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(54) **Waste incinerator flue gas recirculation**

(57) The invention relates to a method for the incineration of waste material in an incinerator, comprising:

supplying waste material to an incineration zone which contains an incineration grid (5), wherein the waste material (6) is supplied to a first side of the incineration grid and is moved to a second side during the method,
supplying from below through the incineration grid (5) and the waste material (6) placed thereon a primary gas so as to at least partially incinerate said waste material in a combustion area that stretches from the incineration grid to a first level above the incineration grid. This method is improved because the incineration zone comprises at least two zones, the waste material being supplied to a first zone, and wherein during the method the waste material is moved to a successive connected zone, and that a first partial primary gas (1-4) supply is supplied to the first zone with an oxygen content of 20% by volume and a temperature from 50°C to 450°C, preferably from 50°C to 300°C.

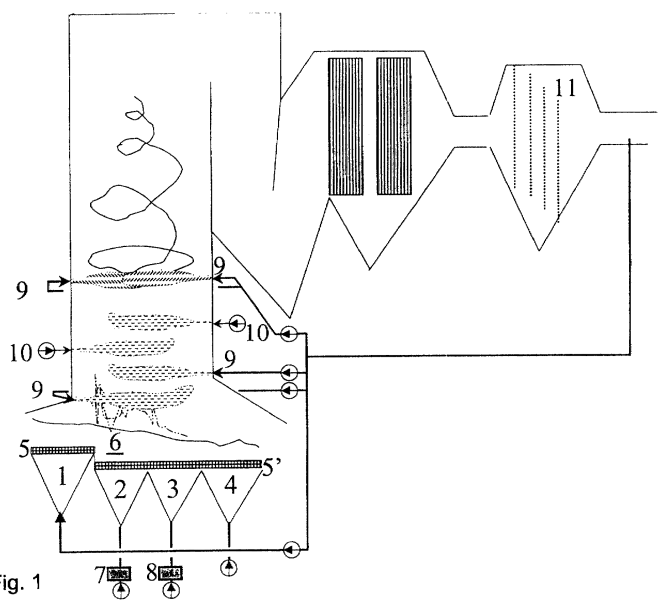

Fig. 1

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Description

[0001] The invention in question relates to a method for burning waste in a waste incinerator according to the preamble of claim 1, as well as a high efficiency waste incinerator.

[0002] Waste incinerators, and the way in which they work, are known in practice. In general the waste material to be incinerated is placed on a support with holes in it, generally known as the incinerator grid, wherein combustion air as primary gas is brought from below up through the incinerator grid and the waste material. This combustion air supplies the necessary oxygen required for the incineration. This air is often pre-heated in order to make the waste burn better, since the hot combustion air has a heating effect on the material to be incinerated, and also partly helps to dry the waste material so that it is easier to ignite. However, because of the inhomogeneous content of the waste material in fact a surplus of oxygen or a shortage of oxygen may arise locally in the waste bed, depending on the position of the waste bed and the amount of incineration that takes place. The gases resulting from the incineration (flue gases) therefore also have an uneven composition.

[0003] In order to further burn these flue gases, which can contain carbon monoxide and particles of other incombustible waste in places, and to mix these with the parts of the gas that still contain oxygen, use is made of a so-called secondary injection. This injection of secondary gas takes place at a particular height above the waste bed, wherein the flue gases mix together sufficiently to form a homogenised whole. The secondary gas consists generally of air, which contains oxygen that can be used by the incineration reaction. This means that there is always a surplus of oxygen available from the point of feeding in the secondary gas.

[0004] In the case of large-scale incinerators it is not always possible to achieve a sufficient mix of the inhomogeneous flue gases by means of the addition of the secondary gas. In this case the addition of a third gas takes place at a height above the input of the secondary gas. For the addition of the third gas there is a preference for using waste gas (flue gas) from the waste incinerator (recirculation of flue gas). This avoids the fact that the third gas should be pre-heated, as might be the case if cold air from outside were to be used.

[0005] While the technique described here is generally adopted, there are a number of drawbacks. The efficiency of the usual waste incinerators is relatively low, and furthermore the flue gases created contain a large proportion of unwanted substances such as a large quantity of nitrous oxides, and carbon monoxide. In the publication DE-A-3915992 a number of improvements are proposed, especially for the reduction of amounts of nitrous oxides.

[0006] The invention aims at providing an improved technique as mentioned in the opening words, wherein these drawbacks can be lessened. In particular the invention aims at providing a technique wherein the efficiency of the installation can be improved and wherein the emission of dangerous substances can be lessened.

[0007] For this the invention provides a method as described in the preamble, which is characterised in that the incineration zone comprises at least two zones, the waste material being supplied to a first zone, and wherein during the method the waste material is moved to a successive connected zone, and that a first partial primary gas supply is supplied to the first zone with an oxygen content of < 20% by volume and a temperature from 50°C to 450°C, preferably from 50°C to 300°C, and the temperature is controlled for each partial primary gas supply. By using these measures a technique is provided which results in an improved efficiency and wherein the amount of dangerous substances is minimised.

[0008] A method according to the invention can especially be advantageously carried out using the measures as described in the claims stated later in this document.

[0009] According to the invention a primary gas is used in the first zone that has a low oxygen content. Because of the low oxygen content, an increase in temperature does not automatically result in the waste material actually combusting. Therefore, even a temperature higher than 300°C, for example 450°C or higher, can also be applied. Because the primary gas serves in the first instance to heat and dry the compact parts of the waste material, in principle this does not result in any problems. In the second instance the easily combustible parts of the waste material combust as a result of the primary part gas supply, which therefore takes place with a deficiency of oxygen. This means that the incineration on the waste bed only partly takes place. Consequently, a relatively large amount of carbon monoxide, CH_4, and other products arising from the reaction in the incineration can be released. Other parts of the first primary part gas supply will not result in any combustion and will therefore leave the waste bed with a low oxygen percentage. These parts of gas that are released in the first zone are mixed together with the secondary gas. The parts of the primary gas which contain a surplus of oxygen, as a result of the combustion not being good enough in parts of the waste bed, thereby ensure at least a part of the carbon monoxide being burnt, as described previously. Because of the limited combustion of the waste material in the first zone, the temperatures in the waste bed remain relatively low and the waste material will only be pyrolyzed to a limited extent. In a following zone where a greater amount of oxygen is added, this results in good combustion and a higher temperature in the waste bed than if combustion takes place in the first zone. Because of the waste material being inhomogeneous, and the inhomogeneous spread of the waste material on the incinerator grid, there will always be some parts of the waste material that receive too little oxygen.

[0010] As mentioned before, the primary gas in the first zone serves in the first place to dry the waste material that has been placed in the incinerator. To do this, the primary gas that is supplied to the first zone is fed in at a temperature from 50°C to 300°C, preferably from 150°C to 300°C. The pre-heating of the primary gas for a waste incinerator requires a great deal of energy, and is especially necessary if the waste material is difficult to burn. The pre-heating of the primary gases is therefore dependent on the so-called thermal value of the waste material. The preference is for the primary gas to be at a temperature of approximately 100°C in the case of a thermal value of 11,000 kilojoules per kilogram, while the temperature of the primary gases should be approximately 180°C in the case of waste material with a thermal value of around 7,000 kilojoules. These values are based on the use of air as the primary gas, both as pre-heating and as ignition gas.

[0011] As mentioned before, the waste material that is placed in a waste incinerator for incineration varies enormously both in its content and its humidity. As for the dampness that can exist in the waste material, it is important how this dampness is spread through the waste material. If one part of the waste material is relatively dry and therefore easily combustible, this part will ensure that the damper waste material surrounding it will dry rapidly and thereby combust. In practice the dry and damp parts of the waste material are not homogeneously divided, so the combustion takes place in a very irregular way. With the combinations of easily combustible waste, and waste that is difficult to burn, and waste material with a high thermal value and that with a low thermal value, one can see that there are, therefore, various different situations, which all pose specific demands on the temperature of the primary gas.

[0012] Waste material that is easily combustible and has a high thermal value demands a very low pre-heating of the primary gas. If air pre-heating is used, this results in a very fierce fire above the waste bed, wherein the firing in the waste bed is very strongly sub-stoichiometric, which results in very high temperatures locally in the incineration chamber. In this case air pre-heating is unnecessary.

[0013] Waste material that is easily combustible but that has a low thermal value also does not require air pre-heating. In addition, there is less chance of a strong sub-stoichiometric combustion.

[0014] Waste material that is not easily combustible and that has a high thermal value requires primary air at a high temperature in order to achieve enough combustion of the waste material on the one hand, and on the other hand because of this the actual burning of the waste material will easily result in a simple sub-stoichiometric combustion. A careful regulation of the temperature of the primary gases is therefore necessary to control the combustion.

[0015] Finally, it is essential to have pre-heated air for waste material that is not easily combustible and has a low thermal value.

[0016] In general current techniques can only provide a single temperature for the primary gases. This means that in general the primary gases are pre-heated, which in many cases will be done in sub-stoichiometric conditions.

[0017] From another viewpoint the invention provides an improved technique as stated previously, wherein it is preferable to be able to regulate the temperature of the primary part gas supply. This enables a regulation wherein the temperature of the primary gas is increased only in the zones where it is necessary, because of the composition of the waste material. For this the primary gas that is supplied to the first zone is at a temperature of from 50°C to 450°C, preferably in the range 50°C to 300°C, with the strongest preference for the range 150°C to 300°C. By choosing for a relatively high temperature in the first zone the heating of the following zones can be a lot lower. The aim is to choose a temperature in the first zone that is so high that in many cases pre-heating can be reduced to zero in the other zones. Besides, by choosing a relatively low airflow for the first zone (from 5% to 15% of the total primary airflow), relatively little energy is used for the pre-heating.

[0018] The following paragraphs describe the invention in more detail, based on the illustrations.

[0019] The figure shows a schematic outline of a waste incinerator according to the preferred design of the invention. The incinerator shown has four different part gas supplies for primary gas (1, 2, 3, 4). These are introduced under the incinerator grid (5), on top of which is the waste bed (6). In the design shown the supply pipes for the first, second and third part supplies of the primary gas are equipped with an air pre-heater (7, 8).

[0020] Waste material is placed on the incinerator grid (5) above the first primary gas supply (1), wherein it is pervaded from below by waste gas that originates from the waste incinerator. This flue gas has a low oxygen content. The primary gas from the first part gas supply (1) will flow through the waste bed (6) by means of the available gas channels. The waste material that comes into direct contact with such a channel is dried more than the rest of the waste material. If the partly dried waste material is moved on to a position where the second part of the primary gas (2) is supplied, because this secondary part of the supply contains oxygen, the flame front is practically immediately progressing downwards through these channels. For this reason it is useful to somewhat mix the waste material and to disturb the existing channels, by placing the grids (5) for the second and successive zones somewhat lower, and preferably at a height that is somewhat less than the average bed height. The result of this mixing is that the parts of the surface already burning in the first zone (1) arrive on the waste bed (6) and ignite or further dry the other waste material, wherein the waste material in the second zone (2) burns more homogeneously. In addition the possibility of being able to regulate the process is increased because in this case the grid in the first zone can be used to fine-tune the regulation of the supply for the remaining part of the process. The flame front above the waste material will reach to the first height. Near this height is a supply of secondary gas (9). It is preferable that a number of supplies (9) are placed around the circumference of the installation. The flue gases that are created in the waste gas that are formed in the flame front above the waste bed are not made up of homogeneous parts. Because of the inhomogeneous composition of the waste material, some parts of it are well incinerated and therefore in those places the oxygen in the primary gas will have reacted. In other parts, where the incineration has not taken place to any large extent, part of the oxygen supplied by the primary gas supply will not have reacted and thereby will remain in the waste gas. By adding a secondary gas a good mix of these waste gas can be achieved. By using use gases that are low in oxygen content, the flue gases from the waste incinerator, as secondary gases, a lot of mixing is created at the first height, the top of the flames where the hottest place in the flue is, but only a limited surplus of oxygen is created so that the forming of NO_x is minimised. Via the supply of the third gas (10) at a position downstream the supply of the secondary gas (9), an oxygen bearing gas is supplied with an adequate O_2 content (preferably a surplus) in order to burn off the remaining CO and any other possible combustible waste products in the flue gases. Because this occurs downstream, the flue gases are homogenous and already somewhat cooler and so the formation of nitrous oxides is less. Especially the fact that the flue gases are now already mixed, local peak temperatures that cause the most formation of nitrous oxides do not arise.

[0021] The subdivision of the supply of primary gas into several zones, as shown in the four zones in the illustration (1, 2, 3, 4), which successively pass through the waste material to be incinerated (6) achieves an optimum combustion. This can especially be achieved because the temperature can be independently regulated for each zone. Because in practice it is difficult to judge the thermal value of the waste material and its ignition behaviour in advance well enough to depend on it, the regulation of the temperature setting of the primary gas takes place by tracking the flame front for each zone. This can be done by hand or via an automatic measurement of the flame front with the help of video cameras for visible light and/or infrared light.

[0022] The primary gases that are supplied to the first zone (1) can be of a high temperature without any problem, because the oxygen content of these is very low. The oxygen content can be 0% by volume or more. The incineration above the first zone is therefore limited. The maximum temperature of the flames in the first zone is thereby reduced in proportion to the available oxygen percentage, wherein no damage to the waste grid can arise. In particular damage by drops of melted metal that weld themselves to the surface of the grid is avoided. With current techniques wherein a water-cooled grid is usually used, it is not possible to obtain this advantage to such a high degree.

[0023] Because the available energy that is released in the first zone is limited, because only a limited oxygen-based combustion takes place, the reaction of waste gas in the first zone is also limited. The waste material can therefore be fully pre-dried without all the material being incinerated in the first zone. This results in a good combustion situation in the second zone, where it is possible that no more air pre-heating is necessary, but where the incineration can still be well regulated. A homogeneous incineration can especially be achieved in the second zone when the incinerator grid (5) is placed at a lower point, as described earlier.

[0024] As mentioned previously, it is preferable that the flue gas recirculation is supplied as the primary gas in the first zone. In this way the waste gas from the incinerator flue after passing through a dust filter (11) are recirculated to the first zone. The oxygen percentage and the temperature are in this case reasonably firmly fixed (depending on the process design) and cannot be used for the actual control of the combustion process. The amount (the flow) of primary gas in the first zone is very easy to vary across a wide range.

[0025] Other possibilities for application as the first primary part of the gas supply are the use of flue gases from gas burners, gas-driven boilers, gas motors or gas turbines, for example. Especially important is the use of gas motors on the basis of available waste gas such as the biological gas that results from fermentation produced by purifying sewage water, for example. Because in this case the heat from the flue gases from the motor are also used efficiently, the efficiency increases significantly compared to the conventional separate set-up of the bio-gas motor wherein only the generated electricity and heat from the cooling water is used.

[0026] The flue gases arising from this can be mixed with air from the outside in order to achieve the required temperature combined with the required oxygen percentage, wherein a certain percentage of oxygen is still added to these gases. The amount of air that is added to the flue gases from the outside depends on the temperature that is necessary for the primary gas in the first zone. In general this will be from 100°C to 270°C. In the case of flue gases from a gas boiler, part of the heat of the flue gas will be recovered, wherein this gas will have a lowered temperature when it is supplied to the first zone. The oxygen percentage in this case will be from 0°C to 15°C. In addition the recovery of the heat from the burning of the gas in the gas boiler will result in a higher efficiency for the entire installation. Waste gas from a gas turbine can also be used in a suitable way. Especially in the case of flue gases from a gas turbine or gas motor, these can have a temperature higher than 270°C, for example 450°C or higher. If the waste contains some humidity and the flow in the first primary zone is mot too high, even with these temperatures the pyrolisis may be limited so that sufficient calorific value remains in the waste, so as to get a good combustion in the subsequent (second) zone. Mixing with cool air or cooler recirculation flue gas is possible as well. The invention is therefore also adaptable for similar cases wherein the temperature of the primary gas supply is higher than 300°C.

[0027] The flue gases from the waste incinerator, as shown in the figure, which are extracted after they have passed through the dust filter (11), are at a temperature of from 100°C to 270°C. A problem that can occur using similar flue gas recirculation is corrosion at 'cold spots' and the leaking of the recirculation gases to the outside in places where high pressure is present. Because of the temperature of the recirculation gases, similar corrosion is possible as the result of condensation of the recirculating gas in the pipes supplying gas to the incineration zone, for example underneath the incinerator grid (5). According to the preferred implementation it is best to enclose the supply of the first part of the primary gas (1) in a housing (12) which will be fed with gases, as shown in Figure 2. This makes good insulation possible. In addition, any leakage of the recirculating gases in this housing (12) will not lead to direct problems in the surrounding area because the leaked gases will be taken up and diluted in the housing (12). These gases can then be passed on to the incineration zone. As shown in Figure 2, the second part of the supply of the primary gas is used to maintain the surroundings of the supply of the first part of the gas supply (1) at the required, higher, temperature so that no condensation can take place. The supply (1), and especially the funnel under the grid (5) for the first zone, as shown in Figure 2, are situated in this case in a casing (12) which is kept at a temperature that is regulated by the second part of the gas supply, and which can also be kept at a higher pressure according to a further recommended implementation. Because this supply of the first part of the gas is insulated and surrounded by the air pre-heated by an air pre-heater, cold bridges can be prevented by this construction. If this air-preheater is the heater of the second part of the primary gas supply (7) this heater should work continuously at a sufficiently high temperature. If necessary, a bypass can be provided in this case wherein the primary gas that is supplied to the second zone does not pass through the air pre-heater (7). It is also possible, using a control valve, to provide a connection between the pre-heated air coming from the housing and the funnel for the first part of the gas supply in order to add oxygen-rich air to the first part of the supply.

[0028] The flue gas that is used for recirculation should preferably be withdrawn from the waste incinerator via a baghouse filter or electrostatic filter (11), so that the amount of dust in the recirculating gas is low and no problems arise with deposits occurring in the pipes. The temperature of the recirculation gas is from 170°C to 270°C, preferably in the area of 190°C and 230°C. This temperature must be high enough to prevent problems with the condensation of the flue gases, but also low enough for it to be treated by common baghouse filter materials, for example a special catalytic layer on the baghouse filter material. By means of an injection of a common and well-known ammonia in the first draught of the flue gas exhaust (SNCR) a catalytic conversion of NO_x with NH_3 is possible at this temperature, in combination with a breakdown of dioxin/furan.

[0029] The primary air for the first zone is regulated in order to control the fire in the second and third zones. The range of the gas supply via the first zone must be approximately 2.5% to 25% of the total amount of primary gas. For normal household waste with a thermal value of approximately 10,000 kilojoules per kilogram, 10% of the total is enough to dry the waste material well, through the high temperature of the recirculation gases used. In the case of good incineration (a short fierce fire in the second zone and a low percentage of remaining material) the drying process is more than good and the amount of the gas supply can be reduced to 5%. In the case where the waste does not combust enough the amount can be increased to 20%.

[0030] The incinerator grid (5) in the first zone, on which the waste material to be burnt (6) is initially placed does not have to be equipped with water cooling. When water cooling is used condensation of water from the recirculated gas can especially occur on the cooled parts. As mentioned previously, the recirculation gases have a very low oxygen content but a relatively high temperature, so that virtually no combustion takes place in the waste material above the first zone. In addition, because of the low oxygen content (at least lower than 20% by volume) flame temperatures can exist of up to a maximum of 500°C if the oxygen content is lower than 10% by volume. Because of the low oxygen content and the low temperature, the flame front can however hardly creep downwards. This means that damage to the incinerator grid (5) in the first zone by overheating of the grid cannot occur.

[0031] The waste material from the first zone that reaches the second zone is, however, very well dried and easily combustible. When this waste material reaches the second zone, a primary air supply is added with a normal oxygen content. This causes the flame front to move downwards virtually instantaneously. For this reason it is preferable that the incinerator grid in the second zone (5) is water-cooled. Because of the oxygen content as well as the good mix of the oxygen and the waste material to be burned, a very fierce fire will occur in the incinerator bed that burns right up to the grid (5). Because of the partial pyrolysis as a result of the high temperature of the primary gas, in the first zone the very easily combustible parts of the waste material (especially synthetic materials) already lose part of their thermal values and the peak temperatures in the second and third zones are lower than in the case where the waste material in the first zone is completely incinerated, as is the usual case when oxygen-rich air is used. The heat that the grid (5) absorbs and gives off to the cooling water is re-used in a suitable way.

[0032] If the combustion in the second and third zones goes very well, the primary gas for the second and third zones can be used without any further air pre-heating (7, 8), thereby lowering grid and flame temperature as well as reducing NO_x formation. For normal household waste (9,000 to 11,000 kilojoules per kilogram) this will generally be the case when the waste material (6) is pre-dried in the first zone with the aid of recirculation gas. The gas that is supplied to the second and third zones can therefore be fresh air that can be supplied directly from the outside. As well as the energy saving that is achieved by this, it has the advantage that when the air is cold, the air speed will be lower for an equal supply of oxygen, wherein less flue dust will be created.

[0033] As described previously, the amount of oxygen that is supplied via the second and third zones to the waste material that is to be burnt (6) must be approximately stoichiometric or somewhat less (from 0.8 to 1.0 times the amount of oxygen necessary for the combustion). Depending on the type of waste material, for each zone approximately 15% to 40% of the total amount of the primary and third gas supply must be supplied to the second and third zones. The preference is that the amount of air that is supplied to the second and third zones is approximately from 25% to 30% of the total amount of gas that is used as the primary and third air supply. The result of this is that the highest heat develops in the waste bed itself. The coal residue, that is to say the percentage of unburned carbon, is therefore improved, and, because of the high temperatures, a maximum of heavy metals is driven out of the resulting slag. The quality of the resulting slag is therefore improved on account of the good drying in the first zone. As mentioned previously, the gas that is used for the second and third zones should preferably not be pre-heated, and in the case of a good enough supply of waste material that can therefore be pre-dried in order to achieve a rapid combustion in the second zone, an air pre-heater (7, 8) can be omitted if required. Contrary to the patent DE3915992A1 mentioned previously, is it not advisable to use a tailored oxygen content in the main combustion zone as well, because the combustion there occurs in an sub-stoichiometric way in any case.

[0034] The last zone, for example a fourth zone or even possibly a fifth zone or even a further zone if several similar zones are used, is a final incineration and cooling zone that only receives from 5% to 15% of the total amount of gas. Recirculated gas can possibly be used here. This has the advantage that the CO_2 and H_2O contained in the recirculated gas, if necessary supplemented with extra water, reacts with the calcium in the slag, wherein this goes through a rapid ageing process and there exists a lower pH value in any later leaching. In this way the quality of the slag is improved because there is less leaching. At times when the incineration in the main incineration zone is not going very well it can be useful to temporarily use an increased oxygen content directly after the main incineration zone in order to bring about a good combustion of the lower ash layer.

[0035] In order to obtain the stated low oxygen content in the secondary gas, it is preferable to supply recirculated gas, that is to say waste gas from the incinerator, as secondary gas.

[0036] For the third air supply the preference is the percentage is from 5% to 30% of the total amount of air supplied, preferably from 10% to 20%.

[0037] When the height of the flames above the waste bed (6) lessens due to inadequate combustion or insufficient ignition, it is preferable to reduce the amount of the third air supply, or possibly even shut if off completely, in order to correct the increasing oxygen percentage in the flue gases that is the result of inadequate combustion.

[0038] To regulate the capacity of the fire, the position of the main combustion zone and the extent to which the waste material is incinerated at the end of the grid, the following control quantities are available:

- the quantity of waste material being fed to the grid
- the transport of the waste material on the grid
- the amount of air supplied to each zone
- the air temperature in each zone
- the oxygen content in the first zone.

[0039] This means that there are a large number of combinations possible. It is preferable to use the waste transport as the primary regulator for the capacity of the plant. The supply of waste material to the grid must be adjusted in order to obtain a good layer thickness. With respect to the creation of low emissions it is not recommended to regulate the amount of air in the main combustion zone, because this would upset the stoichiometry and therefore the balance of the combustion. Only adjustments smaller than approximately 10% of this flow or slow adjustments that are not faster than the supply of waste material to the combustion zone are possible here in order to manage the capacity and the position of the fire, respectively. With the individual regulating of the temperature in each zone proposed in Claim 2 it is possible to temporarily support a local lack of combustion in the main combustion zone without adapting the amount of the air supply. As regards the energy use, the limiting of the formation of NO_x and the negative influence on the waste throughput, aim to keep the nominal air temperature in the main combustion zone as low as possible. This can be controlled by influencing the drying process in the first zone. For this a fixed, as low as possible, oxygen percentage is aimed for in principle, and a high temperature in the first primary gas supply. In this way the first primary gas supply becomes the primary regulating quantity for the drying of the waste material. This flow is regulated such that a good combustion takes place in the second zone, but not more than what is needed to prevent too fierce combustion.

[0040] From the above information it can be seen that the invention provides a much-improved technique for burning waste material in a waste incinerator. The extra investments that are necessary for the recirculation of the waste gas and the more complex construction for the supply of the recirculation gases to the first zone are compensated for by the fact that the waste gas cleaning can be carried out on a smaller scale, and the fact that a lot less energy is needed for the preheating of the primary part of the gas supply. The advantages are especially achieved because the incineration is better and because this results in an ash layer of a better quality. In addition there is an advantage in that waste material with a wide range of thermal values (from 5,000 to 16,000 kilojoules per kilogram) can be processed with incineration that is easily manageable. Because of the good pre-drying in the first zone, a more constant flame temperature and flame height can be achieved, wherein peaks and troughs in the steam production can be avoided. All these measures lead to improved energy efficiency. This makes it possible to achieve an efficiency of electricity production of at least 30% gross / 26% net, 33% gross / 29% net with improved performance, or 36% gross / 33% net with the best performance, when a method described in the present invention is combined with a method such as those described in the patent applications from the same inventors that are submitted together with this patent application. In addition the NO_x content is reduced, first by the lower temperature in the incinerator, and secondly by the catalytic dust filter that can be effectively applied to this technique.

[0041] The invention is not limited to the implementation as shown in the figures and the description given above. These are only limited by the attached claims.

Claims

1. A method for the incineration of waste material in an incinerator, comprising:

    supplying waste material to an incineration zone which contains an incineration grid, wherein the waste material is supplied to a first side of the incineration grid and is moved to a second side during the method,
    supplying from below through the incineration grid and the waste material placed thereon a primary gas so as to at least partially incinerate said waste material in a combustion area that stretches from the incineration grid to a first level above the incineration grid,

    characterized in that the incineration zone comprises at least two zones, the waste material being supplied to a first zone, and wherein during the method the waste material is moved to a successive connected zone, and that a first partial primary gas is supplied to the first zone with an oxygen content of less than 20% by volume and a temperature of from 50°C to 450°C, preferably from 50°C to 300°C.

2. A method according to Claim 1, **characterized in that** the first partial primary gas supply comprises waste gas from an incinerator, preferably waste gas from a waste incinerator, a gas boiler, a gas motor or a gas turbine, waste gas from a waste incinerator being most preferred.

3. A method according to Claim 2, **characterized in that** the waste gas from an incinerator is filtered, preferably through a dust filter.

4. A method according to Claims 1, 2 or 3, **characterized in that** secondary gas is supplied near the first level above the incineration grid and a third gas is supplied at a second level above the first level, wherein the secondary gas has an oxygen content of < 20% by volume and the third gas has a higher oxygen content than the secondary gas.

5. A method according to Claim 4, **characterized in that** the secondary gas contains waste gas from a waste incinerator.

6. A method according to Claims 4 or 5, **characterized in that** the third gas comprises outside air.

7. A method according to Claim 1 - 6, **characterized in that** the temperature is controlled for each partial primary gas supply.

8. A method according to Claims 1 - 6, **characterized in that** the primary gas in the first zone has an oxygen content of from 0% to 15%, preferably from 0% to 10%.

9. A method according to Claims 1 - 8, **characterized in that** the primary gas is supplied by at least three partial supplies, wherein at least:

    - a first partial gas supply has an O_2 content of from 0% to 15% and makes up from 2% to 25% of the total amount of primary gas;
    - one or more successive partial gas supplies make up from 15% to 90% of the total amount of primary gas; and
    - a last partial gas supply makes up from 5% to 25% of the total amount of primary gas.

10. A method according to Claims 1 - 9, **characterized in that** the construction of the supply of the first partial primary gas supply, as far as these comprise waste gas from an incinerator, is enclosed by a housing, said housing being fed with gases at a temperature and/or pressure equal to or higher than the temperature or pressure, respectively, of the pri-

mary gas supply.

11. A method according to Claim 10, **characterized in that** the housing is supplied with gases from a successive partial primary gas supply.

12. A method according to Claims 10 - 11, **characterized in that** the gases from the housing are subsequently supplied to the incineration zone, for example by mixing them with the first partial primary gas supply.

13. A method according to Claims 10 - 12, **characterized in that** the gases from the housing are subsequently supplied to a successive incineration zone, for example via a sidewall, or as secondary gas in the boiler as incineration gas.

14. A method according to Claims 10 - 13, **characterized in that** the housing is supplied with gases at a temperature of at least 150°C.

15. A method according to Claims 10 - 14, **characterized in that** the housing is supplied with gases at a higher pressure than that of the first partial primary gas supply.

16. A method according to Claims 1 - 15, **characterized in that** the pipe for the supply of recirculation gases is enclosed in a pipe that is supplied with gases at a temperature and/or pressure equal to or higher than that of the first partial primary gas supply.

17. A method according to Claims 1 - 16, **characterized in that** the first primary partial gas supply is controlled in order to influence the incineration in the connected main incineration zone by mainly varying the flow of the first primary partial gas supply and the oxygen content and/or temperature is subsequently or simultaneously varied.

18. Waste incineration oven for a waste incinerator, consisting of an incinerator grid for the waste material to be incinerated, means for moving the waste to be incinerated from a first to a second side, primary gas supply means under the incinerator grid, secondary gas supply means at a first level above the incinerator grid and tertiary gas supply means at a second level above the incinerator grid and above the secondary gas supply means, **characterized in that** the secondary gas supply means is connected to an exhaust of off gas from the waste incinerator.

19. Waste incineration oven according to claim 18, **characterized in that** the primary gas supply means consists of at least two separate supplies, the first primary gas supply means being located near the first side under the incinerator grid and the second primary gas supply means being located near the second side under the incinerator grid, and the first primary gas supply means being connected to an exhaust of off gas from a waste incinerator.

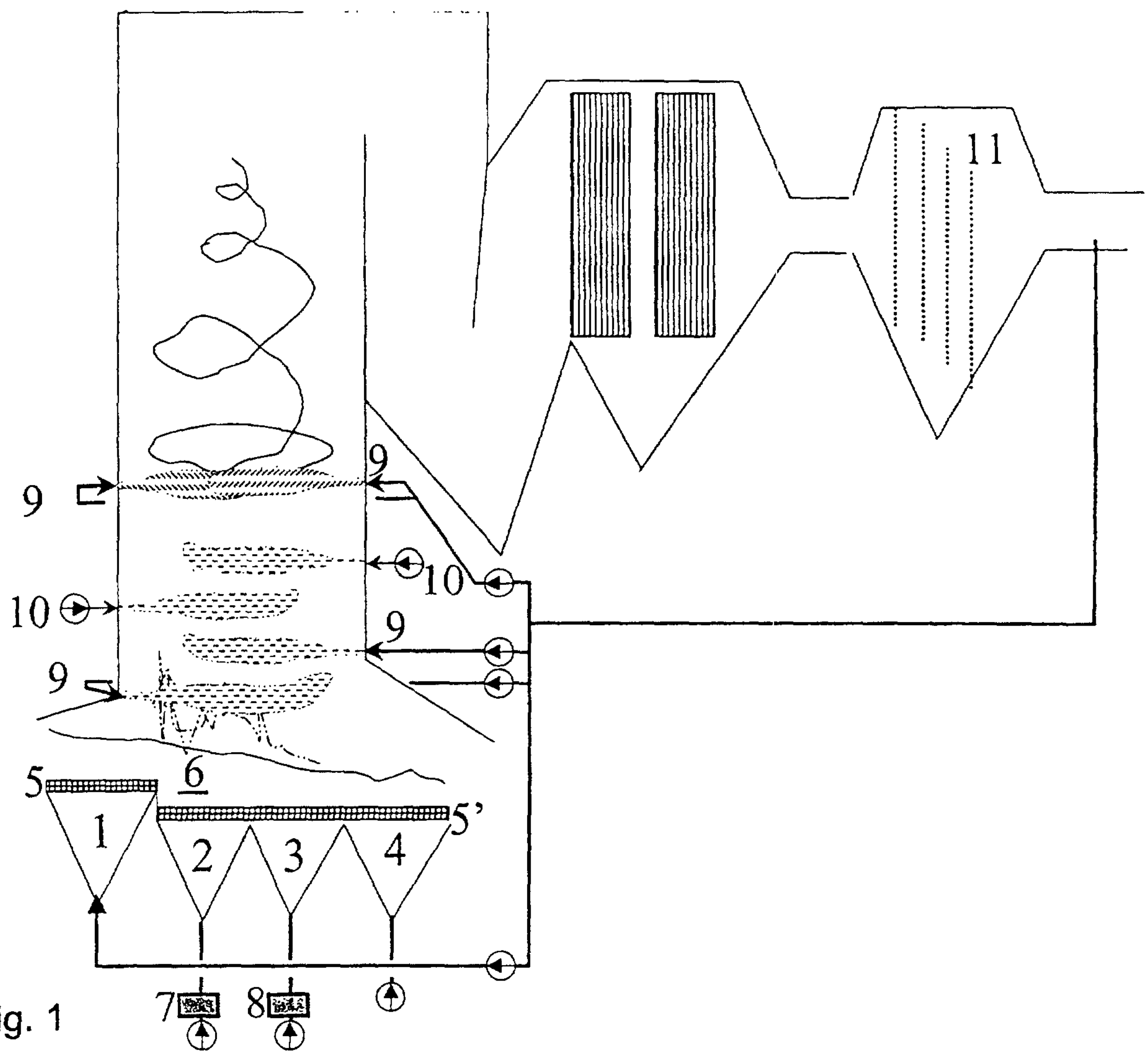

Fig. 1

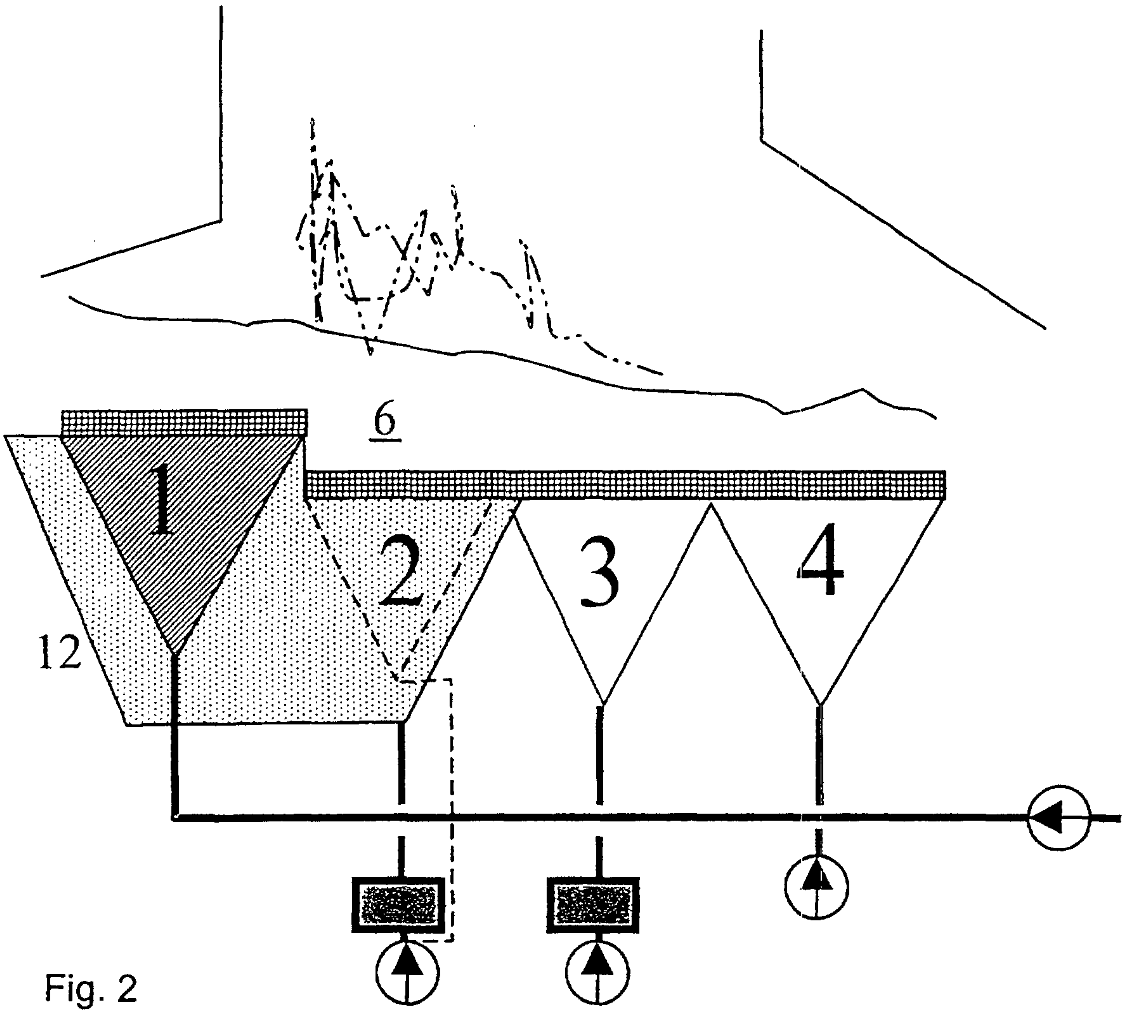

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 01 20 2285

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Place of search	Date of completion of the search	Examiner
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