UDC 628.38: 662.76

PYROLYSIS OF SEWAGE SLUDGE WATER IN WATER VAPOR OF HIGH PRESSURE

Y. Kozhevnikov, A. Chizhikov, S. Pashkin

Of sewage sludge produced in large quantities at the municipal wastewater treatment plants. Sediment from the sludge can occupy an area of several hundred square meters, being the source of noxious fumes with a very bad smell and the deteriorating environmental situation in the surrounding areas.

High (more than 70%) humidity even dewatered sludge prevents burning it using standard techniques, therefore it is necessary either to take away the polygons substrate consisting of 2/3 water to natural drying or to evaporate the residual water, which requires special equipment and high energy costs. Generally, rainfall export for disposal in landfills or dried for later burning in boilers. In both cases, the products of decay of precipitation formed at the sites or the products of combustion in the form of precipitation polluting gases and dust, which is unacceptable from an environmental point of view.

One of the most effective solutions to the above problems is, is the use of a known method of pyrolysis of organic waste, rule-conductive contact of the feedstock with the environment. The significant disadvantages of the most common pyrolysis technologies using heat generated by partial combustion of the organic mass inside the reactor being supplied with air or oxygen, may include a large amount of tar and low calorific value gaseous products of the process.

An experimental study of the pyrolysis products of sewage sludge in the medium high pressure steam without contact with the environment. In this vapor source is water, a part of the feedstock, which allows the thermochemical decomposition reaction of its organic components to form a low molecular weight gaseous compounds, coal and water which after condensing and cooling in the heat exchanger can be returned to the environment or is filed in final purification for such as technical purposes.

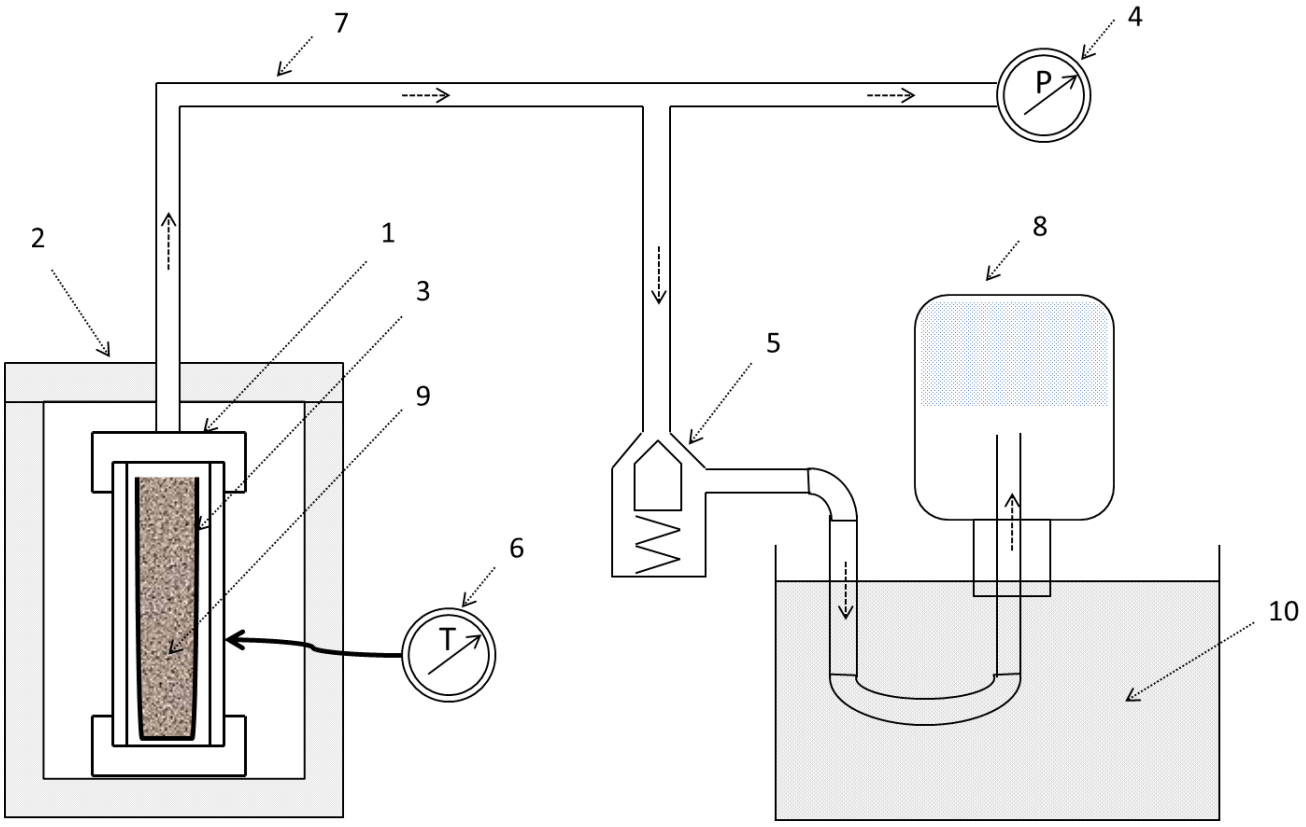
The purpose of research - to determine the effectiveness of the method and the studied parameters.

Materials and methods of research. The experimental mouth-Novki for processing sludge by pyrolysis in the medium high pressure steam is shown in the figure.

The pressure vessel 1 (reactor pressure vessel) has two removable end caps for placement in a beaker with a sample of the feedstock. This device was placed in a muffle furnace 2, which allows to heat the raw material in a vessel with a glass to a temperature of 600 ° C.

Processing of the sample was subjected to many years of sludge wastewater treatment facilities Lyubertsy Moscow Region. Initial samples had a sharp odor and semi-liquid consistency of dark green (almost black) color.

The samples were placed in thin walled stainless steel beaker 3, Koto-ing in turn inserted with a slight clearance in a cylindrical pressure vessel 1. In one of the flanges of the steel pipe was incised at the other end of which is a pressure gauge 4 and 5. Pressure reducing valve has been preset in the relief pressure in the range of 20,0-40,0 MPa, which corresponds to the working process in the developed modes thermochemical reactor industrial applications. To the outer side wall of the cylinder by a thin dielectric spacer attached thermocouple 6 with insulated from external heat sources junction so that the temperature of the temperature of the reactor wall 1. reducing valve 5 communicates pipe 7 for collecting the gases from the reactor with water in a pre-filled bottle 8 placed in the water tank 10.



The experimental setup:

1 - a reactor (autoclave); 2 - muffle furnace; 3 - glass; 4 - the gauge; 5 - the valve-pressure regulator; 6- thermometer with thermocouple; 7 - connecting tube; 8 - a reservoir for collecting gases; 9 - raw water; 10 - tank containing water

Experiments were conducted for samples with different initial moisture content of the mass, which is mixed with organic feed-corresponding appropriate amount of added water and mixed thoroughly until a uniform pulp 9, placed in a beaker 3 prior to pyrolysis.

To achieve the conditions necessary for each particular experiment the autoclave was heated in a muffle furnace 2. In this case, the desired value of the pressure in the reactor 1 was maintained by preset relief valve by overpressure. The maximum temperature in these experiments varied in the range of 350-550 ° C.

The experiment was performed as follows. Once placed in a muffle furnace autoclave containing a glass sample prepared by the raw materials, and thermal insulation

gap comprises heating muffle furnace. When heated to a temperature of 380-400 ° C, the reactor pressure reached the threshold pressure reducing valve 5 through which gas began to flow out with water vapor. At a given temperature, heating was stopped and the reactor was removed from the muffle furnace and cooled. The complete cycle of heating-cooling took time from one to three hours. The reactor is then depressurized and removed from the solid components of the glass raw material processing products. This balance represented the ultrafine mass of dark brown color and neutral smell. The properties of this mass is like a normal ash. Upon contact with water, it is wetted and partially sink, forming a slurry, which almost completely passes through the single-ply paper filter. Composition of the product gas after processing in the autoclave at different temperatures and pressures was measured by Testo t350 S (Germany).

The results of research. The moisture content of the initial sample was determined by evaporating the water in a fume hood for 6-10 hours at a temperature of 110-120 ° C. The weight loss of the samples at these dimensions co-constitutes 75-84%, corresponding to an average moisture content of about 80% of samples. Weight solid thermochemical processing of samples is approximately 10 times less than that of the original organic matter.

The analysis of composition and quantity of gases discharged from the autoclave as a result of the thermochemical treatment. It should be noted a very wide range of variation of the ratio of the gaseous components in the reaction products. This indicates that the maximum variation in temperature can lead to a significant change in the relative composition of the gases. However, it found that the pressure of water vapor and gases does not affect the composition of the gaseous products of thermochemical conversion. For this reason, the data on the dependence of the pressure of the gas composition in the reactor is given.

The amount of gas collected in different experiments also vary considerably. To accurately determine the amount of product gas necessary to consider its volume in the supply tube, remaining at a high pressure.

Used for the rapid analysis of a digital device allows you to simultaneously detect the presence of other gases. Definitely it can be argued that the concentration of carbon dioxide and nitrogen oxides in the products of pyrolysis does not exceed 0.1%. A small number of tests (about 10%) showed the presence of small amounts (less than 0.2%) SO2.

The volume of the resulting experimental data is not sufficient to explain the large variation in the relative concentrations of components of the fuel gas. Specifically, this issue has not been studied, since it goes beyond the basic objectives of this work, which is rather applied character and is to investigate the possibility of recycling sludge residues environmentally effective manner, while ensuring maximum reduction of weight of the solid product.

It can be assumed that the causes of the observed significant variation in relative shares of the gases produced in the processed products in specific experiments are differences in the actual values of the partial pressures of the gas mixture, which determine the kinetics of homogeneous chemical reactions. At the same time the control of these parameters was not provided for the construction of the laboratory setup. The real situation is even more complicated, given the heterogeneity of the temperature distribution of the partial pressures in the flow direction of the reactor to the point of discharge of gases into the receiver via a pressure reducing valve.

The composition of the solids after processing in the autoclave was not determined. It can be described as a fine powder of neutral odor containing no resins or fluids.

Conclusions

The experiments on the pyrolysis of sewage sludge in the medium high pressure steam showed the following:

- Thermochemical processing reduces the dry weight of initial raw material is-about twice the transition a large part of matter in gases;

- Consisting of collected gas at atmospheric pressure contains only combustible components, substantially no carbon dioxide, and nitrogen oxides, and sulfur;

- Combustible gases include hydrogen and carbon monoxide, wherein the ratio of the actual concentrations can vary over a wide range depending on the technological processing modes.

The experimental results confirm the presence of sewage sludge a significant amount of decomposed organic matter, even after long-term storage in open areas. It is shown that the composition of the resulting combustible gas can vary widely, depending on the temperature and other conditions of the pyrolysis process, which indicates the possibility of controlling the composition of the gaseous products useful technological methods.

Further studies will aim to clarify the technological parameters of the pyrolysis of various organic materials in supercritical conditions, the creation and testing of the experimental setup with a continuous production cycle.