- organization of the very process of fuel combustion in the chambers;
- method of premixing a certain portion of air and fuel before feeding them into the combustion chamber.

In recent years, attempts have been made to create so-called two-zone chambers for combustion of fuel in them. The use of two-stage fuel combustion in combustion chambers makes it possible to reduce the output of nitrogen oxides to 45-50% of the initial output when burning natural gas. However, two-stage fuel combustion is associated with the development of a rather complex design of the combustion chamber, which is not fully compensated for by a decrease in nitrogen oxide emissions.

Currently, the simplest and relatively cheap way to reduce emissions of nitrogen oxides with combustion products should be considered a method based on preliminary mixing of fuel with air (lean mixture) before the components are fed into the combustion zone. Increasingly, gas turbine plants are being improved by just this method [2].

In conclusion, we can say that the future of heat power engineering belongs to Thermal Power Plants based on gas turbine units - this is not only a justified decision from the economic point of view, but also from the environmental one. Low emission and noise levels, absence of vibration, make this equipment the only one suitable for use in densely built-up areas such as residential areas, business and resort areas. These features make it possible to consider this equipment as the most popular and promising for use in low-power energy complexes.

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Zamaleev M.M., Zhukova Yu.V., Abramov A.V., Abaidullina Yu.R.
Improvement of a plant for recycling polyethylene and polypropylene waste

*Ulyanovsk State Technical University
 (Russia, Ulyanovsk)*

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Abstract

This article deals with the problem of recycling polymer waste. It is global in nature and is associated primarily with the steady growth of industrial production, which is accompanied by an increase in the amount of solid household and industrial waste. This is due to the possibility of combined production, as well as products and services required in the municipal economy of the city. This article presents the ways to improve the installation for recycling waste polyethylene and polypropylene.

Keywords: Polymer waste disposal, recycling, extruder, electricity.

Аннотация

В данной статье рассматривается проблема утилизации полимерных отходов. Она носит глобальный характер и связана в первую очередь с устойчивым ростом промышленного производства, что сопровождается увеличением количества твердых бытовых и промышленных отходов. Это связано с возможностью комбинированного производства, а также продуктов и услуг, необходимых в муниципальном хозяйстве города. В данной статье представлены способы усовершенствования установки, утилизации отходов полиэтилена и полипропилена.

Ключевые слова: Утилизация, переработка, экструдер, электроэнергия.

Among the modern problems facing the world community, the problem of recycling polymer waste is very urgent. It is global in nature and is associated primarily with the steady growth of industrial production, which is accompanied by an increase in the amount of solid household and industrial waste.

Increasing the energy efficiency of thermal power plants (CHP) has always been a primary task for the development of the country's thermal power industry. In the conditions of the wholesale electricity and capacity market (OREM), the ability of the CHP to compete with other power plants, such as nuclear power plants, hydroelectric power plants and power plants, is significantly complicated. Despite the location of the CHP in the center of loads, electricity rates include a transport component comparable to the cost of electricity production.

A significant drop in heat production with hot water and process steam has a negative impact on the efficiency of the CHP, which leads to a reduction in electricity generation on thermal consumption and an increase in the values of specific fuel consumption for the supply of electric and thermal energy. So, according to the data of the Ministry of Energy of Russia, the fuel burn at the CHP in comparison with 1992 is about 37 million tons. per year.

In the current conditions, when optimizing heating systems, projects for the reconstruction of thermal units are increasingly being considered with the decommissioning of heating turbines and the transfer of thermal load to water heating boilers, i.e. with the refusal to generate electricity.

According to the authors, increasing the efficiency and investment attractiveness of heating systems is possible due to the expansion of the CHP functionality, in particular, due to the development of technical and technological solutions aimed at effective thermal processing of municipal and industrial waste.

Sharing the infrastructure of existing CHPs for heat treatment of municipal and industrial waste makes it possible to use a number of important advantages:

- availability of low-potential heat energy sources at the CHP, suitable for waste drying in order to increase combustion heat and recycling quality;
- possibility to increase the CHP economy due to partial replacement of the main type of fuel by waste, as well as due to the sale of plastic and rubber processing products on the market;
- significant reduction of transportation costs for transportation of waste due to the location of the CHP in the city;
- - reduction of capital costs for construction of thermal waste treatment plants due to use of existing CHP infrastructure;
- possibility of thermal decomposition of poisonous substances in furnaces of CHP power boilers;
- availability of qualified operating personnel at the CHP.

Currently, the Russian Federation is implementing the "Industrial Development Strategy for the Treatment, Disposal and Neutralization of Production and Consumption Waste for the Period until 2030" [1]. The main objective of the Strategy is the introduction of a system of separate collection of municipal waste by fractions: biomass, waste paper, glass, metals and plastics, as well as ensuring maximum involvement of waste in production using the world principle of 3R (prevention of waste generation, reuse and recycling into secondary resources). The target of the Strategy is the share of waste disposed of in the total amount of waste generated, which should be 86% by 2030 [1].

In accordance with the Recommendations on the development of regional programs in the field of waste management [2] from January 1, 2017, thermal disposal of unsorted municipal solid waste is prohibited by Russian law.

Thus, the Russian Federation has initiated the introduction of a system of separate collection of municipal and industrial waste, which allows us to consider projects aimed at the thermal processing of municipal and industrial waste, in particular plastic and rubber.

Extruders are best suited for thermal processing of plastic (see Figure 1) [3].

Figure -1. Extruder for polyethylene and polypropylene processing
The process of processing plastic in extruders is as follows.

Extrusion is a process which involves mechanically pressing the molten polymer through a sizing hole with a profile corresponding to the finished product. In the process of processing plastic products on the extruder, work is carried out continuously, which allows to ensure a very high level of productivity, easy automation of processes, economy and high quality of products.

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The Chinese company «Qingdao Xindacheng» proposes the following extruder GRNW-180-140 to solve the task. The most important advantages are [3]:

- possibility of processing polymer raw materials with different bulk density;
- possibility of film processing with crushed low-pressure polyethylene;
- mobility of the plant due to the presence of an electric heater;
- possibility of processing plastic products with high capacity in large volumes;
- extrusion equipment can be operated continuously, providing a 24-hour working day.

The disadvantages of this extruder are:

- the need for high quality, raw material for melting in an extruder;
- inability to process higher pressure material;
- necessity of electrical network not less than 380 V;
- uneven heating of processed plastic;
- at the outlet, the material to be processed often expands due to uneven heating;
- a large amount of electric power is needed to melt the material;
- short-lived electric heater.

Currently, there are also companies in the Russian Federation that produce plastic processing equipment, one of the leaders is the «AtlasMash» company. But, despite the different types of extruders and different companies, manufacturers with the disadvantages of this type of extruders still remain unchanged.

The authors propose a new solution to the possibility of thermal processing of plastic at a CHP. By evaluating existing plastic processing technologies in the Russian Federation and abroad, we have come to the conclusion that it is necessary to replace the heating surface first [4].

Figure -2. Melting unit of polyethylene and polypropylene processing unit (RF patent № 193148): 1–body of extruder; 2– screw; 3–hollow cylinder; 4– melting zone; 5 – steam inlet pipe; 6– steam outlet pipe

When installing an extruder on the territory of urban CHPs, for example, production steam can be used as a heater.

The most important advantage, which is:

- low cost of production steam, since the extruder will be located on the territory of the CHP;
- high heat transfer coefficient of production steam;
- reducing the cost of plastic delivery, since the CHP is located in the city;
- more uniform heating of the processed plastic;
- increase of electricity generation at thermal consumption due to additional extraction of production steam;
- availability of other sources as the heating medium for the extruder;
- possibility of processing any plastics;
- increase of plastic melting rate due to high heat exchange.

Disadvantages of this extruder include:

- more complex design of equipment commissioning start-up;
- the extruder becomes less mobile due to its attachment to the production pair;
- more metal-intensive, since the use of production steam requires thickening of the extruder body;
- the need to automate the equipment.

The energy and thermal potential of industrial thermal power plants depends significantly on the technological cycle of new technologies introduced into it.

Based on the research conducted by the authors, the following conclusions can be drawn:

1. increased efficiency of CHP due to sale of processing products on the market;
2. analyzed foreign and Russian equipment for processing plastic and polymer products;
3. identified the main problems in the field of processing of plastic products, and proposed ways to solve them;
4. possibility of extruder installation in the CHP area was analyzed;
5. revealed the possibility of switching the CHP to the "green tariff."

Thus, the possibility of thermal processing of plastic at the CHP due to the expansion of its functionality of introducing into it the combined generation of thermal and electrical energy and technological processes necessary for plastic processing, makes it possible to

make the most effective use of the existing infrastructure of the thermal power plant and increase its energy efficiency [5].

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