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«КӨЛІК ЖӘНЕ ЭНЕРГЕТИКАНЫҢ ӨЗЕКТІ МӘСЕЛЕЛЕРІ: ИННОВАЦИЯЛЫҚ ШЕШУ ТӘСІЛДЕРІ» IX ХАЛЫҚАРАЛЫҚ ҒЫЛЫМИ-ТӘЖІРИБЕЛІК КОНФЕРЕНЦИЯСЫНЫҢ БАЯНДАМАЛАР ЖИНАҒЫ

СБОРНИК МАТЕРИАЛОВ IX МЕЖДУНАРОДНОЙ НАУЧНО – ПРАКТИЧЕСКОЙ КОНФЕРЕНЦИИ: «АКТУАЛЬНЫЕ ПРОБЛЕМЫ ТРАНСПОРТА И ЭНЕРГЕТИКИ: ПУТИ ИХ ИННОВАЦИОННОГО РЕШЕНИЯ»

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В сборник включены материалы IX Международной научно – практической конференции на тему: «Актуальные проблемы транспорта и энергетики: пути их инновационного решения», проходившей в г. Нур-Султан 19 марта 2021 года.

Тематика статей и докладов участников конференции посвящена актуальным вопросам организации перевозок, движения и эксплуатации транспорта, стандартизации, метрологии и сертификации, транспорту, транспортной техники и технологии, теплоэнергетики и электроэнергетики.

Материалы конференции дают отражение научной деятельности ведущих ученых дальнего, ближнего зарубежья, Республики Казахстан и могут быть полезными для докторантов, магистрантов и студентов.

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PLASMA UTILIZATION OF INDUSTRIAL WASTE

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The purpose of this article is to consider the main currently existing and promising methods of plasma utilization and processing of industrial waste. The concept of industrial waste and consider their classification according to various criteria: according to their chemical nature, technological signs of formation, the possibility of further processing and use and the degree of their toxicity. Secondly, to characterize the methods of disposal, processing and, if necessary, the conditions of their burial.

The use of low-temperature plasma is one of the promising directions in the field of hazardous waste disposal. By means of plasma, a high degree of neutralization of chemical industry wastes, including halloid-containing organic compounds, from medical institutions is achieved; processing of solid, pasty, liquid, gaseous; organic and inorganic; weakly radioactive; household; carcinogenic substances for which strict MPC standards are established in air, water, soil, etc.

The plasma method can be used for waste disposal in two ways [1]:

- Plasma-chemical elimination of highly hazardous highly toxic waste;
- Plasma-chemical processing of waste in order to obtain marketable products.

The most effective plasma method is for the destruction of hydrocarbons with the formation of CO, CO_2, H_2, CH_4. Non-consumable plasma heating of solid and liquid hydrocarbons leads to the formation of a valuable gaseous semi-finished product, mainly hydrogen and carbon monoxide - synthesis gas - and melts of a slag mixture that are not harmful to the environment when buried in the ground, and synthesis gas can be used as a source of steam for TPP or production of methanol, artificial liquid fuel.

There are a wide variety of modifications of plasmatron installations, the principle of their design and order of operation is as follows: the main technological process takes place in a chamber, inside which there are two electrodes (cathode and anode), usually made of copper, sometimes hollow. Waste, oxygen and fuel enter the chamber under a certain pressure, in predetermined quantities, water vapor can be added. The chamber is kept constant pressure and temperature. The use of catalysts is possible. There is an anaerobic version of the installation [4]. When processing waste by the plasma method in a reducing environment, it is possible to obtain valuable commercial products: for example, acetylene, ethylene, HCl and products based on them can be obtained from liquid organochlorine waste [5]. In a hydrogen plasmatron, by treating organofluorine wastes, it is possible to obtain gases containing 95–98% by mass of HCl and HF [7].

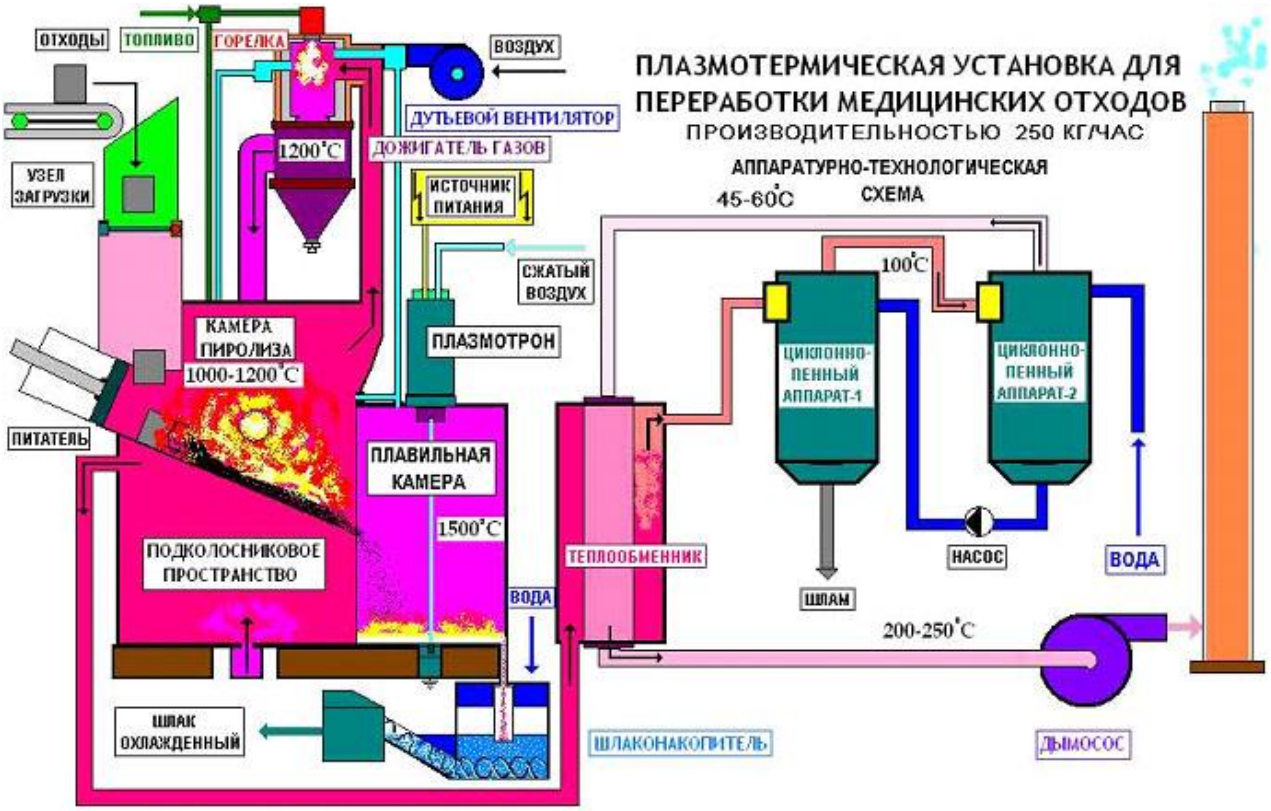
The waste processing technology is based on high-temperature (plasma) gasification of solid organic waste with the production of high-calorific 8-10 MJ / nm3 synthesis gas (CO +H_2), which is intended for the production of electricity. The inorganic component of waste (ash) under the influence of high temperature (4-5 thousand °C) goes into a melt and, with subsequent granulation, acquires neutral properties to the environment and can be used in the construction industry.

The source of the high-temperature medium is an electric arc plasmatron (one or more) of various power with a long service life (500-1000 hours). Gasification is carried out in a plasma electric furnace, synthesis gas purification - in a vortex scrubber and fine filters. Combustion of fuel gas to generate electricity is carried out in gas turbines, gas piston engines and other power generating units.

Advantages and novelty over analogues:

• Application of new design schemes of electric arc plasmatrons with long service life of electrodes (500-1000 h);

• Power of plasmatrons is 2-3 times higher;
• The cost of waste processing is 2 times lower;
• Environmentally friendly technology;
• Waste-free technology: the output is combustible syngas, inert slag for building materials.



Picture 1– Plazma equipment

Table 1- Technical characters of plasmatron

Waste capacity kg/h	250
Installed power of plsamatron, kW	150
Blast air consumption, nm3/h	2400
Compressed air consumption, nm3/h, max	100
Waste gas volume, nm3/h	2900
Exhaust gas temperature, C	1050-1200
in the melting chamber	1300-1500
in the pyrolysis chamber	1050-1200
after the afterburner	1000-1100
Specific electricity consumption, kWh / kg	0.6-0.7
Installation area, m2	150

Technical appraisal and economic benefits

• reduce CO2 emissions into the atmosphere;
• ensure almost 100% combustion of hydrocarbons and carbon;
• to convert the inorganic part of the waste in one technological cycle into the form of a chemically inert slag;
• ensure high environmental safety of waste products. At least 99% of the volume of secondary products meets the sanitary standards of the EEC.

The high energy intensity and complexity of the process predetermines its use for processing only waste, the fire neutralization of which does not meet environmental requirements.

Analysis of waste management in developed countries has shown that countries such as the USA, Japan, Denmark and a number of other countries have long been moving to new waste disposal systems. In these countries, waste management presupposes reliable ways of disposing of waste, minimizing its accumulation and obtaining useful materials and energy from it. Due to the untimely and irrational disposal of waste in Kazakhstan, there is an intensive accumulation of waste, seriously polluting the environment.

To obtain a high degree of decomposition of toxic wastes, especially halogen-containing ones, the design of the combustion furnace must ensure the required residence time in the combustion zone, thorough mixing at a certain temperature of the initial reagents with oxygen, the amount of which is also controlled. To suppress the formation of halogens and their complete conversion to hydrogen halides, an excess of water and a minimum of oxygen are required, the latter causing the formation of a large amount of soot. During the decomposition of organochlorine products, a decrease in temperature leads to the formation of highly toxic and stable substances - dioxins [2, 3]. According to the author of [4], the disadvantages of fiery combustion stimulated the search for effective technologies for the neutralization of toxic waste.

Summing up all of the above, we can say that, despite the lengthy study of this problem, the utilization and processing of industrial waste is still not conducted at the proper level. A multilateral and deep solution to the problem of disposal and recycling of industrial waste is a long and painstaking process that will have to be dealt with by a number of generations of scientists, engineers, technicians, ecologists, economists, workers of various profiles and many other specialists.

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