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## **SYSTEM FOR RECYCLING AND PROCESSING OF SOLID DOMESTIC WASTE OF MILITARY UNITS**

**Abstract.** *Within the framework of this article, the problem of utilization and processing of solid domestic wastes in military units and subunits deployed in the Arctic zone is being raised. Since the process of developing the Arctic by the Armed Forces of the Russian Federation is not new in the history of the state, a brief historical reference is given to the development of the Arctic by military units and subunits during the Soviet period. Due to the lack of a single concept, which caused the unsustainable management of solid domestic waste at that period, the consequences that led to a negative impact on the environment and, as a consequence, the deterioration of the environmental situation in the places of permanent disposition of units are described. To prevent repetition of mistakes at a new stage, the ways of solving this problem are considered and analyzed taking into account minimization of negative impact on the environment of the region. Based on the results of the analysis, a method for integrated waste management is proposed as the basis for the principles of utilization, which meets all the requirements. Also, the search for opportunities to reduce the costs for sorting and transporting solid domestic waste of military units and subunits is being carried out, since in most cases the locations of military installations are considerably remote from large settlements. This circumstance is one of the main factors that require mandatory consideration when choosing the method of utilization of solid domestic waste. The proposed system for recycling and processing of solid domestic waste from military units is described in detail. The main characteristics of the system that distinguish it from all available domestic and foreign analogues are given.*

**Keywords:** *utilization of solid domestic waste, integrated waste management, environmental safety, secondary raw materials, Arctic.*

Recently, the Russian Federation has begun to actively increase its presence in the Arctic region. This is due not only to the presence here of large deposits of minerals, but also to the need to strengthen the country's defense capability in conditions of a complex geopolitical situation.

The history of the presence of the Russian Armed Forces in the Arctic dates back to the Soviet period and is inextricably linked with the Cold War era.

From 1940-1950-ies in the Arctic began to appear military bases, primarily air defense bases, built airfields, radar stations. The Armed Forces created a "shield" on the islands of the Arctic Ocean, designed to save the country in the event of air aggression. It was assumed that the US would strike a nuclear strike precisely through the polar region. In the early 1990s, in connection with the disintegration of the USSR, the military left the Arctic, abandoning unnecessary equipment and leaving behind mountains of debris. For example, the land of Franz Josef is one of the northernmost territories of Russia and the world. It consists of 192 islands with a total area of 16,134 square kilometers. A few years ago, the Alexandra Land and Graham Bell, where Soviet military installations were once based, represented a rather dull picture - the ruins of stone and wooden buildings, wreckage of aircraft, rusted ships, construction and military equipment, containers, endless deposits of barrels and huge cisterns from oil products. All this was like an anthropogenic zone. According to some estimates, only in the coastal zone of the Arctic Ocean is up to four million tons of industrial and construction debris. And this is not counting everyday solid household waste, accumulated in this area for decades and poisoning the products of the decay environment.

Today in the Arctic zone a number of works are carried out to repair the existing infrastructure and create fundamentally new military complexes and bases.

However, the restoration of the presence of the Armed Forces of the Russian Federation in the Arctic should be carried out at a principally new level, which ensures that standards and requirements for environmental safety are taken into account both in the field and in the Arctic region as a whole.

Such an approach should take into account the principles of waste management in the Arctic, which differ significantly from those adopted in regions with a less severe climate. Features of handling waste in the permafrost zone are due to the lack of fertile soils and low temperatures, which prevents natural rotting. The burial of garbage in permafrost soils, according to environmentalists, is unsafe and causes serious damage to the environment.

Examination of existing methods of SDW disposal (incineration, recycling, briquetting, composting, etc.) makes it clear that each of these

methods has a number of shortcomings that can be solved using these technologies in a complex. Recycling of waste must be carried out guided by the principles of different approaches to the disposal of a separate type of solid waste, the most environmentally and economically feasible methods. It is an integrated approach to solving problems in the field of minimizing solid waste, involving in resource consumption and safe disposal, should underlie the modern principles of SDW disposal of military units and subunits in the Arctic zone. The normative act regulating the utilization and processing of solid domestic waste is Federal Law No. 89-FZ of June 24, 1998 "On Production and Consumption Waste" [2].

From the places of permanent deployment, as a rule, the removal of solid household waste is handled by the municipal organizations of a particular region with which the relevant contracts have been concluded, and the waste disposal process is carried out according to the methods used in a particular region, often consisting of landfills. Solid domestic waste generated during the quartering of military units in the field is not disposed of at all, however, modern autonomous field camps like the APL-500 [4] are equipped with a module with an incineration plant (Figure 1), capable of utilizing not only solid waste but also a solid component sewage effluent [5]. The operation of such an installation causes serious damage to the environment, its use is advisable only in the absence of other methods of disposal.



*Figure 1 - Module with incinerator*

It should be noted that the difficult climatic conditions, undeveloped transport network, significant remoteness of military units from settlements and many other factors make it difficult to timely remove waste and lead to their accumulation on the ground and, as a result, to negative impact on the ecosystems of the Arctic.

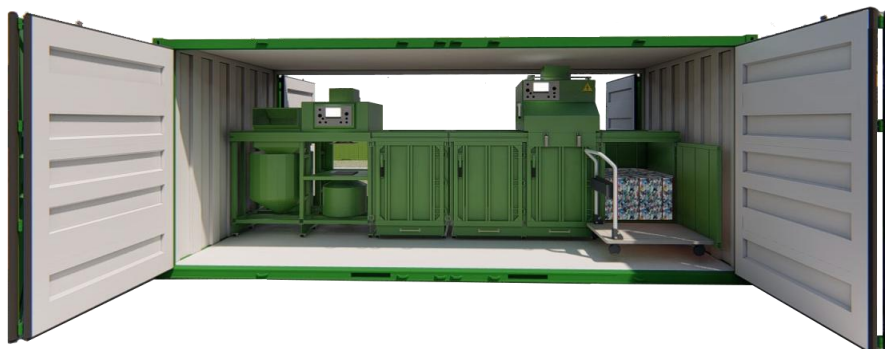
It is possible to solve the task of exporting solid waste from remote parts of the processing enterprises due to a decrease in the volume of exported solid waste. For these purposes, it is proposed to use the system of

recycling and processing of solid domestic waste (see Figure 2) developed specifically for military units, which allows sorting, compaction of solid waste and processing of polymer wastes directly in the places of permanent disposition of units, incl. in the field.



*Figure 2 - General view of the system*

The proposed system for solid domestic waste disposal is compact in size and functionality, it consists of a system for sorting and compacting various types of waste, operating both from the power grid and from a mechanical drive, as well as from a polymer waste recycling system that allows to produce a piece of construction material, such as paving slabs, roofing tiles, wall blocks, etc. The compactness and mobility of the system eliminates the need for large areas and allows it to be placed directly o in military units, it is also proposed to install a sorting and sealing system from four chambers and a system for processing polymeric waste into a special 20-foot container (Figure 3).



*Figure 3 - View of the system in a special container*

Distinctive features from all available analogues is compactness, universality, mobility of the installation. Packaging systems allow the packing of the briquette with polypropylene tape or polyethylene film, special reinforced rollers allow the unit to move freely, and together with liquid collection vessels, liquid waste can remove liquid from the waste, which minimizes the labor costs of the operator. The proposed system is highly efficient, since it can consist of an unlimited number of small modules 940x890x2400mm (LxWxH), transported on any transport platform. This is a key indicator when locating units outside populated

areas, where the problem of solid domestic waste disposal is particularly acute, due to increased transportation costs, which can be significantly reduced, due to a decrease in its volume. Sorted by quality composition of waste, with the possibility of secondary use, can be recycled to enterprises with profit, and manufactured piece building material (paving slabs, roofing tiles, wall blocks, etc.) used for the needs of units.

Thus, the use of the developed system for the utilization and processing of solid domestic waste by military units will allow the Armed Forces of the Russian Federation to increase their presence in the Arctic region, taking into account the preservation of local ecosystems not affected by anthropogenic activities, as well as preventing further degradation of natural complexes affected by anthropogenic activities.

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