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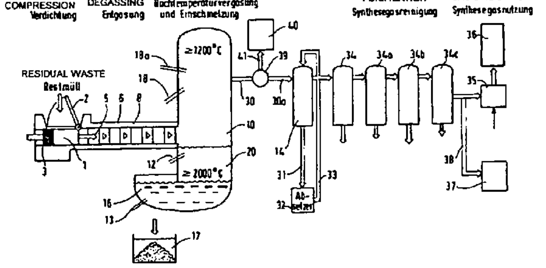
[Fortsetzung auf der nächsten Seite]

(54) Title: METHOD FOR STARTING AND OPERATING A DEVICE FOR DISPOSAL AND UTILISATION OF WASTE MATERIALS

(54) Bezeichnung: VERFAHREN ZUM ANFAHREN UND ABLAUFEN EINER VORRICHTUNG ZUR ENTSORGUNG UND NUTZBARMACHTUNG VON ABFALLGÜTERN



32. SETTLER

(57) Abstract: The invention relates to a method and a device for material preparation, conversion and subsequent treatment of waste material of all kinds, comprising several thermal treatment steps. The treatment steps comprise a low temperature stage with oxygen exclusion and a high temperature stage with oxygen feed at temperatures over 1000 °C. The high temperature stage comprises a stabilisation zone and an outlet for the gas mixture generated during the high temperature stage, in particular from the stabilising zone. The stabilisation zone is furnished with devices for the injection of oxygen and fuel through which fuel and a non-stoichiometric excess of oxygen are injected during the start-up process for heating the high temperature zone. The waste gases are then led directly off to a chimney stack via at least one valve.

(57) Zusammenfassung: Die vorliegende Erfindung bezieht sich auf ein Verfahren sowie eine Vorrichtung zur Stoffaufbereitung, -wandlung und -nachbehandlung von Entsorgungsgut aller Art mit mehreren thermischen Behandlungsstufen. Die Behandlungsstufen umfassen eine Niedertemperaturstufe unter

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Abstract

The present invention relates to a method and also a device for material preparation, conversion and subsequent treatment of disposal material of all types with a plurality of thermal treatment steps. The treatment steps comprise a low temperature stage with oxygen exclusion and a high temperature stage with oxygen supply at temperatures over 1000 °C. The high temperature stage thereby has a stabilisation zone and an outlet for the gas mixture produced in the high temperature stage, in particular in the stabilisation zone. In the stabilisation zone, devices are provided for feeding oxygen and fuel with which, upon start-up of the process, fuel and over-stoichiometric oxygen are injected in order to heat the high temperature zone. The waste gases are discharged then via at least one valve directly via a chimney.

Method and device for disposal and utilisation of waste materials.

The present invention relates to a method and a device for disposal and utilisation of waste goods of all kinds in which ungraded, untreated industrial, domestic and/or special waste, which contain any pollutants in a solid and/or liquid form, and also industrial scrapped goods, are subjected to a step-wise temperature application and to thermal separation or material conversion.

The invention relates in particular to a method for starting or ending the disposal process and the plant used for this purpose.

The present invention relates furthermore to a device which is suitable for the above method.

The known methods for waste disposal offer no satisfactory solution to the increasing waste problems which are a substantial factor in environmental destruction. Industrial scrapped goods made of composite materials, such as automotive vehicles and household appliances but also oils, batteries, enamels, paints, toxic sludges, medicines and hospital waste, are subject to separate, legally strictly prescribed disposal measures.

Domestic waste on the other hand is an unchecked heterogeneous mixture which can contain virtually all types of special waste fractions and organic components and, with respect to disposal, is still not classified in proportion to its environmental impact.

One of the disposal and recovery methods for waste materials is refuse incineration. In the known refuse incineration plants, the disposal materials pass through a wide temperature field of up to approximately 1000 °C. At these temperatures, mineral and metallic residues are not intended to be melted in order as far as possible not to disrupt subsequent gas production stages. The inherent energy in the remaining solid materials is not used or only inadequately used.

A short dwell time of the waste at higher temperatures and the high dust production due to the requirement for large quantities of high-nitrogen incineration air in the non-compressed waste incineration materials encourages the dangerous formation of chlorinated hydrocarbons. For this reason there has been a move therefore towards subjecting the waste gases from refuse incineration plants to a subsequent incineration at higher temperatures. In order to justify the high costs of such plants, the abrasive and corrosive hot waste gases with their high dust component are conducted through heat exchangers. During the relatively long dwell time in the heat exchanger, chlorinated hydrocarbons are reformed which combine with the entrained dusts and in the end lead to blockages and functional disruption and require to be disposed of as highly toxic pollutants. Subsequent damage and the costs of their elimination cannot be estimated.

Current pyrolysis methods in conventional reactors have a broad temperature spectrum similar to refuse incineration. High temperatures prevail in the degassing zone. The self-forming hot gases are used for preheating the not yet pyrolised disposal material, are hereby cooled and likewise pass through the temperature range which is relevant for the new formation of chlorinated hydrocarbons and hence is dangerous. In order to produce an ecologically safe usable pure gas, pyrolysis gases generally pass through a cracker before purification.

The prescribed incineration and pyrolysis methods have in common the disadvantage that the liquids or solid materials, which are evaporated during incineration or pyrolytic decomposition, are mixed with the incineration or pyrolysis gases and are discharged before they reach the temperature and dwell time in the reactor, which is necessary for destruction of all pollutants. The evaporated water is not made usable for water gas formation. For this reason, subsequent incineration chambers generally are connected subsequently in the case of refuse incineration plants and cracker stages are connected subsequently in the case of pyrolysis plants.

A method for disposal and utilisation of waste materials is known from EP 91 11 8158.4 which avoids the above described disadvantages. The waste materials are thereby subjected to a step-wise temperature application and thermal separation or material conversion and the occurring solid residues are converted into a high temperature melt. For this purpose, the material to be disposed of is compressed into compact packets in batches and passes through the temperature treatment stages in the direction of increasing temperature, from a low temperature stage in which, while maintaining the pressure application, a form-fitting and frictional contact is ensured with the walls of the reactor container and organic components are degassed, to a high temperature zone in which the degassed material for disposal forms a gas-permeable bed and synthesis gas is produced by controlled addition of oxygen. This synthesis gas is discharged then from the high temperature zone and can be further utilised.

This discharge of the crude synthesis gas of the high temperature reactor is for its part connected in a fixed manner to a gas chamber for rapid gas cooling which has a water injection device for cold water into the hot crude synthesis gas stream. This rapid gas cooling (shock cooling) prevents renewed synthesis of pollutants since the crude synthesis gas passes very quickly through the critical temperature range because of the shock cooling and is cooled to a temperature at which re-synthesis of the pollutants no longer takes place. This cold water injection into the crude synthesis gas stream in addition binds liquid or solid particles entrained in the gas stream so that, after rapid cooling, a well pre-cleaned crude synthesis gas is obtained.

This plant described in EP 91 11 8158.4 is currently put in operation such that firstly the high temperature reactor is heated from the cold state without introduction of waste. For this purpose, fuel, for example natural gas and O_2 are fed into the high temperature reactor and incinerated. The waste gases thereby produced are passed from the high temperature reactor via the rapid gas cooling and a surge tank into a combustion chamber with a flue where the waste gases are subsequently incinerated with a forced supply of oxygen. Only during the subsequent incineration is an extensive freedom of emissions of gases achieved, in particular an adequately low content of carbon monoxide (CO), so that these can then be discharged via a flue.

Upon reaching a temperature of the high temperature reactor of above 1000 °C, for a short time fuel, for example natural gas, is introduced additionally into the high temperature reactor and the waste gas path is switched in the surge tank to the purification path for the synthesis gas. Only subsequently is there then effected an introduction of waste into the low temperature stage of the high temperature reactor. This waste is extensively degassed in the low temperature stage and subsequently is introduced from this degassing channel into the high temperature stage. During this introduction, the addition of natural gas is maintained in order to quickly obtain a stable synthesis gas production. The purified synthesis gas is then used in a mixed gas operation with natural gas.

If the produced synthesis gas quantity is adequately large, the introduction of combustible gases into the high temperature reactor is ended. It is crucial in this start-up process that the forced-air supplied combustion chamber ensures during heating complete oxidation of the methane- and carbon monoxide residual components into CO_2 and H_2O steam which then can leave the flue with the excess air.

The close-down of the thermal line involves according to the state of the art a pressure drop because of the greatly diminishing synthesis gas productions. The resultant residual synthesis gas is used further with added natural gas in a mixed operation. Only after melting of the solid body charge in the high temperature reactor is the gas path closed in the direction of synthesis gas usage and closed in the direction of gas purification and opened towards the combustion chamber. In this case also, a forced-air supplied incineration of the residual waste gases is effected in the combustion chamber so that the waste gases can be discharged from the combustion chamber extensively emission-free, in particular low in CO or free of CO, via a flue.

With this process of start-up and close-down of the high temperature reactor it is disadvantageous that, whilst heating during start-up or whilst melting during close-down, the resultant gases from the high temperature zone of the reactor must be subsequently incinerated in a combustion chamber with the supply of forced air.

It is thus the object of the present invention to propose a process and a device by means of which the disposal and utilisation process according to the invention can be started or ended in a simply and convenient manner.

According to one aspect of the present invention, there is provided a process for disposal and utilisation of waste materials of all types in which ungraded, untreated, industrial, domestic and/or special waste, which contain pollutants in a solid and/or liquid form, and/or industrial scrapped goods, the process comprising:

- compressing the waste materials into compact packets in batches;
- passing the compact packets through temperature treatment stages in a direction of increasing temperature,

the temperature treatment stages comprising a step-wise temperature application resulting in thermal separation or material conversion of the waste materials in which the resulting solid residues are converted into a high temperature melt, the temperature treatment stages comprising:

- at least one low temperature stage in a reaction container in which an applied pressure is maintained, and in which the waste materials have a form-fitting and frictional contact with the walls of the reaction container;
- at least one high temperature zone, in which the waste materials produce synthesis gas and form a gas-permeable charge; and
- a stabilisation zone for the synthesis gas located above the charge, the produced synthesis gas being discharged from the stabilisation zone,

wherein,

at the start-up of the process for heating of the high temperature zone, fuel and over-stoichiometric oxygen are injected into the stabilisation zone, are incinerated and the resulting waste gases are discharged through a chimney.

According to another aspect of the present invention, there is provided a process for disposal and utilisation of waste materials of all types in which ungraded, untreated, industrial, domestic and/or special waste, which contain pollutants in a solid and/or liquid form, and/or industrial scrapped goods, the process comprising:

- compressing the waste materials into compact packets in batches;
- passing the compact packets through temperature treatment stages in a direction of increasing temperature, the temperature treatment stages comprising a step-wise temperature application resulting in thermal separation or material conversion of the waste materials in which the

resulting solid residues are converted into a high temperature melt, the temperature treatment stages comprising:

- at least one low temperature stage in a reaction container in which an applied pressure is maintained, and in which the waste materials have a form-fitting and frictional contact with the walls of the reaction container;
- at least one high temperature zone, in which the waste materials produce synthesis gas and form a gas-permeable charge; and
- a stabilisation zone for the synthesis gas located above the charge, the produced synthesis gas being discharged from the stabilisation zone,

wherein,
upon close-down of the process, the supply of the item for disposal to the reaction container is ended and, below a specific production rate of synthesis gas, oxygen is injected into the stabilisation zone and the resulting waste gases are discharged through a chimney.

According to a further aspect of the present invention, there is provided a device for material preparation, conversion and subsequent treatment of disposal materials of all types with a plurality of thermal treatment stages, which comprises:

- at least one low temperature stage with oxygen exclusion;
- at least one high temperature stage with oxygen supply at temperatures above 1000 °C;
- a stabilisation zone disposed in the high temperature stage; and
- an outlet for the gas mixture produced in the high temperature stage, wherein all reaction spaces of the treatment stages are connected to each other in a fixed manner without locks and, in the high temperature stage,

devices for feeding oxygen and devices for feeding fuel being provided,

and wherein, in the stabilisation zone, devices for feeding oxygen and fuel are provided and the outlet for the gas mixture or waste gas produced in the high temperature zone is connectable via at least one valve to a chimney to a combustion chamber with flue and/or to a device for using the gas.

The process according to the invention follows the process disclosed in EP 91 11 8158.4, the disclosure of this publication being hereby entirely included in the disclosure content of this application with respect to the process and to the device. The process described there and the device described there are now developed according to the invention in that, in the stabilisation zone of the high temperature reactor, devices are provided for feeding oxygen and fuel, for example combined fuel burners, and the outlet for the gas mixture produced in the high temperature zone is connectable via at least one valve to a chimney, to a combustion chamber with flue and/or to a device for using the gas. According to the invention, fuel and oxygen are thereby injected into the stabilisation zone during start-up of the process for heating the temperature zone into the high temperature zone so that the combustible gas components which are fed in or which can form also during the start-up or close-down process are totally incinerated in the stabilisation region of the high temperature reactor. Consequently, the gases emanating from the stabilisation region of the high temperature reactor have no more relevant emissions, in particular carbon monoxide CO, and can be discharged immediately via the valve directly into a chimney. This direct line is however only used during start-up or close-down.

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These gases can however also be subsequently incinerated in a combustion chamber also before discharge via a chimney or flue.

It is advantageous to operate with an oxygen excess in the stabilisation region during start-up or close-down ($\lambda > 1$), advantageous in such a manner that the residual oxygen content in the waste gas is 5% by volume.

The combustion chamber with flue is consequently required almost only for accidents. It is therefore essentially a safety device which ensures that, even in an accident, all process gas can be completely incinerated and discharged if need be.

A regulation measuring point is advantageously installed in the chimney by means of which the pollutant concentrations in the waste gas can be continuously measured. The pollutants of the waste gases which can form during start-up and close-down are then also measured.

The chimney, via which the waste gases are directly discharged during start-up or close-down, corresponds advantageously to the flue to which the combustion chamber is connected.

If the start-up operation is ended and process equilibrium is achieved, the above-mentioned valve, which previously conducted the waste gases directly to the chimney, is closed so that now the synthesis gas flow is conducted via the ultra-fine wash column and the activated carbon filter and subsequently is supplied for synthesis gas utilisation.

The start-up of the disposal process according to the invention is now intended to be described subsequently by way of example.

At the beginning of the start-up process, all pipes potentially conducting synthesis gas, are made inert by flooding with nitrogen. The direct pipe to the chimney is also fundamentally made inert for safety reasons even if no combustible gases are transported therein.

The valve which is disposed behind the quench washer is adjusted such that all gases or waste gases are conducted directly from the high temperature reactor into the chimney. For this purpose, combustible gases, such as for example natural gas or synthesis gas, are introduced via combined fuel burners into the stabilisation zone in the high temperature reactor, oxygen being metered over-stoichiometrically such that a residual oxygen content of 5% is contained in the waste gas.

In order to prevent the hot atmosphere passing into the empty degassing channel of the low temperature stages and to prevent the channel material being damaged, the degassing channel is also flooded with nitrogen in order to construct a thermal nitrogen barrier relative to the gases in the high temperature reactor.

If the temperature in the high temperature reactor is at least 750 °C, measured in the waste gas flow, because of the heating process, then waste is pushed into the degassing channel which is likewise heated in the interim until the channel is filled. Because of the introduction of waste, thermal and/or chemical processes can now take their course, such as for example the formation of water vapour due to drying of the waste or the partial degassing of the organic waste components. These processes are also taken into account during oxygen metering since, during degassing, hydrocarbon compounds can be produced both in a solid and in a gaseous form, which hydrocarbon compounds are gasified subsequently in the high temperature reactor into CO and H_2.

If the waste gas temperature has reached at least 900 °C, then the gas route to the chimney is closed and the gas route to the activated carbon filter and to the combustion chamber with flue is opened. The valve behind the quench washer is closed so that subsequently the waste gases press the inert gas out of the gas purification and the activated carbon filter into the combustion chamber with flue.

The injection of oxygen into the stabilisation region is henceforth ended and natural gas in an excess is introduced for a short while in order to remove the excess oxygen which is located in the stabilisation region. The oxygen lances are thereupon used only in the melting region for oxygen supply in order to gasify the formed solid carbon in the solid material charge.

Because of the excess of combustible gas, the oxygen component in the gas mixture is zero per cent after a short while, the oxygen boundary threshold measurement being activated. The proportion of combustible gases in the gas mixture increases in series due to the degassing processes in the low temperature stages, these combustible gases being completely incinerated in the combustion chamber with flue.

Once a stable proportion of combustible gases has been achieved, which can be determined via the brightness of the flame in the combustion chamber, then the gas flow is diverted to the boiler in order to be used thermally here. The gas route to the combustion chamber with flue is closed. With increasing synthesis gas flow, other synthesis gas consumers, such as for example gas generators, are also used.

Hence the start-up process is concluded.

The close-down of the disposal process runs in a reverse sequence to the start-up of the process.

At the beginning of the close-down, a solid material column is located in the high temperature reactor-lower part, the carbon proportion of said column being gasified by addition of oxygen and its inorganic components being melted. The inorganic melt is then further treated thermally in a homogenisation reactor.

In the stabilisation region above the solid material column, all long-chain hydrocarbon compounds are cracked at temperatures above 1000 °C and all organic compounds are destroyed. Only synthesis gas is produced, this production being in thermal and chemical equilibrium. The synthesis gas is shock-cooled (quenched), purified and ultra-finely purified and then passes through an activated carbon filter and is available for use, for example in a gas engine and/or boiler.

In order now to end this state, firstly the supply of waste into the low temperature stages (channel) is ended and the channel heating is reduced. Nevertheless, the solid material column in the high temperature reactor is furthermore gasified or melted further.

Because of the finished introduction of waste, the produced synthesis gas quantity is continuously reduced, the consumers (gas engines and/or boilers or the like) being removed correspondingly successively from the plant.

After decomposition of the solid material column, the oxygen metering is slowed down in the melt region of the solid material column.

If the synthesis gas quantity no longer suffices to operate the last synthesis gas consumer, then the valve behind the quench washer is closed in the direction of the synthesis gas usage and the direct gas pipe to the chimney is opened. In order that only low-emission waste gases are released through the chimney into the environment, the oxygen nozzles in the stabilisation region of the high temperature reactor are opened so that residual traces of combustible gas components are totally incinerated and a residual oxygen of 5% is present in the waste gas. Hence the waste gas is extensively free of pollutant emissions, in particular of CO.

If the degassing and gasification process of the residual quantity of waste located in the channel is closed off and the melt in the homogenisation reactor is solidified, the metering of oxygen in the stabilisation region is continuously reduced until finally the close-down process is terminated.

It is thus achieved according to the invention that, both during start-up and during close-down of the disposal plant, the gases streaming out of the high temperature reactor can be released into the environment directly via a chimney, these gases being ecologically completely safe since, because of the oxygen surplus during incineration and in the waste gases, said waste gases are practically pollutant-free. Due to this arrangement, long routes of the waste gases can be dispensed with and also usage of a separate combustion chamber during heating and during close-down of the plant. The combustion chamber with flue can hence be used almost exclusively for accidents and as a safety device which scarcely comes into use in normal operation.

There are shown

Fig. 1 the diagram of a device according to the invention, and

Fig. 2 a further device according to the invention.

Figure 1 shows a device in which two high temperature reactors I and II according to the invention, which are provided with the reference numbers 100 and 200, are connected in parallel. The crude synthesis gases, occurring in the stabilisation zone of the respective high temperature reactors, are discharged from these high temperature reactors 100, 200 via crude synthesis gas pipes 106, 106a, 206, 206a. The synthesis gases are thereby conducted via a rapid cooling 119 or 219 (quench), in which cooling water is injected into the gases in order to cool the gases very rapidly to below 100 °C and at the same time to clean them of solid particles. Because of this rapid cooling, renewed synthesis of pollutants is prevented. The thus cooled and purified gases are conducted via a valve 101 or 201 to a basic washer 103 and then conducted via pipes 110, 210 to activated carbon-/activated coke filters 104, optionally also to a further activated carbon-/activated coke filter 204. In these activated carbon filters, a further fine cleaning of the crude synthesis gas takes place which is then conducted via pipes 111, 211 for further usage. The pipes 111 or 211 are thereby connected on the one hand to a pipe 112 which conducts the purified synthesis gas to devices for synthesis gas usage. Devices of this type can for example be boilers or gas engines. Chemical further processing of the synthesis gas is also possible.

Furthermore, the pipes 111 and 211 communicate via a pipe 113 with a combustion chamber 105 with flue. In the case of disruptions or short-term overproduction of synthesis gas, the resultant synthesis gas can be conducted via the pipe 113 to the combustion chamber 105 with flue and there be incinerated in an environmentally friendly manner and be discharged into the environment via the flue. The combustion chamber with flue is in particular available for use at any time with disturbances of this type.

Via pipes 114 and 115, both cooling air and incineration air or, via a pipe 116, combustible gases such as for example natural gas, are supplied to this combustion chamber 105 in order to make possible at any time a complete and ecologically safe incineration of the synthesis gas which is supplied via the pipe 113. The forced-air supply to the combustion chamber 105 with flue is thereby permanently available, redundantly and authorised for an emergency flow in order to ensure an emergency operation at any point in time.

In the synthesis gas flow after the rapid cooling 119 or 219 there is located a valve 101 or 201 with which the synthesis gas flow can be transferred to pipes 118 or 218. These pipes 118 and 218 lead directly to a chimney 120 via which the gas flow is released into the environment from the high temperature reactor 100 and 200. These two pipes 118 or 218 are switched to when, during start-up or close-down, the combustible gases which are produced in the high temperature reactors 100 or 200 or injected there are incinerated within the high temperature reactors with an oxygen excess at a level of 5% in the waste gas. All the organic components are thereby fully incinerated in the high temperature reactors 100 and 200, the rapid cooling 119 or 219 being prevented so that pollutants do not re-occur during cooling of the gases. Hence the waste gas which is produced in the start-up or close-down phase of the high temperature reactors 100 or 200 is low in pollution and can be discharged into the environment via the valves 101 or 201 and the pipe 118 or 218 directly via the chimney 120.

Separate pipes for conducting the waste gases, which arise during the start-up or close-down phase, into the combustion chamber 105 with flue, are therefore no longer required.

Figure 2 shows the diagram of a plant with a high temperature reactor 10.

It is illustrated in Figure 2 how residual waste is introduced into a compacting press. The compression is thereby effected by a compacting press 1 which corresponds in its construction to a waste refuse press which is known per se, as is used for example for scrapping vehicles. A pivotable pressing plate 2 makes it possible to supply the press 1 with mixed waste. A pressing face 3 is located in the left-hand position so that the supply space of the press is fully opened. By swivelling the pressing plate 2 into the illustrated horizontal position, the waste is initially compacted in a vertical direction. After that, the pressing face 3 is moved horizontally into the position illustrated in the continuous line layout and compacts the waste packet in the horizontal direction. The counter-forces required for this purpose are absorbed by a non-illustrated counter-plate which can be moved in and out. After the compacting process has been completed, the counter-plate is moved out and the compacted waste plug is inserted by means of the pressing face 3, which is moved further to the right, into an unheated region 5 of the batch furnace 6 and thus its entire content is correspondingly transported further, recompacted and held in pressure contact with the channel or furnace wall. Next the pressing face 3 is moved back into the left-hand end position, the counter-plate is moved in and the pressing plate 2 is swivelled back into the vertical position illustrated in broken lines. The compacting press 1 is ready for reloading. The waste compression is so great that the plug of waste inserted into the unheated region 5 of the batch furnace 6 is gas-impermeable. The heating of the batch furnace is effected by flame and/or waste gases which flow through a heating sleeve 8 in the direction of the arrow.

When pushing the compacted waste through the furnace channel 6, a degassed zone extends towards the central plane of the batch furnace 6, assisted by the large surface connected with the side/height ratio > 2 of its rectangular cross-section. Upon entry into a high temperature reactor 10, a mixture of carbon, minerals, metals and partly decomposed degassing-capable components occurs, said mixture being compacted by constant pressure application whilst being pushed through. This mixture is subjected in the region of the entry opening into the high temperature reactor 10 to extremely high radiation heat. The sudden expansion of residual gases in the carbonisation item involved herewith leads to its reduction into lumps. The solid material unit load obtained thus forms a gas-permeable bed 20 in the high temperature reactor, in which bed the carbon of the carbonisation item is incinerated by means of oxygen lances 12 initially into CO_2 or CO. The carbonisation gases flowing above the bed 20 through the reactor 10 during turbulence are detoxified entirely by cracking. Between C, CO_2, CO and the water vapour expelled from the waste, a temperature-conditioned reaction equilibrium is set during synthesis gas formation. In the upper part of the high temperature reactor 10, which consequently forms a stabilisation region of the synthesis gas formation, there are located fuel nozzles 18 and oxygen nozzles 18a, if necessary as a combined fuel burner in order to inject fuels and/or oxygen into the reactor, as described above, during start-up of the reactor or during close-down of the reactor. This crude synthesis gas is conducted via crude synthesis gas pipes 30 and 30a to a container or chamber 14 in which the synthesis gas is cooled by water injection in a shock treatment to less than 100 °C. Any components entrained in the gas (minerals and/or metal in a molten state) are deposited in the cooling water, water vapour is condensed so that the gas volume is reduced and thus the gas purification is facilitated which can follow shock cooling in arrangements which are known per se. The water used for shock-type cooling of the synthesis gas flow can if necessary be used in turn for cooling after purification and consequently be returned into the circulation. During rapid cooling of the crude synthesis gas by injection of cooling water into the crude synthesis gas flow, not only liquid components and solid material components (dusts etc.) are removed from the crude synthesis gas but also the cooling water absorbs in addition gas components from the crude synthesis gas. This is effected for example by emulsification of the ultra-fine gas bubbles in the cooling water or by dissolution of gases from the crude synthesis gas. In the core region of the bed 20 which has a temperature of more than 2000 °C, the mineral and metallic components of the carbonisation item are melted. Because of the different density, they thereby cover each other and are mixed. Typical alloy elements of iron, such as for example chrome, nickel and copper, form with the iron of the waste, a treatable alloy, other metal compounds, for example aluminium, oxidise and stabilise the mineral melt as oxides.

The melts enter directly into a subsequent treatment reactor 16 in which they are subjected to temperatures of more than 1400 °C in an oxygen atmosphere introduced by means of an O_2 lance 13, if necessary assisted by non-illustrated gas fuel burners. Entrained carbon particles are oxidised, the melt is homogenised and lowered in its viscosity.

During their common discharge into a water bath 17, mineral matter and iron melt granulate separately and can subsequently be graded magnetically.

The cooling water is conducted from the container 14 via a pipe 31 into a settling region, here a lamellar classifier 32, where the solid materials contained therein, for example floating components are deposited. The thus purified cooling water is inserted via a pipe 33 into the container 14 once again for cooling the crude synthesis gas and consequently is introduced into circulation. The purified crude synthesis gas leaves the container 14 in order to be subjected subsequently to a fine wash or fine purification in washers 34, 34a, 34b, 34c.

The thus finely purified synthesis gases can be supplied via a pipe 38 for use, for example in a gas generator 37 or else be supplied in the case of a fault to a combustion chamber 35 with flue 36 where they can be incinerated in an ecologically safe manner with the supply of forced air and be disposed of.

Furthermore, the device according to the invention has a valve 39 which is connected to a chimney 40 via a pipe 41. This valve 39 is disposed in Figure 2 between the high temperature reactor 10 and the chamber 14 for rapid cooling.

As described above, the resultant waste gases from the high temperature reactor during start-up and during close-down of the process can be supplied directly to the chimney 40 via the valve 39, it requiring to be observed however that the waste gases contain an oxygen surplus in the region of 5% by volume. In this case, direct disposal of the waste gases via the flue 40 is ecologically safe.

The flue 40 can thereby be also identical to the flue 36 of course so that only one flue is required.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A process for disposal and utilisation of waste materials of all types in which ungraded, untreated, industrial, domestic and/or special waste, which contain pollutants in a solid and/or liquid form, and/or industrial scrapped goods, the process comprising:

- compressing the waste materials into compact packets in batches;
- passing the compact packets through temperature treatment stages in a direction of increasing temperature, the temperature treatment stages comprising a step-wise temperature application resulting in thermal separation or material conversion of the waste materials in which the resulting solid residues are converted into a high temperature melt, the temperature treatment stages comprising:
  - at least one low temperature stage in a reaction container in which an applied pressure is maintained, and in which the waste materials have a form-fitting and frictional contact with the walls of the reaction container;
  - at least one high temperature zone, in which the waste materials produce synthesis gas and form a gas-permeable charge; and
  - a stabilisation zone for the synthesis gas located above the charge, the produced synthesis gas being discharged from the stabilisation zone,

wherein,

at the start-up of the process for heating of the high temperature zone, fuel and over-stoichiometric oxygen are injected into the stabilisation zone, are incinerated and the resulting waste gases are discharged through a chimney.

2. A process according to claim 1, in which the waste gases are discharged through a chimney after rapid cooling.

3. A process according to any one of the preceding claims, in which oxygen is injected in a surplus during a start-up of the process in such a manner that a residual oxygen content of at least 5% is contained in the waste gas.

4. A process according to one of the preceding claims, in which the waste gases are discharged via the chimney until the temperature in the high temperature zone reaches approximately 900°C.

5. A process according to one of the preceding claims, in which the waste gases are subsequently incinerated in a combustion chamber before discharge through the chimney.

6. A process according to one of the preceding claims, in which the reaction container is supplied with waste as soon as the temperature in the high temperature zone is approximately 750°C.

7. A process according to one of the preceding claims, in which upon reaching a waste gas temperature of 900C, the supply of oxygen into the stabilisation zone is ended, a surplus of combustible gas is introduced for a short time into the stabilisation region and the gas mixture is conducted to a combustion chamber with flue and is further incinerated.

8. A process according to one of the preceding claims, in which after reaching a stable proportion of combustible components in the gas mixture, the contained gases are conducted for thermal usage and hence the start-up is ended.

9. A process according to one of the preceding claims, further comprising:

a degassing channel which is made inert, during start-up before introduction of the item for disposal.

10. A process according to claim 9, in which the degassing channel is made inert by flooding the channel with nitrogen.

11. A process according to one of the preceding claims, in which all pipes conducting waste gas and/or a pipe between the stabilisation zone and chimney are made inert, at the beginning of the start-up.

12. A process according to claim 11, in which the pipes are made inert by flooding the pipe with nitrogen.

13. A process for disposal and utilisation of waste materials of all types in which ungraded, untreated, industrial, domestic and/or special waste, which contain pollutants in a solid and/or liquid form, and/or industrial scrapped goods, the process comprising:

- compressing the waste materials into compact packets in batches;
- passing the compact packets through temperature treatment stages in a direction of increasing temperature, the temperature treatment stages comprising a step-wise temperature application resulting in thermal separation or material conversion of the waste materials in which the resulting solid residues are converted into a high temperature melt, the temperature treatment stages comprising:
  - at least one low temperature stage in a reaction container in which an applied pressure is maintained, and in which the waste materials have a

form-fitting and frictional contact with the walls of the reaction container;

- at least one high temperature zone, in which the waste materials produce synthesis gas and form a gas-permeable charge; and
- a stabilisation zone for the synthesis gas located above the charge, the produced synthesis gas being discharged from the stabilisation zone,

wherein,

upon close-down of the process, the supply of the item for disposal to the reaction container is ended and, below a specific production rate of synthesis gas, oxygen is injected into the stabilisation zone and the resulting waste gases are discharged through a chimney.

14. A process according to claim 13, in which the waste gases are discharged through a chimney after a rapid cooling.

15. A process according to claim 13 or 14, in which the oxygen is injected in an excess.

16. A process according to any one of claims 13 to 15, in which oxygen is injected in an excess in such a manner that a residual oxygen content of at least 5% is contained in the waste gas.

17. A process according to one of the claims 13 to 16, in which upon maintaining the oxygen excess, combustible gas is introduced into the charge until the inorganic components of the charge are extensively melted.

18. A process according to one of the claims 13 to 17, in which the waste gases are subsequently incinerated in a combustion chamber before discharge through the chimney.

19. A process according to one of the claims 13 to 18, further comprising a pipe between the stabilisation zone and the chimney which is made inert. at the beginning of the close-down.

20. A process according to claim 19, in which the pipe is made inert by flooding the pipe with nitrogen.

21. A process according to one of the claims 13 to 20, in which the supply of oxygen into the stabilisation zone is reduced continuously as soon as the waste located in the reaction container is degassed or gasified completely and the melt has solidified.

22. A process according to one of the preceding claims, in which the pollutant concentrations in the chimney are measured continuously.

23. A process according to one of the preceding claims, in which in normal operation, at least the low temperature stage is passed through whilst maintaining the pressure application in form-fitting and frictional contact with the walls of the reactor container with the exclusion of oxygen.

24. A process according to one of the preceding claims, in which in normal operation, the low temperature stage is passed through in the temperature range between 100°C and 600°C.

25. A process according to one of the preceding claims, in which in normal operation, the high temperature stage is passed through with the addition of oxygen.

26. A process according to the preceding claim, in which in normal operation, the carbon components in the charge are gasified by metered addition of oxygen into

carbon dioxide, and in that carbon dioxide is reduced into carbon monoxide during penetration of the carbon-containing charge.

27. A process according to one of the preceding claims, in which in normal operation, the high temperature stage is passed through at temperatures of more than 1000°C.

28. A process according to one of the preceding claims, in which the discharged synthesis gas or the waste gases are subjected to a water application for shock-type cooling below 100°C directly after leaving the high temperature reactor and thereby are freed of dust.

29. A device for material preparation, conversation and subsequent treatment of disposal materials of all types with a plurality of thermal treatment stages, which comprises:

- at least one low temperature stage with oxygen exclusion;
- at least one high temperature stage with oxygen supply at temperature above 1000°C;
- a stabilisation zone disposed in the high temperature stage; and
- an outlet for the gas mixture produced in the high temperature stage, wherein all reaction spaces of the treatment stages are connected to each other in a fixed manner without locks and, in the high temperature stage, devices for feeding oxygen and devices for feeding fuel being provided;

and wherein, in the stabilisation zone, devices for feeding oxygen and fuel are provided and the outlet for the gas mixture or waste gas produced in the high temperature zone is connectable via at least one valve to a chimney to a combustion chamber with flue and/or to a device for using the gas.

30. A device according to the preceding claim, in which the gas outlet side of the high temperature stage before/or after the valve is connected to a rapid gas cooling which has a water injection device for cold water into the hot flow of the gas mixture or of the waste gas.

31. A device according to the two preceding claims, in which the outlet for the synthesis gas mixture has a throttle device, for example a regulatable throttle valve.

32. A device according to one of the claims 29 to 31, in which a device for gas purification is disposed after the outlet for the synthesis gas mixture.

33. A device according to one of the claims 29 to 32, in which a device for gas usage, for example a gas engine, a steam producer with turbine and a generator or the like, is disposed after the outlet for the synthesis gas mixture.

34. A device according to one of the claims 29 to 33, in which the reaction space for the low temperature stage is a horizontally disposed, externally heated batch furnace having a rectangular cross-section, the ratio of oven width to oven height of which is greater than 2, the furnace length being given by the equation $L_{ofen} \geq 5 \sqrt{F_{ofen}}$, with F_{ofen} as the cross-sectional surface of the batch furnace.

35. A device according to one of the claims 29 to 34, in which the reaction space for the high temperature stage is configured as a vertical shaft furnace into which the reaction space for the low temperature stage opens above its base.

36. A process for disposal and utilisation of waste materials and substantially as herein described with reference to the accompanying drawings.

37. A device for material preparation, conversion and subsequent treatment of disposal materials and substantially as herein described with reference to the accompanying drawings.

Dated this 18th day of August 2004
THERMOSELECT AG
By their Patent Attorneys
GRIFFITH HACK
Fellows Institute of Patent and
Trade Mark Attorneys of Australia

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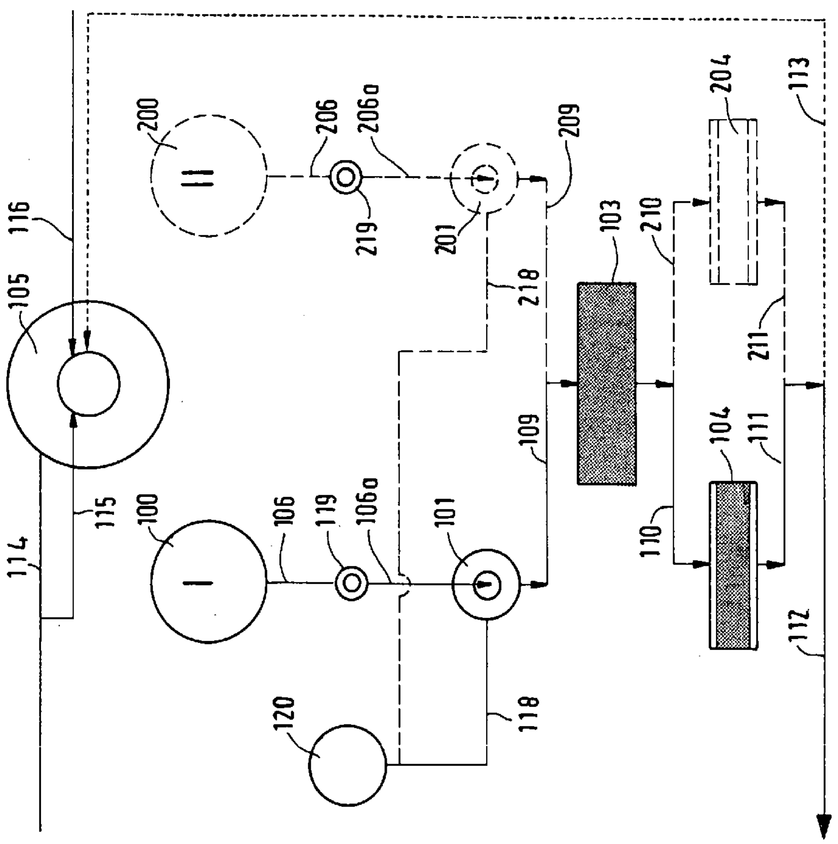
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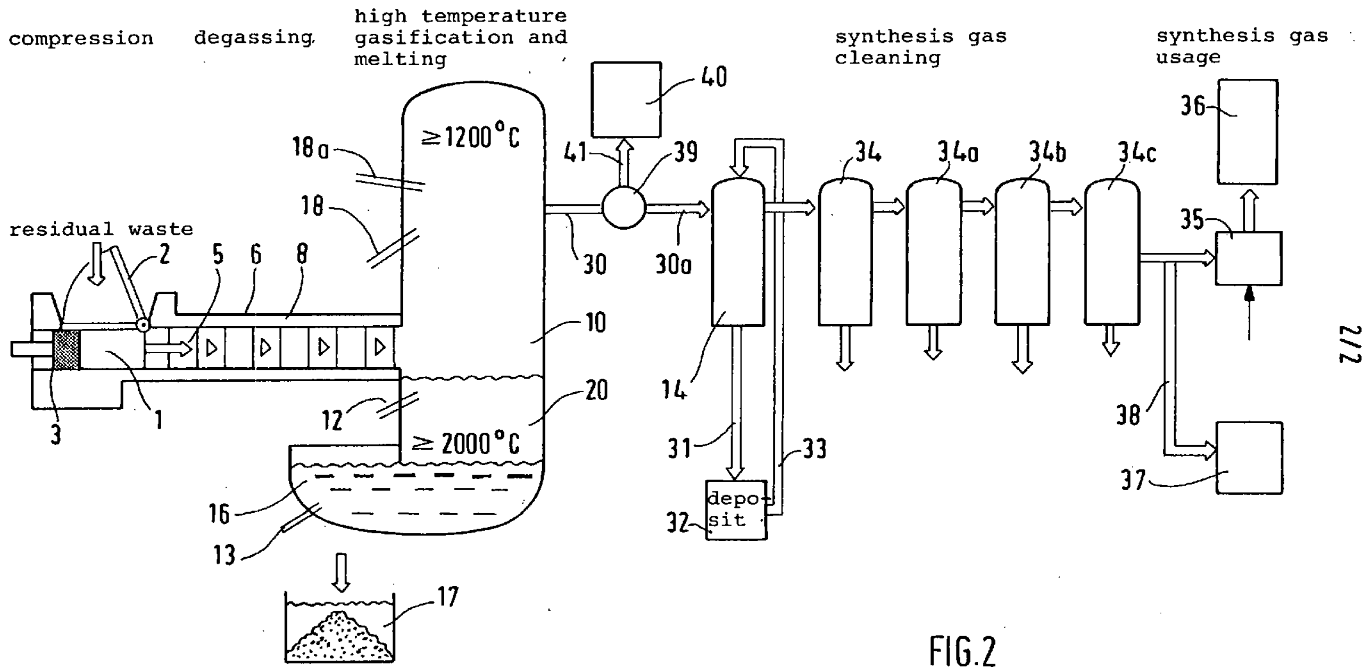
FIG.1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high temperature gasification and melting
synthesis gas cleaning
synthesis gas usage
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FIG.2