

Possibilities of sorting out the organic part of municipal solid waste to produce biogas in the context of solving the problem of minimizing its accumulation

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Abstract

The authors proposed a decentralized approach to managing decentralized solid domestic wastes, which consists in application of individual gathering by phone call of organic part of waste which sorted out by population. The need for this approach is aimed at the receiving of a valuable resource component (organics for biogas) and creating conditions for the implementation of a centralized waste residual mass sorting.

Keywords

municipal solid waste, organic fraction of waste, resource-valuable components, sorting, biogas

Introduction

According to the Law of Ukraine 'About alternative types of fuel' [1] one of the principles of state policy in the field of alternative kinds of fuel is to promote the development and rational use of alternative energy sources and kinds of energy raw materials for production (extraction) of alternative kinds of fuel in order to save fuel and energy resources and reduce the dependence of Ukraine from imports. Non-traditional sources and types of energy resources include raw materials of vegetable origin, waste, solid combustibles and other natural and artificial sources and types of energy resources.

One of non-traditional forms of energy is biogas derived from biomass and used as fuel. [1] Biomass is a biologically renewable stuff of organic origin that sustain biological decomposition, it primarily is waste of agriculture, forestry and related to it technological fields of industry, and the organic part of the industrial and domestic waste.

So one of the sources of biogas are municipal solid waste, namely an organic part of it. Next we consider the possibilities of sorting the organic part of domestic waste to produce biogas in the context of solving the problem of minimizing its accumulation and maximal using of the resource potential of each waste fraction.

Results of the study

The use of only centralized approach to municipal solid wastes sorting (MSW), which is realized by extracting the resource-valuable components of mixed waste at a waste sorting complex, is inefficient. This is confirmed by a number of factors, including poor quality of sorted secondary raw materials, a low percentage of resource-extraction from valuable components from waste, high cost of raw materials, significant capital intensity of mechanized sorting and so on.

The low percentage of sorting of resource-valuable fractions is caused many components of domestic waste and the inability of mechanized devices to identify some part resource-valuable components. Using manual sorting of domestic solid waste on the conveyor can increase the productivity of sorting, but the presence of the organic fraction in municipal waste lead to: loss of secondary raw materials quality (especially waste paper); additional costs associated with clearing some of the resource-valuable fractions (plastics, polymers, glass); impossibility of sorting some resource-valuable components (broken glass, etc.).

Decentralized sorting that involves sorting of MSW with public participation, is more efficient manner, as is done at the source of their formation. This sorting can prevent the mixing of the organic fraction with other resource-valuable components contained in MSW. In European countries are established highly effective MSW sorting systems with the participation of the population, enabling a separation of resource-valuable fractions to maximize use of the resource potential of each of these fractions.

Decentralized sorting can occur through:

- 1) sorting of MSW when using waste bins of general use (usually a different color);
- 2) sorting of MSW with further delivering of sorted secondary raw materials to collection points;
- 3) sorting of MSW with further individual collection of sorted raw materials by specially created enterprise.

Each of these methods requires the implementation of various organizational forms of waste management and has different results. Features of the using of each of them are described in the work [2].

Next, we consider in more detail the third of decentralized sorting way.

This method is implemented by means of individual services of each families, organizations, institutions and other objects where waste is formed by a specialized company. There are alternative variants of this sorting method.

In particular, the *individual collection of sorted by population waste components* can be done by establishing a modernized individual bins for each facility maintenance, and without the use of bins, for example, by collecting resource-valuable fractions by phone call.

Collecting of resource-valuable fractions by a telephone call can be realized by the following methods:

- individual service of each family (organization, institution) by a telephone call for the collection of sorted resource-valuable fractions (e.g., waste paper and plastics);
- individual service of each family (organization, institution) by a telephone call for the collection of sorted organic part of the MSW and others.

The first way is that people should just sort some of resource-valuable fractions and by a telephone call cause the employee who take the package with this raw material.

For organizations and institutions this technique is quite acceptable, since the proportion of waste paper, glass and polymers is big enough. For example, for the Sumy city proportion of these components is respectively 36%, 9% and 7%.

For the private sector and sector of high-rise buildings this method has some disadvantages:

first, the number of fractions of recycled materials that can be sorted by population is limited to 2-3;

second, the proportion of waste paper, glass and polymers for the private sector and high-rise sector is not as great as, for example, the proportion of organic matter;

third, the inability of the extract of organic after mixing it with other components of the waste, the proportion of which is large enough; for example, in Sumy for high-rise buildings sector it is 39%, for the private sector - 25%;

fourth, the effectiveness of the using of centralized sorting to the residual waste will be low, as it will include the organic fraction.

For the private sector and sector of high-rise buildings it is advisable to use the second method. The proportion of organic for high-rise buildings sector and the private sector is 39% and 25% respectively. Sorting of organic matter will not only significantly reduce the amount of waste, but also to get biogas and compost later. Also, there are prerequisites for the implementation of a centralized sorting of residual waste.

Second method is that people should just sort out the organic part of MSW and by means of a telephone call cause the employee who take the package with organics.

This will not only allows to sort the organic fraction, but also to form a flow of dry residual waste and do maximum sorting of resource components at the waste sorting station by using a centralized approach.

Next, consider by the example of Sumy city the effectiveness of the use of personal service for each family by phone call for collection of sorted organic part of the waste.

Structure of MSW by source of their formation is as follows (Figure 1):

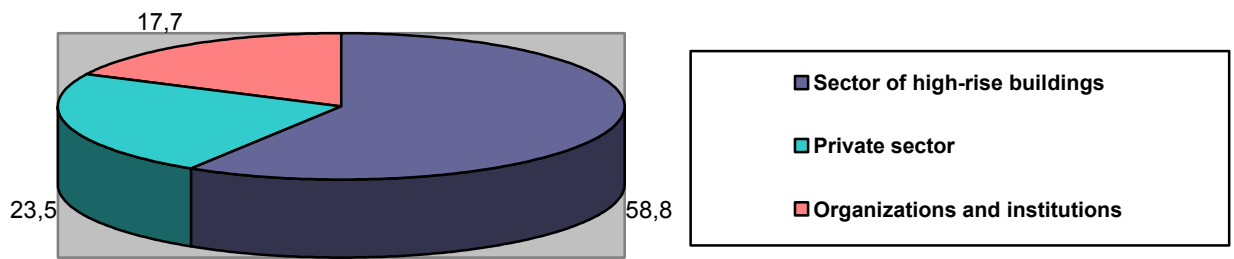
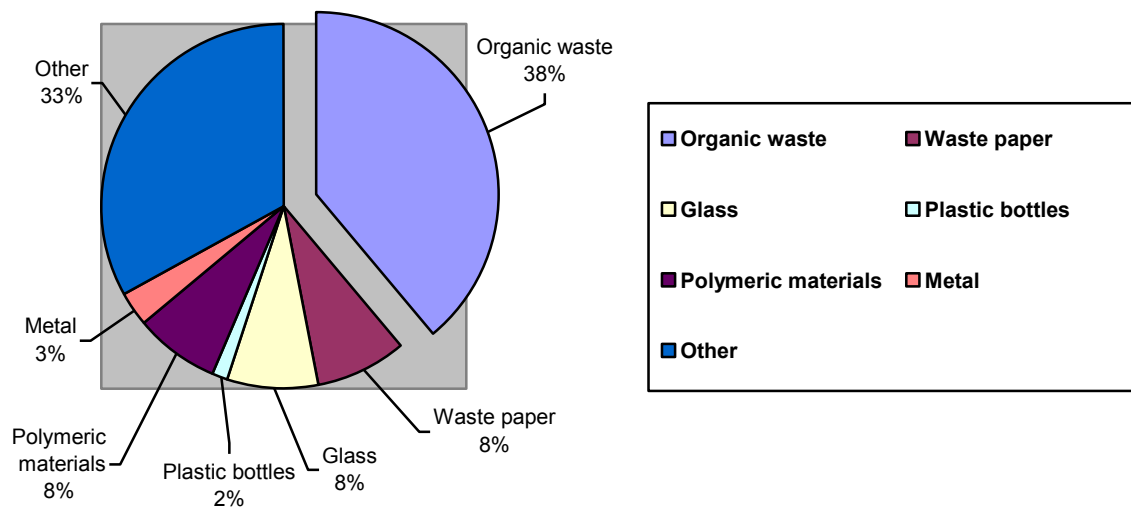


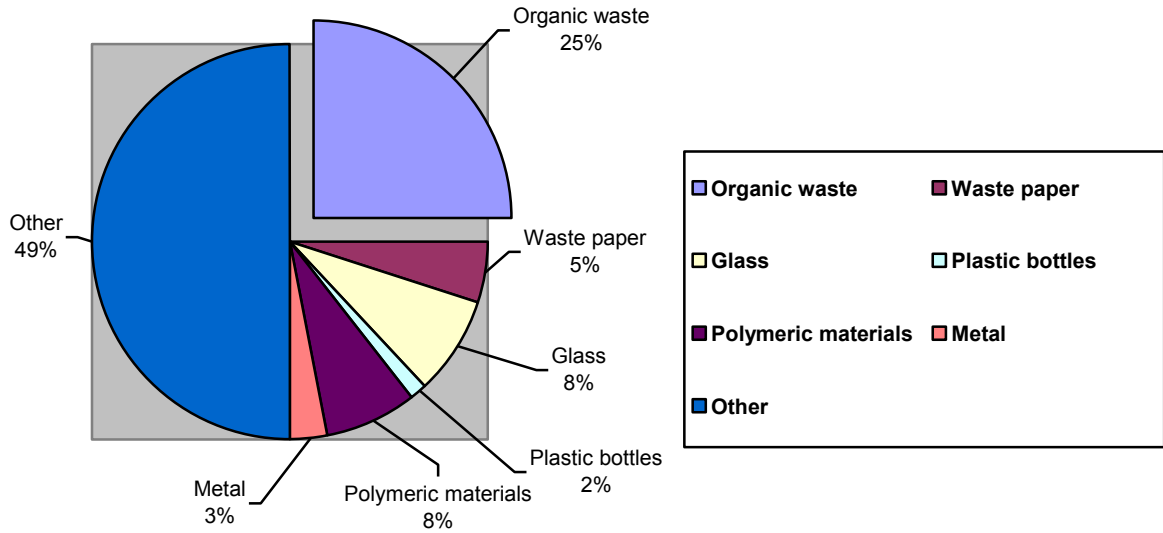
Figure 1. Structure of MSW by source of their generation in Sumy

So the greatest amount of MSW produced in sector of high-rise buildings, it is almost 60%.

Note that solid waste for each of the sources of their formation has a different morphological structure. Figure 2 shows the morphological composition of household waste in organizations and institutions, the residential sector. For residential sector a large proportion is an organic part, for the high-rise sector - 39% for the private sector - 25%. For organizations and institutions organic portion is only 6%. However, it should be noted that the morphological composition can vary significantly by type of institutions and organizations.



(a) Sector of high-rise buildings



(b) Private sector

Figure 2. Morphological composition of MSW in the residential sector

With personalized service for each family by phone calls for collection of sorted organic waste the potential volume of organics collection for the residential sector is 24 486 tons, respectively for high-rise buildings is 19 492 tons, for the private sector is 4 993 tons (Figure 3).

To use the resource potential of the organic fraction of MSW, aerobic and anaerobic processing of organic methods can be used for getting organic fertilizer as the main product in the first method and biogas in the second method.

Remaining wastes will accumulate in public tanks, site locations of which must be re-equipped in order to maintain quality characteristics of dry residual fractions. Then mixed waste will be disposed at a solid waste sorting complex for centralized separation of the residual waste by mechanized and/or manual methods.

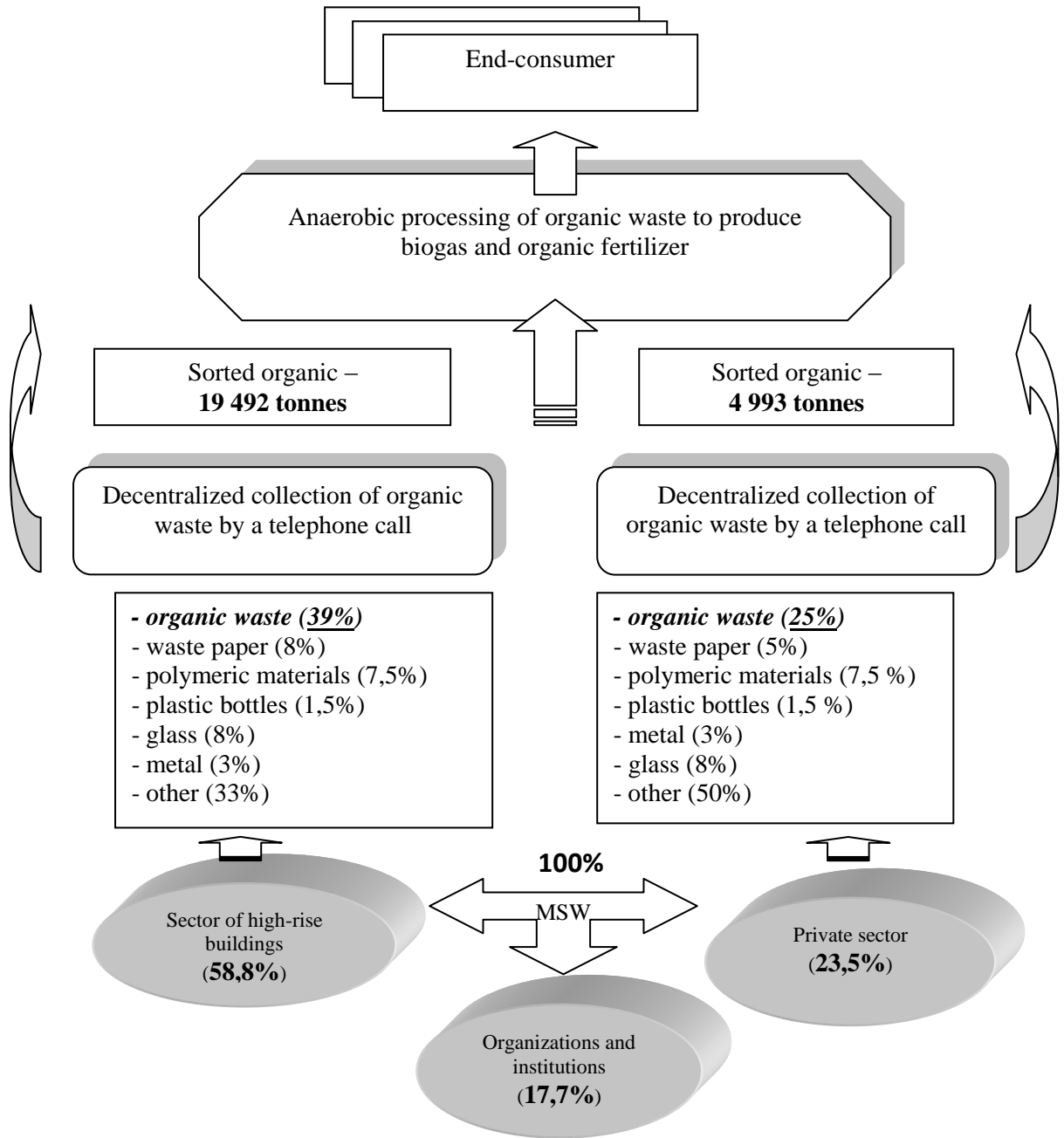


Figure 3. Effectiveness of the individual collecting the organic of MSW by a telephone call for the residential sector in Sumy

Conclusion

Individual collection of the organic waste by phone call will make possible not only sort the organic fraction, but also form a flow of dry residual waste and make maximum sorting of valuable resource components at the waste sorting station by using a centralized approach.

Applying this technique to the sorting of MSW will provide not only the minimum capital investment in associated infrastructure, but also the high effectiveness of process of mechanical sorting of the residual waste. The need for individual organic collection is equally conventional by

obtaining valuable resource component as organic and by creation of conditions for the implementation of a centralized sorting of residual mass of MSW.

This approach to sorting waste will allow to use most of the resource potential of each fraction of waste, including organic, which can be used not only to produce biogas, but also to produce compost.

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