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Компанія A-Clima

V Міжнародна науково-практична конференція «Екологія. Довкілля. Енергозбереження»



Полтава, НУПП, 19 грудня 2024 року

UDC 502.174:628.4,02(477)''364''

MARTIAL LAW AND THE WASTE MANAGEMENT SYSTEM IN UKRAINE – CURRENT SITUATION

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The impact of military actions on the infrastructure of Ukrainian cities has resulted in the partial or complete destruction of buildings and structures across a large part of Ukraine. Residential buildings have suffered the most, and it is worth noting that the facts of devastation due to constant shelling are still recorded almost daily [1-3]. The waste left after the destruction caused by military aggression differs from «ordinary» construction waste, as it consists of (potentially dangerously contaminated) residues of materials of different structures and origins, making it difficult to sort and reuse them. We can find metal and glass, facade decoration materials, reinforcing mesh, mineral wool, interior decoration materials, wall materials, roofing, household items, and wood fragments. Individually, all of these residues could be used, but in their current state, they require very careful sorting. This is quite problematic in the current conditions and volumes [4, 5].

The problem of uncontrolled waste management in Ukraine existed partly already before the war. The current practice of handling household waste is focused on its removal and disposal in landfills and dumps, most of which do not meet the requirements of environmental safety, and are also uncontrolled «temporary» landfills of household waste. In addition, the lack of recycling systems leads to the loss of large volumes of resource-intensive (valuable) materials. With the outbreak of war, this situation has worsened, despite the adoption of very important regulations on the waste management system after February 2022.

It must be noted that the data on the amount of construction waste is constantly changing, and the final estimates will be possible only after the war is over. An important aspect of the study was the consequences of the impact of military actions on the waste management system and construction waste in particular [6,7]. Considering the state of destruction and the number of destroyed facilities, the country has an urgent problem of generating a huge amount of construction waste.

Step-by-step instructions for handling demolition waste [8] have already been developed for Ukrainian communities affected by military actions. In most of these areas, special sites have been set up to store «sorted» waste. However,

there is an urgent need to assess the generation, sorting effectiveness, and composition of such waste. Moreover, due to the change in daily lifestyle and consumption behavior, municipal solid waste (MSW) generation and composition are expected to change. Finally, a lot of infrastructure in the waste management sector has been destroyed, which means that large amounts of unsorted and untreated waste currently end up in landfills, most of which are uncontrolled.

Destruction of infrastructure and building sector caused by the war

As of January 2024, the total amount of direct damage to Ukraine's infrastructure during the two years of war was about \$155 billion [9]. This estimate also includes the damage caused by the destruction of the Kakhovka hydroelectric power plant in June 2023. However, it is worth noting that the increase in the number of damaged and destroyed infrastructure, housing, industry, energy, education, and healthcare facilities is still going on.

Ukraine's housing fund has suffered the most losses, and the number of damaged and destroyed residential buildings is increasing every day due to hostilities and shelling. As of 2024, the number of such buildings exceeds 250,000, including 222,000 private houses, more than 27,000 apartment buildings, and 526 dormitories. It is estimated that the direct damage from the destruction of these facilities is \$58.9 billion, which is \$4.8 billion more than at the end of 2023.

The information is based on media reports, supplemented by information from government agencies, academic and non-governmental organizations, and other sources.

Current Waste Management organization and situation in Ukraine

Resolution of the Cabinet of Ministers of Ukraine No. 1073 of September 27, 2022, approved the Procedure for Waste Management resulting from damage (destruction) of buildings and structures as a result of hostilities, terrorist acts, sabotage, or work to eliminate their consequences (hereinafter referred to as the Procedure) [8]. It is aimed at carrying out recovery work to eliminate the consequences of armed aggression and hostilities during martial law and the reconstruction period within 90 calendar days after its termination or cancellation. Local self-government bodies are responsible for identifying and accounting for destruction waste, as well as organizing the management of such waste.

Following the Procedure, the operations of handling demolition waste include:

- 1) primary clearing of territories (collection of demolition waste, including, if possible, sorting of individual components of demolition waste)
- 2) transportation of demolition waste from the place of its generation to waste management facilities or temporary storage facilities;
- 3) final (after dismantling of damaged (destroyed) objects) clearing and cleaning of the territories (if necessary);
- 4) storage of destruction waste at temporary storage sites or other waste management facilities (until their utilization or disposal);

5) treatment (processing) of demolition waste and/or its neutralization (if necessary);

6) utilization of demolition waste (use of waste as secondary material or energy resources);

7) removing residual demolition waste, including its disposal.

In addition to the Procedure, which contains step-by-step instructions, experts from the U-LEAD program (Ukraine – Local Empowerment, Accountability, and Development, which is a program of cooperation between the Ukrainian government, the European Union and its member states Germany, Poland, Denmark, and Slovenia) created a brochure – a guide to managing demolition waste [10]. It contains the basic information in a clear and understandable form. Accordingly, now every community on the ground can properly organize the disassembly and dismantling of damaged or destroyed objects, know how to sort and store demolition waste, and how to keep records of such waste.

The authorized bodies shall submit information on construction and demolition waste to the regional state administrations monthly. Thus, there is a certain algorithm for post-war waste management, which includes information on the types of waste, possible problems and threats in their management, rules for separation and sorting, and measures to organize temporary storage facilities.

It is worth distinguishing two groups of waste left behind after the destruction caused by military actions, as they differ from the usual construction waste.

1. Typical waste:

- structural materials, such as bricks, concrete, steel, wood, plasterboard, slate, roofing material, etc;
- parts from water supply and sewage systems
- parts of electrical networks, including electrical poles, wires, electrical equipment, and transformers;
- waste, soil, fallen trees, branches, etc;
- damaged vehicles and military equipment.

2. Specific waste:

- furniture, household appliances, household chemicals, carpets, etc., including burnt and damaged ones
- office furniture, office equipment, including burnt and damaged furniture
- chemicals, industrial waste, raw materials and products, production equipment
- road surface;
- medical waste, including epidemically dangerous waste
- chemical plant protection products and fertilizers.

An important aspect is the duration of response and recovery phases after the destruction of infrastructure, as they are crucial in making decisions on waste management after the war:

1. Emergency phase – 0-72 hours after the destruction.
2. Early recovery phase – approximately 72 hours after the destruction.
3. Recovery phase – after the end of armed aggression or military danger.

During each phase, the actions to be taken and the key issues to be resolved are clearly defined, with mandatory compliance with safety requirements. The result of these actions should be the elimination of all waste left after the destruction and the sustainable operation of the waste management system.

According to local governments, as of the beginning of 2024, about 600 thousand tons of demolition waste have been accumulated at temporary storage sites and landfills. These are the volumes accumulated only in the territory controlled by Ukraine, excluding waste generated in the temporarily occupied territories and territories of active hostilities [11].

In general, such accounting should be carried out at temporary storage sites for the destruction of waste. However, the following situation is observed in practice: the authorized bodies do not properly keep records of waste generated on the territory of their communities. Such records are kept only in the process of removing waste at the places of its temporary storage, while many wastes remain at the places of their generation and thus are not included in official statistics, since they are not recorded at the place of generation. Consequently, sorting is not carried out properly, so it is currently difficult to obtain high-quality secondary raw materials for further processing [12].

Currently, Ukraine does not have clear, understandable, and informative statistics on the quantitative and qualitative composition of demolition waste, and the existing data is not complete and does not allow for a correct assessment of the situation. To do this, it is necessary to characterize the housing stock by certain indicators, such as the distribution of houses by year of construction, data on the area, and a number of stories of houses, as well as to analyze the classification of residential buildings depending on the quality of housing and available engineering equipment [13].

Thus, waste management in Ukraine is currently a priority area of work for local governments, and most territorial communities need to improve their understanding of the role and responsibility of waste management. Therefore, this issue is becoming increasingly relevant and requires the development of a high-quality waste management system at the local level.

An important and necessary step may be the assistance of other countries, through the introduction of European practices and experience in reforming and improving the waste management system in Ukraine. The process of post-war economic development should be used for Ukraine's fundamental transition to a green and clean economy and should be built on modern circular economy principles to preserve resources.

Acknowledgments

We would like to express our gratitude to the MSCA4Ukraine team for the support of researchers who moved from Ukraine and the funding of the conducted research (Grant: MSW – PostWar, № 7813015388).

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