

CURRENT STATE AND TRENDS IN SOLID WASTE RECYCLING IN UKRAINE

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| Key words: <i>Household waste Recycling Disposal</i> | ABSTRACT The article is devoted to the issue of solid waste recycling in Ukraine. The article analyzes the scope and structure of solid waste. Analysis of trends of solid waste proved imperfection of the current state of areas of waste management in Ukraine. Advantages and disadvantages of possible options of waste recycling are considered. Highlighting the important role of the state government reviewed measures to improve the situation of waste. Were analyzed the directions of the use of funds aimed at the development of the waste management. The main ways of improving the process of solid waste in Ukraine are determined. |
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СУЧАСНИЙ СТАН І ТЕНДЕНЦІЇ ПЕРЕРОБКИ ТВЕРДИХ ПОБУТОВИХ ВІДХОДІВ В УКРАЇНІ

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У статті здійснено аналіз обсягів, структури і напрямів утилізації твердих побутових відходів, який довів недосконалість сучасного стану сфери поводження з відходами в Україні. Розглянуто державні заходи щодо покращення ситуації з переробкою відходів. Проаналізовано напрями використання коштів, спрямованих на розвиток сфери поводження з відходами. Визначено переваги і недоліки можливих варіантів переробки відходів та основні шляхи удосконалення процесу переробки твердих побутових відходів в Україні.

Ключові слова: *тверді побутові відходи, переробка, утилізація.*

Introduction. Household waste management is one of the most important issues of our time. Recycling and waste management — is complicated and multifactorial ecological, economic, technological and social problem. This problem is especially relevant in big cities with high population density. This is due to the rapid and not always controlled development of sphere of small business, trade, medicine, household chemicals, and many other factors.

Current issues of recycling, processing and disposal of solid waste requires currently investing substantial funds and the traditional method of storing waste in

landfills is ineffective and dangerous for the environment. Overcrowded dumps and landfills occupy the large areas and poison water and air. Requirements for landfills are increasing, which increases the cost of waste disposal.

The issue of household waste recycling exists in Ukraine for a long time, but actuality it has increased during the last 5 years. Also the issue of waste recycling in Ukraine is characterized by increasing volume of waste accumulation, increasing number of polygons and dumps for waste burial, deteriorating sanitary conditions in cities.

Aimsofhearticle. The goal of the article is to characterize the current state of recycling in Ukraine and identification of areas of its improvement. The main methods that were used during writing the article were analysis and descriptive method.

The main results. According to the Ukrainian Law “About Waste” there is such definition of household waste — waste generated in the course of human life and activity (solid, large, repair, rare, except of wastes related to production activities of enterprises) and are not used in the place of storage [4].

Solid household waste (SHW) — waste that is generated in the process of human activity (food waste, paper waste, glass, metals, plastics, etc.) and is accumulated in apartments, social and cultural institutions, civic, educational, medical, commercial and other buildings [4]. The morphological structure of solid waste is divided into: food wastes, bones, paper, cardboard, wood, textiles, polymers (plastics, polyethylene, etc.), leather, rubber, ceramics, glass, metals (ferrous and nonferrous) and others.

The characteristic difference of solid waste in Ukraine is mixed waste. The share of mixed waste during the analyzed period is over 90 % (Table 1). Mix of solid wastes' components starts from the stage of their formation in waste bucket or container, then — in a garbage truck and then — in the burial places (on the polygon or the dump).

Table 1. Structure of transportation of solid household waste in 2011—2013, developed by authors according to [1; 6, 7]

| Components of solid household waste | Volume of transportation of solid household waste, thousand tons | | | Structure of transportation of solid household waste, % | | |
|--------------------------------------|--|----------|----------|---|--------|--------|
| | 2011 | 2012 | 2013 | 2011 | 2012 | 2013 |
| Mixed solid household waste | 13705,08 | 16656,21 | 11506,02 | 94,77 | 94,85 | 90,90 |
| Large solid household waste | 304,62 | 231,34 | 267,24 | 2,11 | 1,32 | 2,11 |
| Waste paper (cardboard, paper) | 138,11 | 163,89 | 205,66 | 0,96 | 0,93 | 1,62 |
| Polymers (packets polyethylene) | 38,82 | 29,54 | 37,04 | 0,27 | 0,17 | 0,29 |
| Tetra Pack packaging | 7,93 | 6,98 | 4,10 | 0,05 | 0,04 | 0,03 |
| Metals (black and color) | 10,65 | 182,18 | 190,52 | 0,07 | 1,04 | 1,51 |
| Glass (glass bottles, broken glass) | 50,35 | 106,78 | 73,95 | 0,35 | 0,61 | 0,58 |
| Textiles (synthetic, natural, mixed) | 7,05 | 4,96 | 4,76 | 0,05 | 0,03 | 0,04 |
| Organic components (food waste) | 86,73 | 93,45 | 55,76 | 0,60 | 0,53 | 0,44 |
| Electronic and energy equipment | 0,05 | 0,13 | 0,05 | 0,00 | 0,00 | 0,00 |
| Dangerous components | 0,49 | 0,01 | 229,53 | 0,00 | 0,00 | 1,81 |
| Wastes green farms and productions | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Other | 111,09 | 84,98 | 83,94 | 0,77 | 0,48 | 0,66 |
| Totally: | 14460,98 | 17560,45 | 12658,58 | 100,00 | 100,00 | 100,00 |

The volume of solid household waste is 21.43 % higher in 2012 than in 2011 mainly due to 21.53 % increase of mixed solid household waste. In addition, there

was an increase of transportation of waste paper, metal, glass, organic components, electronic and energy equipment. But in 2013 decreased by 27.9 % due to the reduction of mixed solid household waste.

Despite the fact that the amount of these elements has increased their effective use has decreased.

The increase of waste paper is 25.78 thousand tons (18.66 %) in 2012 compared with 2011. However almost 72 % of all waste paper is directed to landfills for disposal. While in 2011, only 15.9 % of waste paper was directed to landfills. The situation improved somewhat in 2013 — 54.2 % was directed to landfills.

According to expert estimates in order to get just one ton of wood cellulose it is needed up to 6 m³ of wood, not less than 350 m³ of water and up to 2,000 kW/h of electricity [8]. Today domestic enterprises use 60 % of recycled materials during production of paper and cardboard. If the trend of using recycled paper remained in 2012 it would help to save up to 496.16 thousand m³ of wood, 28942.85 m³ of water and 165387.7 kW/h.

A similar situation exists with processing of metals, the amount of which increased on 179.87 thousand tons in 2013. 36.8 % of waste metals were directed on recycling in 2011, and only 1.96 % in 2013. Most of waste metals (98.04 %) were sent to landfills for disposal.

The biggest decrease of volumes of transportation of solid household waste occurred in large solid waste, polymers, TetraPak packaging, textiles and other.

Table 1 shows that the largest share belongs to mixed solid household waste (94.78 % in 2011 and 93.13 % in 2012 and 90.9 % in 2013). Mixed solid household waste is difficult to recycle because it contains both organic and inorganic materials.

Generally, there are following methods of waste utilization in Ukraine:

Disposal of waste on landfills (specially equipped landfills and burial of waste there). Disadvantages: large areas of land, pollution of environmental pollution - soil, groundwater and air. Advantages: low cost of energy and labor, simplicity disposal technologies;

Incineration of waste (in special waste incineration plants takes place on temperatures above 8000 C). Disadvantages: high initial costs of construction of waste incineration plant, emissions of air pollutants, current costs of incineration. Advantages: doesn't need large areas, no pollution of soil and groundwater, receiving thermal or electrical energy from burning solid household waste;

Separate collection with following recycling (is carried out on waste recycling plants by types of waste materials (paper, plastic, glass, metal, food waste, etc.). Disadvantages: high initial costs, increasing costs for waste storage and transportation, certain types of solid household waste can't be recycled. Advantages: no environment pollution, decreasing needs of primitive types of materials (wood, metal, oil, gas) due to recycling.

The structure of recycling directions is presented in Figure 1.

This figure shows a negative trend in household waste disposal areas, as most products (93.3 % in 2011, 96.9 % in 2012, 96.1 % in 2013) disposed in landfills, and the residue under or recycled or incinerated.

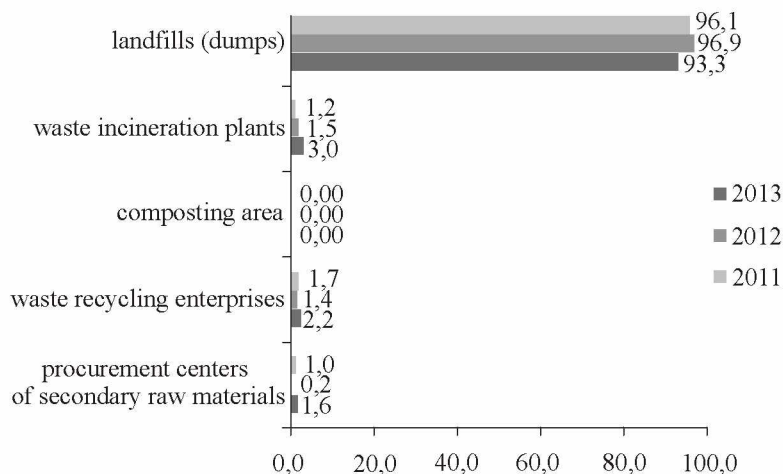


Fig. 1. The structure of waste recycling directions in Ukraine, %, developed by authors according to [1, 6, 7]

This trend is primarily connected with the low cost of burial in landfills. As a result, each year the number of polygons increases (Fig. 2).

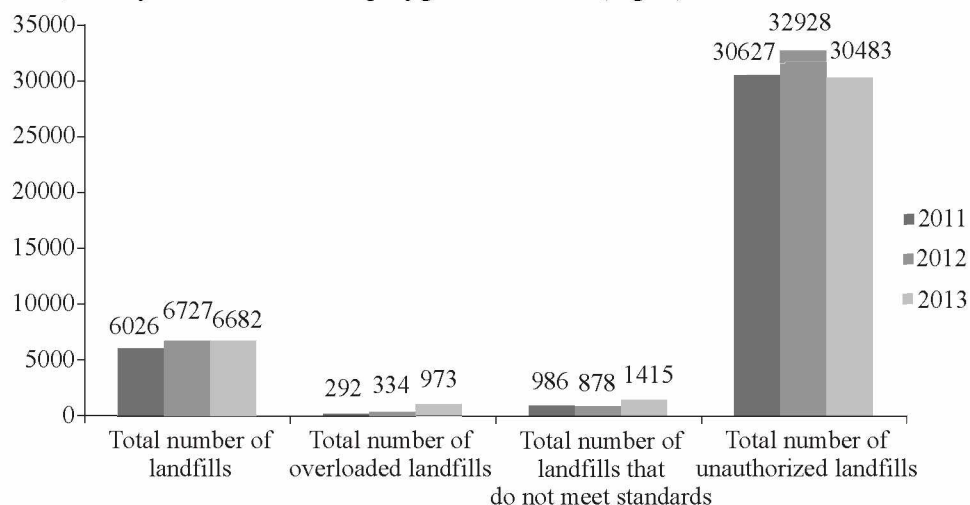


Fig. 2. The number of landfills and waste dumps in Ukraine in 2011—2013, developed by authors according to [1, 6, 7]

As shown in Fig. 2 in 2012 compared to 2011 year, the total number of landfills for waste disposal increased by 701 or 11.6 %, and in 2013 decreased by 45 landfills or 0.67 %. But it increased the number of polygons in the congested 639 items. Same applies to unauthorized landfills, which increased by 2301 units or 7.5 % in 2012 and decreased for 2445 (7.43 %) in 2013. The positive is to reduce the number of polygons that do not meet safety standards for 108 units or 19.95 % in 2012, but in 2013 their number increased by 537 units (61.16 %).

Waste dumps constitute a high risk to the health of people living near these landfills, because they are the breeding of insects, rodents, stray animals that carry

pathogens. The unsatisfactory state of geological and adjacent environments in the zone of landfills and unorganized dumps due to the fact that places waste do not meet health and safety standards and is operated without the use of preventive measures and reliable isolation of their groundwater. With atmospheric waters from landfill waste in the soil gets a lot of polluting substances, which are then delivered to the underground (especially ground) water and open water, leading to contamination of water supply sources. In addition, due to uncoupling of organic waste materials, especially those that easily rot, formed with an unpleasant odor gases (ammonia, hydrogen sulfide, indole, skatole, mercaptans) that pollute the air. These negative developments affecting the formation of hydrochemical hazards and dangers of air pollution.

Total area of landfills increased during two years for 1278.7 hectares or 14 %. The area of unauthorized landfills increased by 814.16 % or 72.8 %. In total area landfills and unauthorized landfills in 2011 was 10.23 thousand hectares. In 2012 — 11.46 thousand hectares, and in 2013 — 12323.6 hectares. This is about 1 % of the total area of nature reserves in Ukraine and 0.02 % of the total area of Ukraine. Increase in the number and area of unauthorized landfills more due to the fact that not all of Ukraine's population covered with services for collection of solid waste. Thus, in 2011 the percentage of population coverage with services for collection of solid waste was 75.08 % in 2012 — 75.86 % and in 2013 — 78.15 % .

Thus, there is a paradoxical situation when the percentage of coverage of population by services for collection of solid waste increases, the number of points of separate collection grows, the amount of solid waste sorting lines increases (Fig. 3), and the amount of recycled waste reduces.

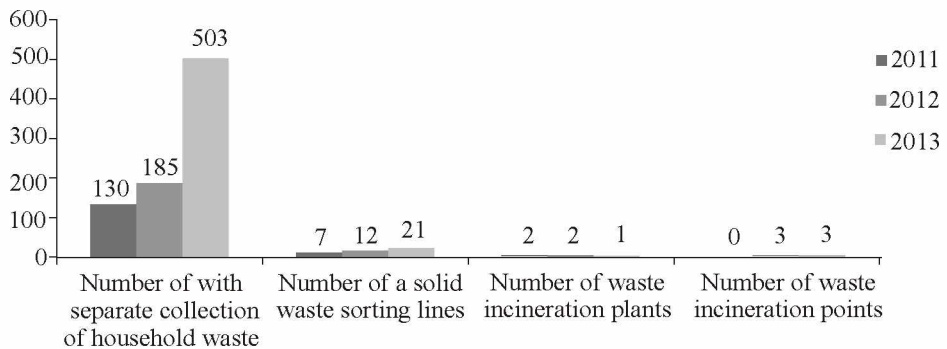


Fig. 3. The number of solid waste sorting lines and incineration plants in Ukraine in 2011—2013, developed by authors according to [1, 6, 7]

Growing number of cities with separate collection of household waste demonstrates the government intention to introduce separate collection of waste for effective recycling as secondary raw materials or energy.

The number of waste incineration plants has not changed. In Ukraine, the 80—90 s There were built four incineration plants in Kyiv, Dnipropetrovsk, Odessa and Sevastopol in Ukraine in 1980—1990th, but by far there are only two of them still working — in Kiev and Odessa. These are two almost identical plants that were built in 1988, by the Czech firm “Dukla” with the project lifetime 25 years, so their

service time is over. The equipment of these plants is out of date and does not meet modern environmental standards. In addition, when the plant was built morphological composition of household waste was completely different and contained less polymer materials. Plants are not fully loaded because of high cost of incineration compared to disposal of waste. To compare the cost of incineration of 1 ton of waste in Kiev factory “Energia” is 127.56 UAH., And the cost of waste removal to landfills is 90—100 UAH. (If landfill is unauthorized, the cost is half cheaper).

Increasing number of solid waste lines was mainly due to establishment of low-power domestic production lines, which are much cheaper than foreign lines. They are able to allocate about 15 % of the most liquid secondary raw materials in a mixed waste. Payback period of such lines is 1.5 years [3].

The Government of Ukraine is trying to make a difference by adopting appropriate legislation. The Concept of the National Program for Waste Management during 2013—2020 years was approved by Cabinet of Ministers on 01.03.2013. However, as practice shows, not all programs that are approved and adopted for implementation will be realized.

In general, it should be noted the decline in funds aimed at the development of waste management sector. Thus, the total amount of funds directed to the development of waste management sector accounted 224.62 million UAH in 2013, 235.53 million UAH in 2012, 248.17 million UAH in 2011. Directions of using these funds are shown in Figure 4.

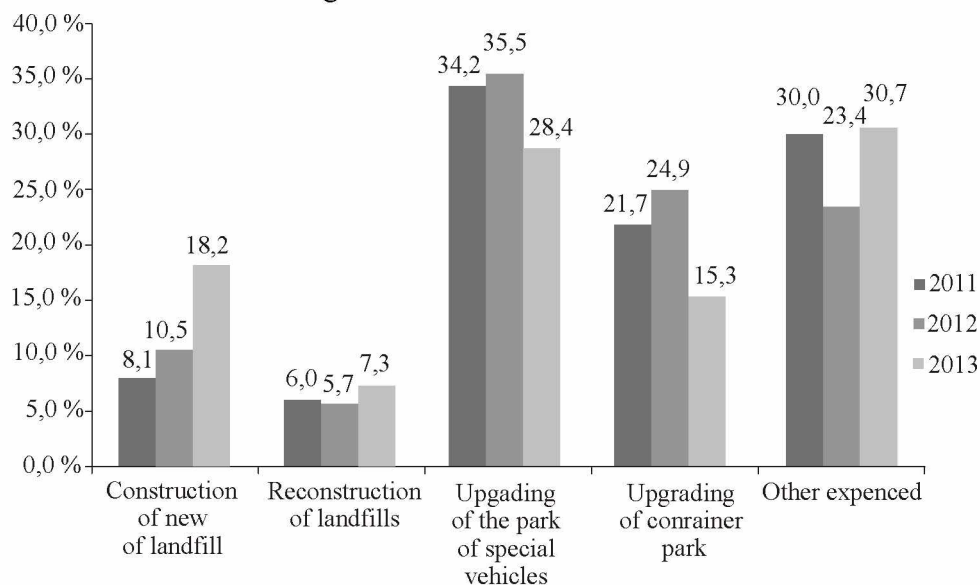


Fig. 4. Directions of using funds directed to the development of waste management field in Ukraine in 2011—2013, %, developed by authors according to [1, 6, 7]

Most of the funds directed to upgrading of the park of special vehicles. And it is really relevant, because the average degree of deterioration of special vehicles was 67.52 % in 2011 and 66.99 % — in 2012, in 2013 — 66.45 %.

The increase of costs occurred towards the construction of new landfills and reconstruction of landfills.

However, positive changes should be mentioned. According to the Law of Ukraine concerning improvement of regulation mechanism and increasing responsibility in the field of waste management, starting from 1 January 2013 all households will be required to sign individual contracts with enterprises engaged in garbage collection. In addition, according to this law disposal of unprocessed household waste will be punished by penalties.

In 2010, the State Agency of Investments and National Project Management has created a state-owned enterprise “National Project “Clean City”. Its main objective is to implement projects in the field of waste management [5]. The project provides construction of processing plants in 10 cities in Ukraine. The program provides application of the following methods of solid waste recycling: waste disposal on landfills; separate collection of waste; thermal recycling (incineration, gasification, pyrolysis); biological processing (composting, anaerobic fermentation, hydraulic separation).

Implementation a national scale integrated approach to solid waste management is essential for Ukraine. Only in this way can now be fundamentally solve the problem of acute shortage of new landfills, waste resources and existing areas of non-compliance with current environmental standards — problems that led to the huge number of illegal dumps. The basis of the modern system of solid waste management — minimizing waste, separate collection, recycling and safe disposal of waste that can not be reused. Currently separate collection allows up to 70 % of waste reused as raw material. With the same total (unsorted) waste can be extracted only 15 % of the mineral components [2].

Within the framework of the national project “Clean City” the depth of waste processing should be not less than 50 %. First, there should be implemented selection and selling of secondary raw materials (metal, glass, paper, PET) from total volume of household waste. Then — selection of fractions with high caloric content which can be recycled into alternative fuels: plastic, rubber, dirty PET and cardboard. Next — Recycling of organic matter, biogas production, collection and burning it in a gas turbine plant with the production of electricity and heat.

Conclusions

In order to attract investors and implement effectively the national project “Clean City” it would be appropriate to bring solid waste to the list of alternative energy sources and to establish “green” tariff for production of electrical energy from it. The draft law which makes these changes to the Ukrainian legislation of Ukraine was unfortunately rejected by the Parliament.

Many years' experience of developed countries shows that the environmental problems associated with disposal of solid waste shall be resolved by the use of waste as a feedstock for energy production.

Also, in our opinion, is to revise tariffs for garbage collection (which must include costs of processing) and tariffs for waste disposal. Tariffs may be set differentially depending on sorted solid household waste. Tariffs for disposal of solid waste must increase because at the moment is the most economical and popular option of recycling.

The important aspect is the separate collection of waste, because it is possible to allocate only 15 % of secondary raw materials. It is therefore important to create favorable conditions for implementation of separate collection of household waste and widely promote its importance to the public in the media.

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СОВРЕМЕННОЕ СОСТОЯНИЕ И ТЕНДЕНЦИИ ПЕРЕРАБОТКИ ТВЕРДЫХ БЫТОВЫХ ОТХОДОВ В УКРАИНЕ

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В статье проведен анализ объемов, структуры и направлений утилизации твердых бытовых отходов, который доказал несовершенство современного состояния сферы обращения с отходами в Украине. Рассмотрены государственные меры по улучшению ситуации с переработкой отходов, проанализированы направления использования средств, направленных на развитие сферы обращения с отходами. Определены преимущества и недостатки возможных вариантов переработки отходов, а также основные пути совершенствования процесса переработки твердых бытовых отходов в Украине.

Ключевые слова: *твердые бытовые отходы, переработка, утилизация.*