hopper 3 of the refuse incinerator 1, fed onto the fire grate 2 for flat bed combustion. Since the non-combustible separated in the non-combustible separation process 15 contains small amount of combustible, it is supplied from the non-combustible supply line 21 to the hopper 3, and incinerated together with the coarse combustible. Sometimes, part or all of the coarse combustible is fed again to the second breaker 16a from the re-breaking line 23 for further breaking.

In addition, the fluff is supplied as fuel from the fine combustible incineration supply line 24A to the combustion fluff burner 5, and blown into the secondary combustion chamber 7 for suspended combustion. At this moment, oxygen enriched air is supplied from the oxygen concentrator 31 to downstream to the combustion fluff burner 5 through the combustion enriched air supply line 32A, and blown into the secondary combustion chamber 7 from the secondary air nozzle 6 for secondary combustion. This lowers concentration of NOx, and promotes agitation and mixing with the fuel for efficient combustion.

Incineration residue discharged from the refuse incinerator 1 is supplied to the ash fusion furnace 8. Then, the fluff is supplied to the fusion fluff burner 9 through the fine combustible fusion supply line 24B, and burnt together with oxygen enriched air which is supplied to the burner 9 through the fusion enriched air supply line 32B. The heat

heats and melts the incineration residue to form molten slag. The molten slag is cooled in the slag cooling chamber 10 to produce granulated slag. At the moment, since the fluff is burnt with oxygen enriched combustion air concentrated to oxygen concentration of about 30%, the fluff only 1 mm square or less of which can be burnt in the normal oxygen concentration can be burnt even if it is 5 mm square or less. In addition, it can be burnt at higher temperature, and flame can be stabilized so that combustion efficiency can be improved. Furthermore, since amount of exhaust gas can be reduced by about 30%, it is possible to improve the heat efficiency and to reduce the size of an exhaust gas treatment facility. In addition, various fuel may be mixed in the fluff as auxiliary fuel, and burnt in the fusion fluff burner 9.

Exhaust gas exhausted from the refuse incinerator 1 is discharged from the superheater 42 through the exhaust gas treatment unit. Then, steam obtained from the superheater 42 is superheated to steam with higher temperature by the independent superheater 43, supplied to the steam turbine 44, and used by the generator 45 for electric power generation. In the independent superheater 43, the fluff is supplied through the fine combustible superheating supply line 24C, and burnt in the superheating fluff burner 43a with oxygen enriched combustion air supplied from the oxygen concentrator 31 through the superheating enriched air supply line 32C. Steam is superheated by the heat therefrom. At the moment, since the fluff is burnt in oxygen enriched combustion air

concentrated to oxygen concentration of about 30%, even fluff of 5 mm square or less can be burnt, whereby combustion can be performed at a higher temperature and flame can be stabilized, so that the combustion efficiency can be improved.

Furthermore, since amount of exhaust gas can be reduced by about 30%, it is possible to improve the heat efficiency and to reduce the size of the exhaust gas treatment facility. Of course, various fuel may be mixed as auxiliary fuel for the fluff, and burnt in the superheating fluff burner 43a.

According to the above embodiment,

(1) Since coarse combustible and combustible accompanied by non-combustible are flat bed burnt in the fire grate 2 of the primary combustion chamber 4, and burned in suspended combustion in the secondary combustion chamber 7 by the combustion fluff burner 5 with the fluff as fuel, even refuse containing plastics by 30 wt.% or more can be burnt without any trouble. In addition, refuse can be disposed at amount of incineration of 1,000 tons/day or more without limitation of strength of the fire grate 2.

(2) Since the fluff is burnt by supplying oxygen enriched combustion air concentrated to oxygen concentration of about 30% to the secondary air nozzle 6 and the fusion fluff burner 9, fuel for the ash fusion furnace 8 can be significantly reduced. In addition, the fluff can be burnt without breaking to 1 mm square or less, so that the operating cost can be significantly reduced. Furthermore, amount of exhaust gas can be reduced by about 30%, so that the

processing capacity of the treatment facility for exhaust gas can be reduced.

(3) Since, in the electric power generation facility 41, the superheating fluff burner 43a is installed on the independent superheater 43, and supplied with oxygen enriched combustion air concentrated to oxygen concentration of about 30% to burn the fluff, fuel for the independent superheater 43 can be significantly reduced. In addition, the oxygen enriched combustion air can burn even fluff of 5 mm square or less, and reduce the amount of exhaust gas by about 30% with efficient combustion. Therefore, it is possible to significantly reduce the operating cost, and to lower burden on the exhaust gas treatment facility.

Then, a second embodiment of the refuse incinerator provided in the refuse incineration facility is described with reference to Figs. 2 - 4.

This refuse incinerator 51 has a feature in a combustion fluff burner 53 provided in the secondary combustion chamber 52. That is, when fluff is burnt in the secondary combustion chamber 52 with the combustion fluff burner 53, combustion is caused only with secondary combustion to deteriorate mixing with combustion gas from a primary combustion chamber 55 burnt on a fire grate 54, so that temperature and oxygen concentration are non-uniformly distributed. Consequently, if there arises variation where air ratio in the entire refuse incinerator 51 lowers, unburnt components such as CO and DXNs are generated.

To solve such situation, the combustion fluff burner 53 comprises, as shown in Fig. 3, a fluff supply tube 61 disposed at the center of shaft, an air supply tube 62 fitted over the fluff supply tube 61, and an agitation exhaust gas supply tube 63 fitted over the air supply tube 62. Then, the fluff supply unit 56 to which a fine combustion supply line 24A is connected supplies predetermined amount of fluff to the fluff supply tube 61, a secondary air fan 57 supplying secondary combustion air with ordinary oxygen concentration to the air supply tube 62 to form a secondary combustion region with fluff fuel and the secondary combustion air. Furthermore, exhaust gas drawn by an exhaust gas fan 57 from the exhaust gas outlet of the refuse incinerator 1 is supplied as agitation gas to the agitation gas supply tube 63 through an exhaust gas circulating pipe 58, swirled by an agitation fan 63a, and blown around the secondary combustion region.

If the exhaust gas outlet temperature is about 950° comparison between the conventional system where no exhaust gas is blown in and the above system shows, as shown in Fig. 4, an effect by blowing of the exhaust gas as low CO concentration is found as the result of experiment. Therefore, according to the above embodiment, mixture with combustion gas rising from the primary combustion chamber 55 is improved, and temperature and oxygen concentration are uniformly distributed, so that generation of unburnt components such as CO and DXNs is prevented even if there is variation such as lowering of air ratio.

In this second embodiment, exhaust gas is used as the agitation gas. This is advantageous in that, although it requires facilities such as the exhaust gas fan 57 and the exhaust gas circulation pipe 58, there is no need to increase the capacity of exhaust gas post-treatment facility, and that excessively elevated temperature in the secondary combustion chamber 52 can be effectively lowered so that it can be used for control. As shown in Fig. 2 with a phantom line, in place of the exhaust gas fan 57 and the exhaust circulation pipe 58, a secondary air fan 57 and an agitation gas supply tube 63 are connected by an air supply pipe 59 to use air in place of the exhaust gas. This is advantageous in the facility cost.

Then, a third embodiment of the refuse incinerator provided in the refuse incineration facility is described with reference to Figs. 5 and 6.

This refuse incinerator 71 is characterized in cooling gas nozzles 73A and 73B provided in a secondary combustion chamber 72. That is, when fluff is burnt in the secondary combustion chamber 72 by a combustion fluff burner 74, temperature in the secondary combustion chamber 72 rises to increase generation of NOx and to generate slugging.

To solve this, as shown in Fig. 6, a secondary combustion air nozzle 75 is provided with an air supply tube 75a disposed at the center of shaft, and a cooling gas nozzle 73A over which a swirl fin 73a is fitted and mounted. In addition, another cooling gas nozzle 73B is provided below the combustion fluff burner 74. Then, post combustion air is

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supplied from an air supply fan 76 to the air supply tube 73a, and blown into the secondary combustion chamber 72, exhaust gas drawn from the exhaust gas outlet of the refuse incinerator 71 by an exhaust gas fan 77 being supplied to the cooling gas nozzles 73A and 73B through the exhaust gas circulation pipe 76 and blown into the secondary combustion chamber 72. Amount of exhaust gas supplied from the gas supply tube 73b is controlled by operating exhaust gas control valves 78a and 78b with a controller 79 based on a value detected by a temperature detector which detects the temperature of the secondary combustion chamber 72, so that the temperature of the secondary combustion chamber 72 is adequately controlled.

According to the above embodiment, since the exhaust gas and the air are separately supplied and mixed in the secondary combustion chamber 72, instead of previously mixing and supplying them, the amount of the exhaust gas to be mixed can be sufficiently assured, so that temperature can be effectively controlled in the secondary combustion chamber 72. In addition, since the exhaust gas is utilized, there is no need to change specifications of the exhaust gas treatment facility such as its capacity.

Then, a fourth embodiment of the refuse incinerator provided in the refuse incineration facility is described with reference to Figs. 7 and 8.

This refuse incinerator 81 is characterized in that a reduction combustion region 84 is formed between a primary

combustion chamber 82 and a secondary combustion chamber 83 to perform three stage combustion. That is, when fluff is burnt in the secondary combustion chamber 82 with a combustion fluff burner 85, combustibility is improved in the primary combustion chamber 82 and the secondary combustion chamber 83 to rise temperature, leading to a problem that much NOx is increased.

To solve this problem, there is provided a plurality of reduction fuel nozzles 87A and 87B downstream of the combustion fluff burner 85 and between the primary and secondary combustion chambers 82 and 83, the nozzles blowing into the furnace from a reduction fuel supply unit 89 reduction fuel such as fluff fuel, natural gas or LPG gas used in the combustion burner 86. There is also provided a secondary air nozzle 88 for blowing post-combustion air.

With the above arrangement, the reduction combustion region 84 is formed upstream of the primary combustion chamber 82 by supplying reduction fuel from the reduction fuel nozzles 87A and 87B into the furnace so as to reduce NOx generated in the primary combustion chamber 82 to N₂. Air ratio in the reduction combustion region 84 is set to a range of 0.65 - 0.90. Thus, NOx level is lowered.

Here, if the exhaust gas outlet temperature is about 950° and oxygen concentration is 5 - 6%, comparison between the conventional system where no exhaust gas is blown in and the above system shows, as shown in Fig. 8, that NOx and CO are attained to be lowered in the exhaust gas.



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CLAIMS

1. A method for incinerating refuse comprising a preprocessing process for preprocessing combustible, said preprocessing process comprising a first breaking step (12) for primarily breaking combustible; a separation step (13) for separating metal and noncombustible from the broken combustible; a second breaking step (16) for secondarily breaking the separated broken noncombustible; and a classification step (17) for classifying the broken combustible into coarse combustible and fine combustible; wherein the preprocessed and formed coarse combustible is fed onto a fire grate (2) of a refuse incinerator (1) for combustion in a primary combustion chamber (4), the preprocessed and produced fine combustible being supplied as fuel to a combustion burner (5) for a secondary combustion chamber (7) which is provided above the primary combustion chamber (4) of the refuse incinerator (1).

2. The method for incinerating refuse in a refuse incineration facility according to Claim 1, wherein the preprocessed and produced fine combustible is supplied as fuel to a fusion burner (9) in a burner type ash fusion furnace (8) also provided in the refuse incinerator (1).

3. The method for incinerating refuse in a refuse incineration facility according to Claim 1 or 2, wherein the





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preprocessed and produced fine combustible is supplied as fuel to a superheating burner (43a) of an independent superheater (43) in an electric power generation facility (41) also provided in the refuse incinerator (1).

4. The method for incinerating refuse in a refuse incineration facility according to Claim 1, wherein at least one of secondary combustion air supplied to the secondary combustion chamber (7) of the refuse incinerator (1) and combustion air supplied to the combustion burner (5) is oxygen enriched air.

5. The method for incinerating refuse in a refuse incineration facility according to Claim 2, wherein combustion air supplied to the fusion burner (9) in the ash fusion furnace (8) is oxygen enriched air.

6. The method for incinerating refuse in a refuse incineration facility according to Claim 3, wherein combustion air supplied to the superheating burner (43a) of the superheater (43) is oxygen enriched air.

7. The method for incinerating refuse according to Claim 1, wherein agitation gas is blown around the secondary combustion region formed by the combustion burner (53) of the refuse incinerator (51), and combustion exhaust gas discharged from the refuse incinerator or air is used as the agitation

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gas.



8. The method for incinerating refuse according to Claim 1, wherein post-combustion gas is blown downstream of the secondary combustion region formed by a combustion burner (74) of a refuse incinerator (71) from a secondary combustion air nozzle (75), and combustion exhaust gas discharged from the refuse incinerator (71) and air is used as the post-combustion air.

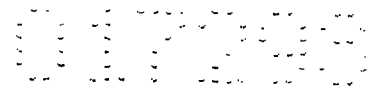
9. The method for incinerating refuse according to Claim 1, wherein reduction fuel is supplied between a primary combustion chamber (82) on a fire grate of a refuse incinerator (81) and a secondary combustion chamber (83) having a combustion burner (85) to form a reduction combustion region (84).

10. An incineration facility comprising a preprocessing facility (11) comprising a first breaker (12a) for primarily breaking combustible, a metal sorter (13a/13b) for sorting metal from the broken combustible, a noncombustible separator (15a) for separating noncombustible from the broken combustible, a secondary breaker (16a) for breaking coarse combustible after the separation, and a classifier (17a) for classifying the secondarily broken combustible into coarse combustible and fine combustible; a refuse incinerator (1) formed with a primary combustion chamber (4) on a fire grate





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(2) for incinerating the combustible processed in the preprocessing facility (11), and with a secondary combustion chamber (7) thereabove; a coarse combustible supply line (22) for supplying the coarse combustible separated by said classifier (17a) to the primary combustion chamber (4) of the refuse incinerator (1); and a fine combustible incineration supply line (24A) for supplying as fuel said fine combustible to a combustion burner (5) mounted in the second combustion chamber of the refuse incinerator (1).

11. The incineration facility according to Claim 10 further comprising a burner type ash furnace (8) for heating and melting with a fusion burner (9) incineration residue discharged from the refuse incinerator (1) thereby to produce slag, and a fine combustible fusion supply line (24B) for supplying coarse combustible separated by the classification process (17a) as fuel to the fusion burner (9).

12. The incineration facility according to Claim 10 further comprising an electric power generation facility (41) having an independent superheater (43) for heating steam obtained from a boiler (42) of the refuse incinerator (1), and generating electric power by driving a turbine (44), and a fine combustible superheating supply line (24C) for supplying coarse combustible separated by the classifier (17a) as fuel to a superheating burner (43a) of the independent super heater (43).





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13. The incineration facility according to Claim 10 further comprising downstream of the secondary combustion chamber (72) of the refuse incinerator (71) a secondary combustion air nozzle (75) for blowing post-combustion gas, said secondary combustion air nozzle (75) comprising an air supply tube (75a) disposed at the center of the shaft thereof and for blowing secondary combustion air into the secondary combustion chamber, and a cooling gas supply tube (73A) fitted over said air supply tube (75a) and for blowing combustion exhaust gas from the refuse incinerator (71) into the secondary combustion chamber (72).

14. The incineration facility according to Claim 10 further comprising a reduction fuel nozzle (87) disposed between the primary combustion chamber (82) and the secondary combustion chamber (83) of the refuse incinerator (81), thereby a reduction combustion region (84) being formed with supplied reduction fuel.

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