

METHOD FOR DESTROYING ORGANIC WASTE WITH A LOW WATER CONTENT

Field of invention

The invention relates to methods of disposing household waste, in particular, to methods of disposing waste with low content of water by plasma-chemical destruction.

Prior Art

There is a known method of solid organic waste treatment implemented in a device of patent RU2741004 (published on January 22, 2021), where solid organic waste is treated by way of vapor plasma gasification conversion with generation of syngas. The treatment is performed by a high-temperature plasma reactor, where water vapor is used as a plasma-supporting gas and temperature of reaction area is about 1600 to 2000 °C.

Disadvantages of this method are requirement of substantial heating for its carrying out and incomplete treatment of solid organic household waste, since the treatment results in syngas that also needs to be disposed.

According to document [1], plasma of discharges under atmospheric pressure exerts an effect on water and causes formation of free radicals upon destruction of water molecules: $\text{H}_2\text{O} \rightarrow \text{OH}\cdot + \text{H}\cdot$. According to document [2], chain reaction of organic substances oxidation process in presence of water may be initiated by atmospheric oxygen and ozone, but with a low rate. High-rate chain reaction is initiated by $\text{OH}\cdot$ radicals. With insufficient amount of water, concentration of free radicals is insignificant, which does not allow initiating chain reaction of organic substances oxidation in water.

Summary of invention

The invention is directed to attaining a technical effect of broadening range of technical solutions by providing a method of destruction of organic waste with low content of water.

This technical effect is attained by a destruction method, where organic waste with low content of water is loaded into a reactor via an input opening, and waste of biological origin is loaded additionally. The reactor is provided in form of a closed cavity, which inner surface is made conductive entirely or partially and grounded. An electrode protrudes into the reactor, and this electrode is isolated from the grounded surface. High-voltage pulses are supplied to the electrode. The pulses cause formation of corona discharge streamers in a gap between the electrode and the conductive surface of the reactor.

This is known that waste of biological origin contains up to 98% of water (“Algae” in Table 2 of article “Water” in The Great Soviet Encyclopedia). Plasma of streamers of corona discharge initiated in the reactor exerts an effect on water contained in the waste of biological

origin, thus causing formation of free radicals due to disintegration of water molecules $\text{H}_2\text{O} \rightarrow \text{OH}\cdot + \text{H}\cdot$ contained therein. In addition, other active substances are formed in the reactor due to corona discharge streamers: O_3 , $\text{O}_2(\text{a}^1\Delta)$, H_2O_2 , OH , $\text{O}(\text{}^3\text{P})$, NO , HNO_2 and HNO_3 . Corona discharge also causes ultraviolet (UV) radiation. The above-mentioned active substances and UV radiation exert destruction action on any organic and inorganic substances contained in the household waste, including organic waste with low content of water, thus providing complete destruction thereof and formation of harmless gaseous reaction products, namely, water and carbon dioxide. Non-organic contents of the waste are destroyed by acids.

In other words, this method provides plasma-chemical destruction of both organic and inorganic substances contained in the waste, including the organic waste with low content of water.

Preferably, size of the gap between the electrode and at least one of conductive portions of the cavity inner surface is provided in range of 5 to 50 millimeters.

Preferably, entry of atmospheric air into the reactor is restricted, when implementing the method.

Preferably, the waste is loaded into the reactor in dosed amounts.

Preferably, the waste doses are loaded into the reactor in compressed form, while ingress of atmospheric air into the reactor is restricted.

Preferably, the household waste with low content of water and the waste of biological origin are loaded into the reactor simultaneously or consequently, when implementing the method.

Preferably, pressure inside the reactor is decreased by 0.1 to 1.0 Pa compared to atmospheric pressure.

In one embodiment of the method, depression is provided at the reactor output to decrease pressure inside the reactor.

Brief description of drawings

Fig. 1 shows a vertical cross-section of the reactor for implementation of the claimed method, where the following designators are used:

- 1 reactor body with inner cavity;
- 2 input opening;
- 3 output opening;
- 4 inner surface of reactor cavity;
- 5 conductive portions of inner surface of reactor cavity;
- 6 tipped electrode;
- 7 isolating members;

- 8 source of high-voltage pulses;
- 9 electrode tip;
- 10 conductive bottom of reactor;
- 11 device for dosed loading waste to be treated;
- 12 electrostatic filter with extraction air fan providing depression at reactor output.

Detailed description of embodiments

The method is implemented by use of the reactor provided in form of the closed body (1) with the bottom (10) that is made conductive and grounded. The electrode (6) having the tip (9) protrudes into the body (1). The tip (9) is isolated from the conductive bottom (10) of the body (1) and directed towards it. A portion of compressed organic waste with low content of water is loaded from the device (11) for dosed loading waste to be treated via the input opening (2) of the body (1), after that a portion of compressed waste of biological origin is loaded, while entry of atmospheric air into the body (1) is restricted. High-voltage pulses are supplied to the electrode (6) from the source (8). As it is known from document [1], large number of streamers occur near the tip (9) of the electrode (6) with each pulse. The streamers start multiplying and spreading towards the conductive bottom (10) of the body (1), gradually populating the inter-electrode gap and forming streamer corona discharge. Plasma of the corona discharge exerts an effect on water contained in the waste of biological origin that is loaded into the reactor and causes formation of free radicals upon destruction of water molecules: $\text{H}_2\text{O} \rightarrow \text{OH}\cdot + \text{H}\cdot$, which after their formation, exert influence on the organic waste with low content of water either. In addition, other active substances are formed in the reactor due to corona discharge: O_3 , $\text{O}_2(\text{a}^1\Delta)$, H_2O_2 , OH , $\text{O}(\text{}^3\text{P})$, NO , HNO_2 and HNO_3 . Corona discharge also causes ultraviolet (UV) radiation. The above-mentioned active substances and UV radiation exert destruction action on any organic and inorganic substances contained in the waste to be treated, thus providing complete destruction thereof and formation of harmless gaseous reaction products, namely, water and carbon dioxide. Non-organic contents of the waste are destroyed by acids. Process of oxidation of organic substances in water is a chain reaction [2]. Low-rate chain reaction may be initiated by atmospheric oxygen and ozone. However, high-rate chain reaction is initiated by $\text{OH}\cdot$ radicals only, which formation in the reactor is caused by effect of corona discharge plasma exerted on water that is contained in the waste of biological origin. In other words, the device provides plasma-chemical destruction of both organic and inorganic substances contained in the waste, including the organic waste with low content of water. Gaseous products of destruction enter the output opening (3) of the reactor.

Thus, the specified technical effect is attained in form of providing the method of plasma-chemical destruction of both organic and non-organic substances contained in waste, including organic waste with low content of water.

Non-patent documents

[1] Аристова Н.А., Пискарев И.М., Ивановский А.В., Селемир В.Д., Спиров Г.М., Шлепкин С.И. Иницирование химических реакций под действием электрического разряда в системе твердый диэлектрик-газ-жидкость // Журнал физической химии. 2004. Т. 78. № 7. С. 1326–1331. (Aristova N.A., Piskarev I.M., Ivanovskiy A.V., Selemir V.D., Spirov G.M., Shlepkin S.I. Initiation of chemical reactions by electrical discharge in dielectric-gas-liquid configuration // Physical Chemistry Journal, 2004, Vol. 78, #7, pages 1326–1331.)

[2] Пискарев И.М. Окислительно-восстановительные процессы в воде, инициированные электрическим разрядом над ее поверхностью // Журнал общей химии. 2001. Т. 71. Вып. 10. С. 1622. (Piskarev I.M. Oxidation-reduction processes in water initiated by electrical discharge above water surface // General Chemistry Journal, 2001, Vol. 71, Issue 10, page 1622.)

Claims

1. A method of destruction of organic waste with low content of water, *characterized by that* organic waste with low content of water is loaded into a reactor via an input opening, and waste of biological origin is loaded additionally, wherein the reactor is provided in form of a closed cavity, which inner surface is made conductive entirely or partially and grounded, an electrode isolated from the grounded surface protrudes into the reactor, high-voltage pulses are supplied to the electrode, which cause formation of corona discharge streamers in a gap between the electrode and the conductive surface of the reactor.

2. The method of destruction of organic waste with low content of water according to claim 1, wherein size of the gap between the electrode and at least one of conductive portions of the cavity inner surface is provided in range of 5 to 50 millimeters.

3. The method of destruction of organic waste with low content of water according to claim 1, wherein entry of atmospheric air into the reactor is restricted during loading the waste.

4. The method of destruction of organic waste with low content of water according to any one of claims 1 to 3, wherein the waste is loaded into the reactor in dosed amounts.

5. The method of destruction of organic waste with low content of water according to claim 4, wherein the waste doses are loaded into the reactor in compressed form.

6. The method of destruction of organic waste with low content of water according to any one of claims 1 to 5, wherein the organic waste with low content of water and the waste of biological origin are loaded into the reactor simultaneously or consequently.

7. The method of destruction of organic waste with low content of water according to claim 1, wherein pressure inside the reactor is decreased by 0.1 to 1.0 Pa compared to atmospheric pressure.

8. The method of destruction of organic waste with low content of water according to claim 7, wherein depression is provided at the reactor output.