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ENVIRONMENTAL HAZARD OF UNCONTROLLED ACCUMULATION OF INDUSTRIAL AND MUNICIPAL SOLID WASTE OF DIFFERENT ORIGIN IN UKRAINE

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Abstract. The analysis of the generation, recycling and landfilling of waste in Ukraine is carried out. Significant generation of various wastes leads to their storage on the ground surface, as it is the most widespread way of waste treatment in Ukraine. Frequently, the stored waste burns (waste heaps, waste coal, landfills), causing significant accumulation of hazardous substances in the environment. The main way of environmental hazard reducing in the landfill area is the implementation of an effective policy of prevention of waste generation at the local authority level and state control over the waste disposal sites.

Key words: waste, municipal waste, environmental safety, environmental hazard, environment

Introduction

Every country in the world faces a waste management problem. Even if some countries have fixed the problems with the recycling of municipal waste, then the handling of industrial and hazardous waste is merely under consideration. Ukraine has accumulated about 36 billion tons of waste, or more than 50 thousand tons per 1 km^2, among them only 30 % of industrial and 4 % of municipal waste are utilized. The volume of the generation, placement, recycling and disposal of waste is constantly updated, taking into account the criteria for their assigning to different types and classes of hazard [1].

There is a number of classifications of man-made wastes based on different principles, approaches, methods of analysis. In our opinion, from the position of environmental hazard caused by solid waste, it makes sense to classify them according to technological and organizational measures that should be taken for minimizing of this environmental hazard. A simplified classification system of solid man-made waste is shown in Fig. 1.

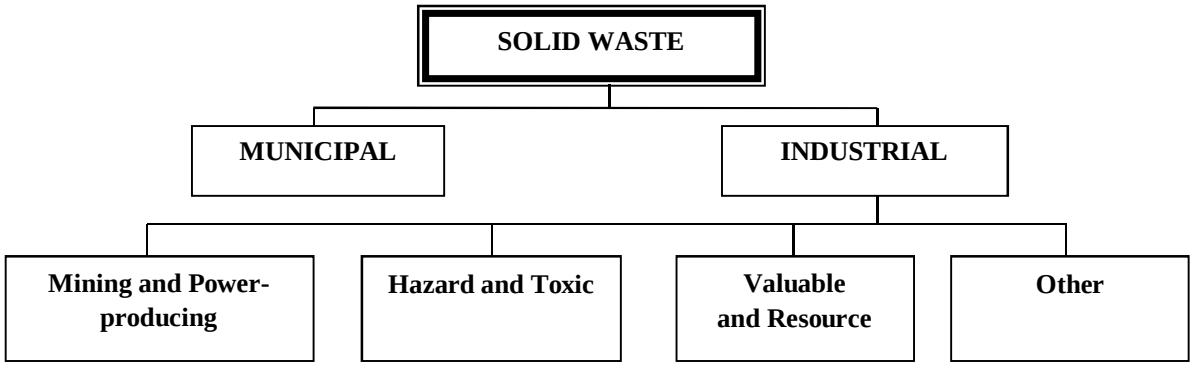

Fig. 1. Solid wastes classification according to technological and organizational measures that should be taken for minimizing of environmental hazard

Mining and power-producing waste include coal-mining waste, phosphogypsum, tailings (sulphuric, phosphorous, potash ore, etc.), slags of thermal power plants, slurry, sludge, etc. These wastes are characterized by large-tonnage. In order to avoid the environmental hazard caused by their accumulation only technologies of large-tonnage application (production of building materials, highways construction, use as a waste fill on coffins and dead pits, etc.) are suitable.

Hazardous and toxic wastes include radioactive, toxic, medical and other types of waste. A significant threat to the environment and biota is made up by medical waste containing hazardous pathogens and opportunistic microorganisms. Every year, the state produces 350 thousand tons of medical waste, which creates a high risk of spreading of infections and diseases [2]. Such a situation with the wastes generation leads to an increase of the regional environmental hazard and affects the national security of the state. Recycling technologies of hazardous and toxic wastes are special cost technologies that provide the maximum completeness of waste disposal.

Recycling technologies of valuable and resource waste are the special technologies, individual for each type of waste that provides the maximum recovery of valuable components. With the development of innovative technologies of processing to this category may be added the waste, which currently are stocked in man-made deposits.

For processing of other waste there are special technologies, individual for each type of waste according to its physical and chemical characteristics and volume of accumulation.

Human life is also concerned with huge amount of solid municipal waste (SMW). Significant growth of resources and goods consumption around the world in recent decades contributes to it. The best ways of SMW processing are:

– elemental or separate waste collection, which is an optimal solution of the problem of their disposal and the comprehensive recycling of secondary raw materials.

– exportation to sanitary-industrial zones, where they are sorted for obtaining of secondary raw materials and burned in special furnaces for power generation.

– processing of solid municipal waste by burial on special landfills.

Existing municipal landfills are considered to be one of the most hazardous objects for environment and human health. In this regard, almost all Ukrainian cities are involved in intensive discussion of the prospects of landfill closure and switching to another waste management technology. The alternatives in the new technology are:

• A new landfill designed and operated in accordance with Ukrainian and EU norms and also gives an opportunity of biogas power generation$

• Waste recycling plant, where garbage from the collection system passes through the preliminary separation stage where valuable components are extracted, and then are either applied to an anaerobic digestion, or burned, or stored at the SMW landfill. It is also possible to apply different methods of processing to different group of waste;

• An incineration plant where all garbage from the collection system is burned. Solid residue and dust captured by the waste gas treatment system are stored at a SMW landfill according to the hazard class of the waste.

Presently, only 3.5 % of solid municipal waste is burned at two waste incinerators. About 0.1 % of municipal waste is hazardous. The most hazardous components of landfills are filtrate, biogas and biodegradable waste products. Filtrate, accumulated at the foot of the landfills, is rich in hazardous substances and heavy metals, that have a destructive effect on the environment [3–5]. Biogas, released from the landfill site, leads to local combustion and even explosions [6–8].

Aim, methods and tasks of the research

The aim of the work is to determine the specifics of waste management in Ukraine and their impact on environmental safety. According to the aim it was supposed to solve the following tasks:

• carry out an analysis of the generation, processing and disposal of waste in Ukraine;

• establish the volume of municipal waste generation per person;

• propose the ways to overcome the environmental problems caused by waste.

In the process of research, the following methods were used: comparative ecology, mathematical-statistical, system analysis and methods of logistic reasoning. The results were processed using mathematical programming in the MS Excel package.

Results of the research

In Ukraine there is a tendency to increase the amount of municipal waste generation. Having considered the statistics on waste generation, it should be noted that since 2014 the amount of waste per year has decreased. The reason is the exclusion from calculations the municipal waste in annexed territories. Data on the waste generation over the years is shown in Fig. 2.

It should be noted that the amount of municipal waste per person increases every year. Figure 3 shows that the amount of municipal waste per person has slightly decreased, but these data do not consider the generation of municipal waste in annexed territories.

In 2014–2016 there was an increasing tendency of the amount of burnt waste (at 2 waste incinerators).

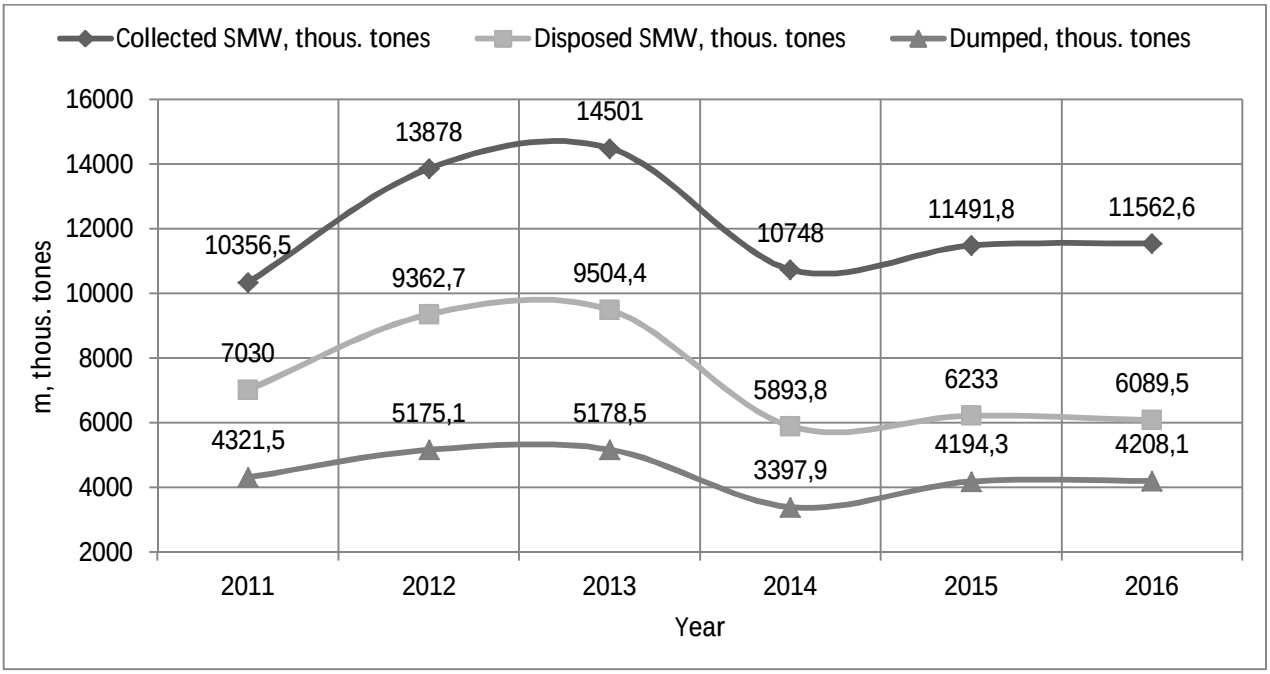

Fig. 2. Municipal waste management
in Ukraine in 2011–2016

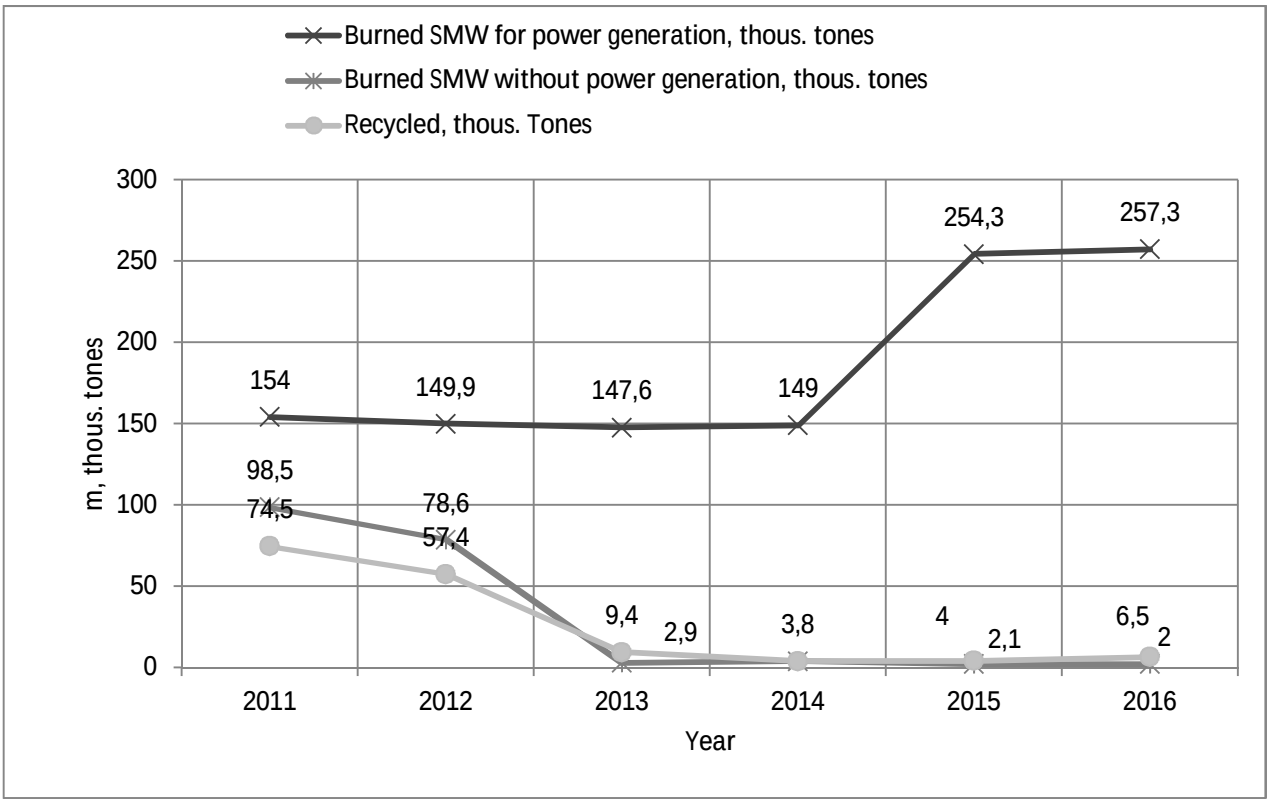

Fig. 3. Dynamics of incineration and recycling of municipal waste
in Ukraine during 2011–2016

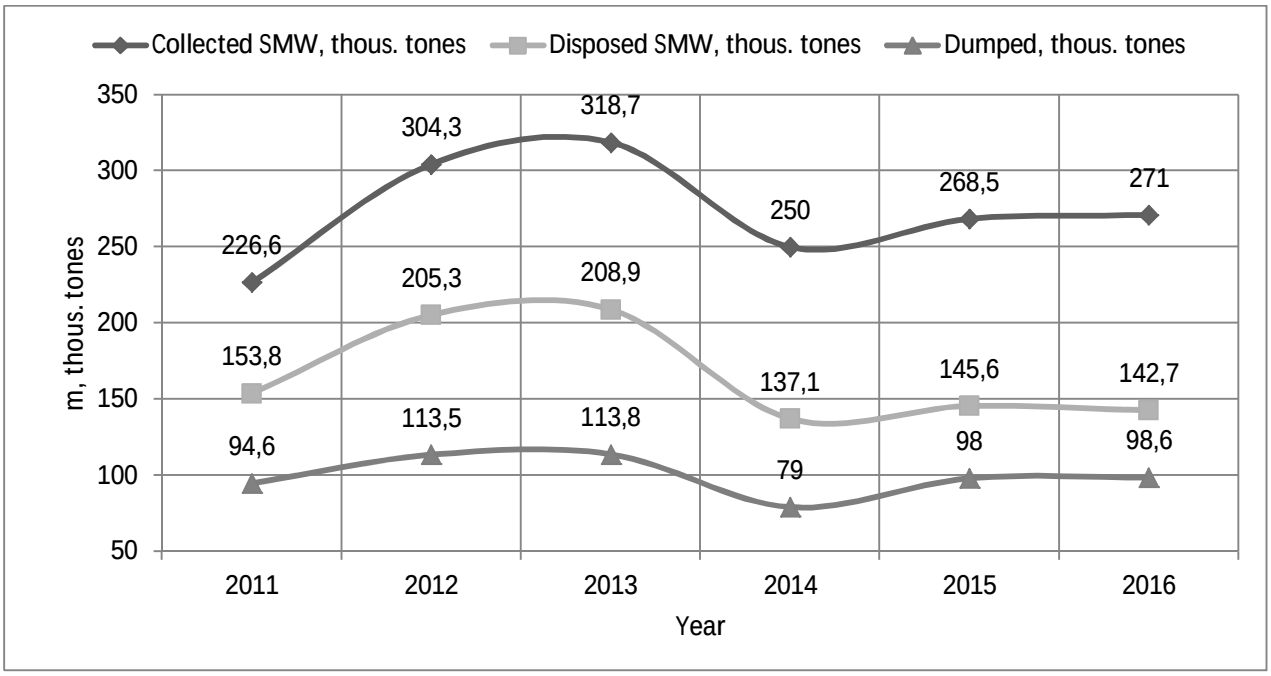

Fig. 4. Dynamics of municipal waste generation annually per person in Ukraine

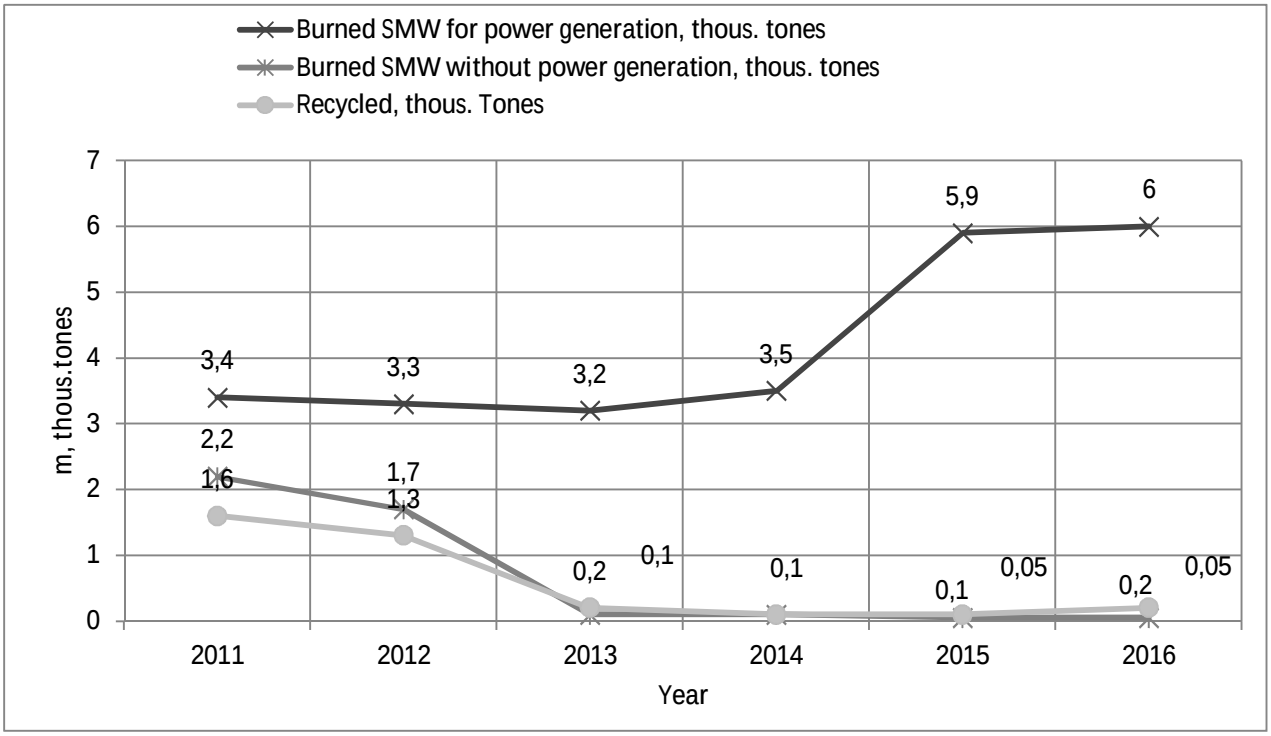

Fig. 5. Dynamics of incineration and recycling of municipal waste per person in Ukraine during 2011–2016

The total amount of accumulated hazardous waste in Ukraine is about 1.6 billion tons. Presently, chemical crop protection products are stored in breach of legal requirements for environmental and technological safety in 4075 warehouses. The incorrect storage of specific waste generated in medical service, veterinary practice, related researches, and after getting to the municipal waste containers and landfills may lead to various infectious diseases [1].

Totally in 2017 366423.5 thousand tons of waste of I-IV classes were formed, recycled – 96057 thousand tons, burned – 1105 thousand tons, disposed to special places or objects – 193607.9 thousand tones (Fig. 6). It should be noted that the given data doesn't include the temporarily occupied

territories in the Donetsk and Luhansk districts and the Autonomous Republic of Crimea.

The development and management of waste of hazard classes I to IV in 2017 is given in Table 1. It should be noted that mostly the following types are formed: industrial waste sediments, iron-and-steel waste, vegetable waste, animal excrement, urine and manure, household and similar waste, mixed and non-differentiated materials, mineral and mixed construction waste, mine soil.

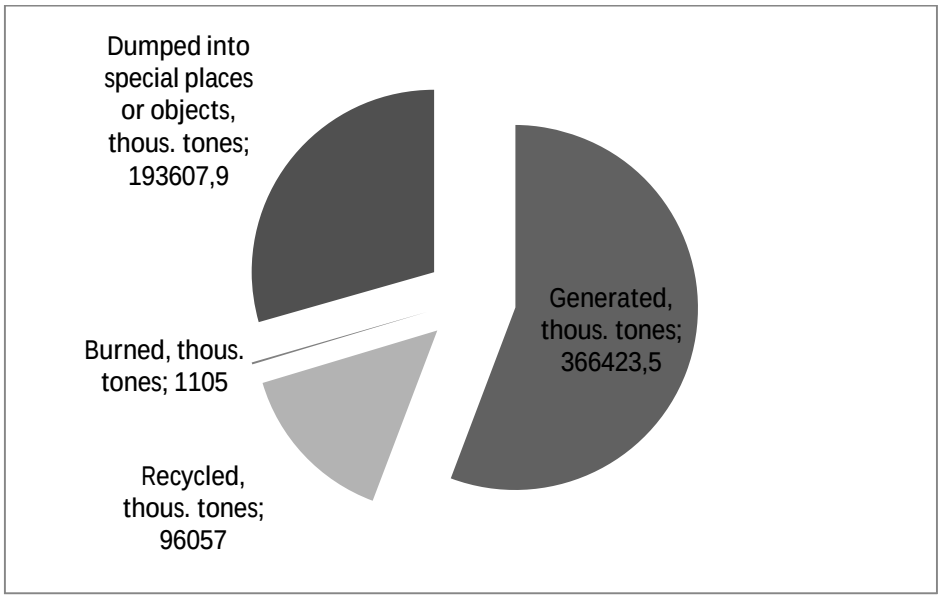

Fig. 6. Structure of waste management measures in 2017

Table 1

Development and management of waste of hazard classes I to IV in 2017

Type of Waste	Generated, th. tones	Processed, th. tones	Burned, th. tones	Disposed, th. tones
1	2	3	4	5
Waste solvents	1.2	0.4	0.2	0.0
Waste of acids, alkali or salts	213.1	78.9	4.2	102.5
Waste oils	18.0	18.2	1.0	0.2
Chemical waste	848.3	9.8	16.0	787.3
Industrial sewage sludge	3644.1	609.7	2.4	389.0
Spent slurry and liquids of waste treatment facilities	974.6	64.4	0.1	940.5
Biological and medical service wastes	0.8	0.1	1.4	0.0
Iron-and-steel waste	3555.2	3041.3	0.1	773.1
Nonferrous waste	29.2	5.9	0.0	0.0
Mixed ferrous and nonferrous waste	9.1	2.1	0.0	0.9
Glass wastes	34.4	3.4	0.0	0.3
Wastepaper	185.0	31.5	0.3	2.9
Rubber wastes	26.5	6.1	0.2	1.1
Plastic wastes	64.4	13.7	1.0	2.4
Wood waste	814.8	57.9	374.3	17.9
Textile wastes	21.0	1.1	0.3	0.3
Waste containing polychlorinated biphenyl	0.2	0.0	0.1	–
Unfit equipment	16.0	1.0	0.1	0.1
Non-serviceable vehicle	1.7	0.0	0.0	–
Waste accumulators and batteries	5.7	35.1	0.0	0.0
Animal waste and mixed food waste	589.4	311.2	4.1	8.1
Phytogenic waste	8678.7	2425.9	414.3	54.5
Animal excrement, urine and manure	3651.6	2614.0	–	52.7
Municipal waste	6605.7	16.6	283.8	6589.9
Mixed and non-differentiated materials	10798.2	1459.9	0.9	2834.8
Sorting residuals	62.3	1.6	0.0	17.3

Continuation of table 1

1	2	3	4	5
General residuals	513.1	40.6	–	209.8
Mineral and mixed construction waste	975.5	387.0	0.0	1109.9
Other mineral waste	265739.8	68755.2	0.1	138932.8
Incineration waste	12901.5	4070.1	0.0	7133.9
Soil waste	367.3	80.9	0.0	156.8
Mullock	45028.0	11913.0	0.0	33478.6
Hardened, stabilized or glazed waste; mineral processing waste	49.1	0.4	0.1	10.3
Total	**366423.5**	**96057.0**	**1105.0**	**193607.9**

It should be noted that the significant formation of various wastes leads to their storage on the ground surface, since in Ukraine this is the most widespread way of waste treatment. Frequently, the stored waste burns (waste heaps, waste coal, landfills), causing significant accumulation of hazardous substances in the environment.

Fig. 7. Burning of Ternopil city landfill

According to the "Waste Management Concept for 2013–2020", the main reasons for the problem of municipal waste treatment are: the imperfection of the mechanisms of collection, transportation, storage, treatment, recycling, disposal, neutralizing and land burial of waste, which leads to the accumulation increase; the absence of environmentally safe methods and techniques of waste management, which leads to an increase in man-made and environmental risks; low rates of implementation of low-waste technologies, development of waste management infrastructure, especially for hazardous waste; imperfection of legislation and state regulation system in the field of waste management; the absence of a single body authorized with waste management functions [1].

Conclusions

Waste management in Ukraine involves a single final stage – storage on an open area. As a result, landfills, waste heaps, tailings ponds, slurry reservoirs are located on the territory of the whole country. It leads to an increase of the regional environmental hazard level. This situation is primarily caused by the lack of appropriate processing plants and technologies. The main way of environmental hazard reducing in the landfill area is the implementation of an effective policy of prevention of waste generation at the local authority level and state control over the waste disposal sites.

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