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WASTE ENERGY CAPACITY FOR ENERGY PRODUCTION

Considering the current state of waste management, it should be noted that recently more and more attention has been paid to the transition to a circular, green economy. According to Eurostat data for 2020, the amount of waste processed has increased from 870 million tons in 2004 to 1221 million tons. Recycling in the total volume of waste processing has increased from 46% in 2004 to 60% in 2020. The amount of waste disposal decreased from 1027 million tons in 2004 to 808 million tons in 2020 (a decrease from 54% to 45%).

In 2018, the European Strategy for Plastics in the Circular Economy (EU Plastics Strategy) was proposed [1]. This pan-European regulation regulates the life cycle of plastic products from creation to use, reuse and recycling. A fairly ambitious program is being planned, which aims to reach a 90% separation rate for plastic bottles by 2029. By 2025, it is planned to introduce a separate tissue collection model across all EU countries. The same ambitious plans apply to other types of waste. All these measures are only the initial stage in the global waste management process. Then there are different ways to use these resources. The economic component of this problem showed that there are prospects for use for investment in the future. The global waste market for 2020 amounted to more than 1.35 trillion. The annual growth of this market by more than 5.5% is predicted to be about $2.0 trillion by the end of 2030. At the same time, industrial waste occupies the largest market share in terms of profitability, with household waste in second place. Ukraine's potential in this resource sector is unconditional. According to statistics, more than 470 million tons of industrial and household waste are generated in Ukraine per year. Of this volume, more than 90% of waste is disposed of in landfills, 2-3% is burned and about 5% is recycled.

One of the highest priority areas is the use of waste to generate energy. It is the slogan «energy recycling of waste – fuel from waste» that is the main trend. Conventional waste incineration is not effective both from the point of view of environmental protection and from the energy efficiency of using such resources. In a broad sense, rational waste management for energy production is both individual technologies and an integrated approach as a conglomeration of a number of technological processes connected in one chain. The ultimate goal is the same – obtaining an energy-valuable product.

Based on global trends and energy-economic trends in waste management, attention should be paid to the existing classification of waste. Modern waste classification is the process of organizing data about them by assigning them to certain groups according to certain criteria.

According to the Law of Ukraine «On Waste» [2], the Law «On Waste Management» [3] and other regulatory legal acts, several groups are distinguished:

1. By type of formation – production, consumption, household and other waste.

2. According to the degree of danger and the nature of the impact on the environment and humans – toxic, explosive, flammable, radioactive, etc. (hazardous waste).

3. Depending on the state in which they are - gaseous, liquid, hard, mixed.

Almost all existing documents lack an energy component, such as energy capacity, which takes into account the possibility of using waste in the production of an energy-useful product. The feasibility of this classification is due to the possibility of certainty in the use of waste in the energy sector.

Usually we have only two variations of waste: high-energy and low-energy [4, 5]. For example, fuel from garbage in two types SRF and RDF are a high-calorie fraction of safe combustible components of solid household, commercial, construction or industrial waste. The first is SRF, solid renewable fuel: produced from secondary resources - safe combustible waste. The second is RDF. This fuel is also recovered from garbage, but the name is used to describe unspecified waste after its basic processing to increase the heating value of solid waste, primarily municipal waste. RDF and SRF are obtained through basic processing: sorting, separation of organic biomass, extraction of hazardous and mineral fractions to increase the calorific value. In these two cases, we have only one and also undefined formulation – high-calorie, but it is not clear how to apply this term.

Based on an analysis of scientific publications in the field of thermal power engineering, thermodynamics and heat transfer, it was concluded that the calorific value, that is, the energy capacity, of an existing natural element such as wood can become the basis for such a classification. When decomposed into the basic energy elements found in wood, it produces approximately 50% carbon, 6% hydrogen and 44% oxygen. Moreover, its calorific value ranges from 13 to 18 MJ/kg, depending on the type of wood, under normal temperature conditions. It should be noted that there are fairly developed technologies for the production of hard biofuels from composites based specifically on plant waste. And using this example, we can test the proposed approach to ranking waste according to the principle of energy efficiency. Typically, wood waste is stored without protection from weather conditions, so either an increase or decrease in moisture content in the wood occurs. Fuel pellets obtained from wood increase the calorific value due to binding materials to 29.9 MJ/kg.

This energy approach was considered and discussed when analyzing the formation of waste mixtures for recycling based on energy efficiency [6]. We consider it appropriate that for more efficient use of waste, the following energy classification can be proposed, based on energy capacity:

- High-energy waste (heat of combustion above 30 MJ/kg);
- Medium-energy waste (heat of combustion – from 5 to 30 MJ/kg);
- Low-energy waste (heat of combustion does not exceed 5 MJ/kg).

It is advisable to use thermal methods of waste combustion from the point of view of thermal energy and ecology when the calorific value of the feedstock is at least 7 MJ/kg [7].

Considering in the future the possibility of applied use of this approach, we see advantages from the point of view of the energy-efficient use of waste as raw materials. Taking into account the energy capacity of the various components, the required thermal energy obtained can be determined in advance.

In our opinion, this variation is more flexible from the point of view of the formation of the energy-fuel component for generating thermal energy. This will certainly allow for a more rational use of such a resource as waste.

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