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(54) **Titre : "Reactor for a waste transformation device".**

(57) **Abrégé :**

The invention relates to devices for disposal of waste in solid, liquid and gaseous state thereof, in particular, it relates to devices for providing waste disposal by plasma-chemical destruction. A technical effect obtained by this invention is implementation of a reactor providing destruction of both organic and inorganic substances of residential solid and/or liquid waste. The technical effect is obtained by a reactor provided in form of a closed cavity having an input orifice connected to a waste feed apparatus and an output orifice for outputting gaseous products of destruction. Inner surfaces of the cavity are made electrically conductive entirely or partially and an electrode is inserted into the reactor. The electrode is isolated from the conductive surfaces and connected to a source of high-voltage pulses, and size of a gap between the electrode and the conductive surfaces of the cavity provides formation of streamers of plasma by corona discharge.

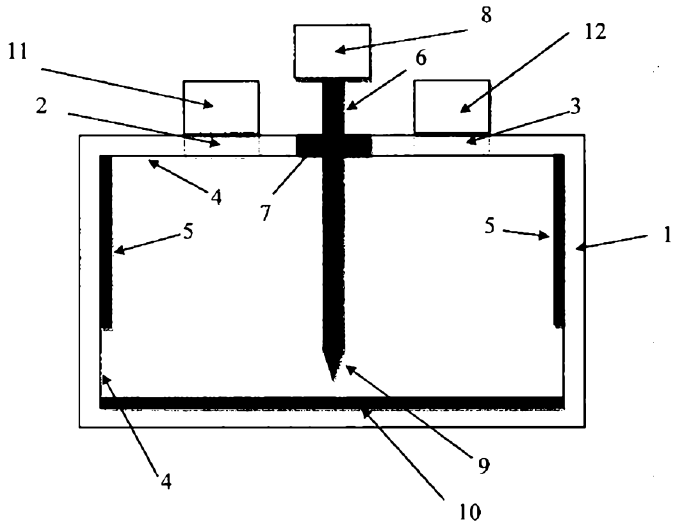

Fig. 1

REACTOR FOR WASTE DISPOSAL DEVICE

Field of the invention

The invention relates to devices for disposal of waste in solid, liquid and gaseous state thereof, in particular, it relates to devices for providing waste disposal by plasma-chemical destruction.

Prior art

There is a known method of conversion of solid organic waste according to patent RU2741004 (published on 22 January 2021), wherein conversion of solid organic waste is performed by way of steam plasma gasification with obtaining syngas. The treatment is provided using a high-temperature plasma reactor that employs water steam as a plasma forming gas and provides a temperature of about 1600–2000°C in the active area.

Limitations of this reactor are incomplete conversion of solid organic waste since the result of conversion is syngas that shall also be converted, and its inability to convert non-organic substances of residential solid waste.

Summary of the invention

A technical effect obtained by this invention is implementation of a reactor providing destruction of both organic and inorganic substances of residential solid and/or liquid waste.

The technical effect is obtained with a reactor provided in form of a closed cavity having an input orifice connected to a waste feed apparatus and an output orifice for outputting gaseous products of destruction. Inner surfaces of the cavity are made electrically conductive entirely or partially and an electrode is inserted into the reactor, wherein the electrode is isolated from the conductive surfaces and connected to a source of high-voltage pulses and size of a gap between the electrode and the conductive surfaces of the cavity provides formation of plasma streamers of corona discharge.

Preferably, the electrode is cylindrically shaped and has a sharpened tip.

Preferably, the electrode is made of steel.

In one embodiment, the cavity bottom is covered with a conductive moisture-contained liquid.

Preferably, the gap between the electrode and at least one portion of the inner conductive surfaces of the cavity or surface of the conductive moisture-contained liquid covering such a portion is provided in range of 5 to 50 mm.

Preferably, the conductive portions of the inner surfaces of the cavity are made of steel or other metal and grounded.

In one embodiment, inner non-conductive surfaces of the cavity may have a protective coating made of a dielectric material.

In one embodiment, the cylindrical electrode is equipped with wings provided in form of steel strips attached to the electrode by short sides thereof, while long sides of the steel strips are directed to the electrode and the wings are angularly disposed relative to the electrode towards the sharpened tip of the electrode.

Preferably, the angle between the steel strips and the electrode axis is selected in range of 20 to 60 degrees.

Preferably, 3 to 6 steel strips are to be used.

In one embodiment, the cavity bottom is flat and conductive and the cylindrical electrode is located transversally to the bottom with a gap.

In one embodiment, a steel grid is secured in parallel to the bottom through isolating spacers attached to the bottom. The grid has an opening for the cylindrical electrode so as a gap is formed around the electrode and free ends of the wings abut on the isolating spacers secured to the grid.

Preferably, the gap around the cylindrical electrode is provided in range of 3 to 10 mm, but it is less than the gap between the cylindrical electrode tip and the conductive bottom.

Preferably, pressure inside the reactor is lower than atmospheric pressure by 0.1 to 1 Pa.

In one embodiment, the under pressure inside the reactor is provided by connecting an electrostatic filter with a sucking air blower to the output orifice.

Preferably, the reactor is implemented with limitation of intake of air.

In one embodiment, the limitation of intake of air is provided by use of a wad that closes the reactor inlet, wherein the wad is pre-formed by pressurizing waste prior to feeding to the reactor.

Brief description of drawings

The invention is illustrated by Figures.

Fig. 1 shows a vertical cross-section of the reactor with the following designators:

1 – reactor body with inner cavity;

2 – input orifice;

3 – output orifice;

4 – inner surface of reactor cavity;

5 – conductive portions of inner surface of reactor cavity;

6 – sharpened electrode;

7 – isolating spacers;

8 – source of high-voltage pulses;

9 – electrode tip;

10 – conductive bottom of reactor;

11 – apparatus for metered feed of waste to be processed;

12 – electrostatic filter with sucking air blower.

Detailed description of the invention

The invention may be implemented in a reactor having a body. The reactor body has an input orifice 2 connected to an apparatus 11 for metered feed of solid and/or liquid waste to be processed. The apparatus 11 is configured to limit amount of air that is let into the reactor. The reactor body has an output orifice 3 intended for removing gaseous destruction products and connected to an electrostatic filter with a sucking air blower. Portions 5 of the body cavity inner surface and a bottom 10 are made of steel. An electrode 6 is inserted into the cavity of the body 1 through an isolating spacer 7. The electrode 6 is connected to a source 8 of high-voltage pulses. A tip 9 of the electrode 6 is located with a gap of 20 mm relative to the conductive bottom 10 of the reactor body 1.

The device is operated in the following way. High-voltage pulses are fed to the electrode 6 from the source 8. As known from [1], each pulse causes a large number of streamers at the tip 9 of the electrode 6. The streamers multiply and spread towards the conductive bottom 10 of the body 1, gradually populating the inter-electrode gap and forming corona discharge. After that, for example, a portion of pressed solid residential waste is fed into the device from the apparatus 11 for metered feed of waste to be processed via the input orifice 2, so intake of atmospheric air into the body 1 via the input orifice 2 is limited. Corona discharge plasma acts on water contained in input waste causing generation of free radicals upon disruption of water molecule $H_2O \rightarrow OH\bullet + H\bullet$. Additionally, streamers of pulse corona discharge cause formation of other active substances, namely O_3, $O_2(a^1\Delta)$, H_2O_2, OH, $O(^3P)$, NO, $HNO_2$and HNO_3 in the reactor. Corona discharge is also a source of ultraviolet (UV) radiation. The active substances and UV radiation provide a disruptive impact upon any organic and inorganic substances contained in waste to be processed, thus assuring disintegration thereof with formation of harmless gaseous products, namely water and carbon dioxide. Inorganic content of waste is disrupted by acids$HNO_2$and HNO_3formed in the reactor due to the corona discharge. Oxidation process in water for organic substances is a chain reaction [2]. A low rate chain reaction may be initiated by atmospheric oxygen and ozone. A high rate chain reaction is initiated by OH• radicals. In other words, plasma-chemical destruction of both organic and inorganic substances contained in waste is provided in the device. Gaseous destruction products flow into the output orifice of the reactor.

Thus, the indicated technical effect is obtained by the device owing to plasma-chemical destruction of both organic and inorganic substances contained in residential waste.

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Claims

1. A reactor for waste disposal device, the reactor provided in form of a cavity with an input orifice connected to a waste feed apparatus and an output orifice for outputting gaseous products of destruction, characterized in that inner surfaces of the cavity are entirely or partially conductive, and an electrode is inserted into the reactor, wherein the electrode is isolated form the conductive surfaces and connected to a source of high-voltage pulses and size of a gap between the electrode and the conductive surfaces of the cavity provides formation of streamers of pulse corona discharge plasma when the high-voltage pulses are supplied to the electrode.

2. The reactor for waste disposal device of claim 1, characterized in that the electrode is cylindrically shaped and has a sharpened tip.

3. The reactor for waste disposal device of claim 1, characterized in that the electrode is made of steel.

4. The reactor for waste disposal device of claim 1, characterized in that the cavity bottom is covered by a conductive moisture-containing liquid.5. The reactor for waste disposal device of claim 1, characterized in that the size of the gap between the electrode and at least one portion of the conductive inner surfaces of the cavity is 5 to 50 mm.

6.The reactor for waste disposal device of claim 4, characterized in that size of a gap between the electrode and surface of the conductive moisture-containing liquid covering a portion of the conductive inner surface of the cavity is 5 to 50 mm.

7. The reactor for waste disposal device of claim 1, characterized in that conductive portions of the inner surfaces of the cavity are made of steel or other metal and grounded.

8. The reactor for waste disposal device of claim 1, characterized in that non-conductive inner surfaces of the cavity have a protective coating made of a dielectric material.

9. The reactor for waste disposal device of claim 2, characterized in that the cylindrical electrode is equipped with wings provided in form of steel strips attached to the electrode by short sides thereof, while long sides of the steel strips are directed to the electrode and the wings are angularly disposed relative to the electrode towards the sharpened tip of the electrode.

10. The reactor for waste disposal device of claim 7, characterized in that the angle between the steel wings and axis of the electrode is 20 to 60 degrees.

11. The reactor for waste disposal device of claim 7 or claim 8, characterized in that the cylindrical electrode is equipped with 3 to 6 steel wings.

12. The reactor for waste disposal device of claim 2, characterized in that a bottom of the cavity is flat and conductive and the cylindrical electrode is located with a gap transversally to the bottom.

13. The reactor for waste disposal device of claim 10 or claim 11, characterized in that a steel grid is secured in parallel to the bottom through isolating spacers attached to the bottom, wherein the grid has an opening for the cylindrical electrode so as to form a gap around the electrode and free ends of the wings abut on the isolating spacers secured to the grid.

14. The reactor for waste disposal device of claim 12, characterized in that size of the gap around the cylindrical electrode is 3 to 10 mm, but it is less than size of the gap between the electrode tip and the conductive bottom.

15. The reactor for waste disposal device of any of claims 1–13, characterized in that pressure inside the reactor is lower than atmospheric pressure by 0.1 to 1 Pa.

16. The reactor for waste disposal device of claim 14, characterized in that the under pressure inside the reactor is provided by connecting an electrostatic filter with a sucking air blower to the output orifice.

17. The reactor for waste disposal device of any of claims 1–15, characterized in that intake of air into the reactor is limited.

18. The reactor for waste disposal device of claim 16, characterized in that intake of air is limited by a wad that closes an inlet of the reactor, wherein the wad is pre-formed by pressurizing waste prior to feeding to the reactor.

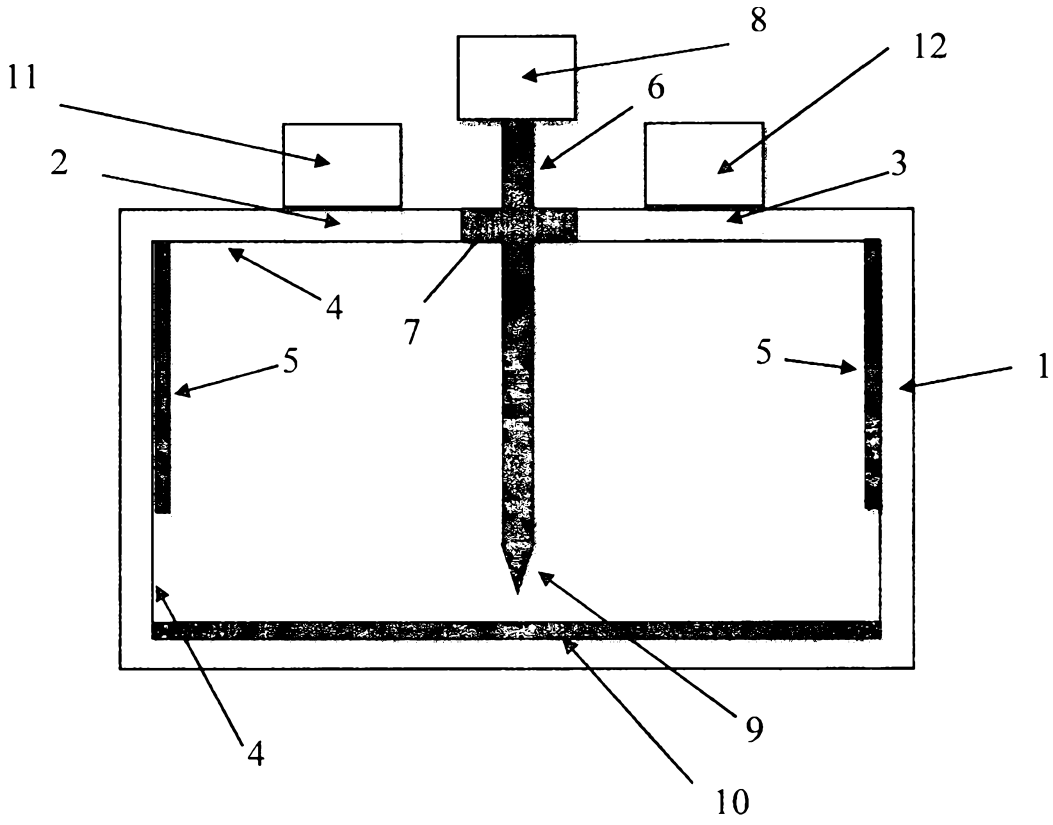

Fig.1

Abstract

The invention relates to devices for disposal of waste in solid, liquid and gaseous state thereof, in particular, it relates to devices for providing waste disposal by plasma-chemical destruction. A technical effect obtained by this invention is implementation of a reactor providing destruction of both organic and inorganic substances of residential solid and/or liquid waste. The technical effect is obtained by a reactor provided in form of a closed cavity having an input orifice connected to a waste feed apparatus and an output orifice for outputting gaseous products of destruction. Inner surfaces of the cavity are made electrically conductive entirely or partially and an electrode is inserted into the reactor. The electrode is isolated from the conductive surfaces and connected to a source of high-voltage pulses, and size of a gap between the electrode and the conductive surfaces of the cavity provides formation of streamers of plasma by corona discharge.