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MANAGEMENT OF SPENT CHEMICAL CURRENT SOURCES  
IN UKRAINE: PROBLEMS AND WAYS OF THEIR SOLUTION

*The article analyzes the regulatory and legal framework in the field of spent chemical current sources management in Ukraine in terms of its compliance with environmentally safe management of hazardous substances. The national practice of utilization of chemical current sources of low capacity is studied. The Strategic guidelines for Ukrainian state ecological policy in the spent household batteries disposal are offered. A range of economic instruments to encourage the development of entrepreneurial activity on treatment of spent household batteries is proposed.*

*Keywords:* chemical current sources; hazardous wastes; waste management; spent batteries.

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ПОВОДЖЕННЯ З ВІДПРАЦЬОВАНИМИ ПОБУТОВИМИ  
ЕЛЕМЕНТАМИ ЖИВЛЕННЯ В УКРАЇНІ: ПРОБЛЕМИ  
ТА НАПРЯМИ ЇХ ВИРІШЕННЯ

*У статті проаналізовано нормативно-правове забезпечення у сфері поводження з хімічними джерелами живлення в Україні з точки зору відповідності вимогам екобезпечного поводження з небезпечними речовинами. Досліджено вітчизняну практику господарської діяльності щодо утилізації відпрацьованих хімічних джерел живлення малої ємності. Визначено стратегічні орієнтири державної екологічної політики України в регулюванні досліджуваної галузі. Запропоновано комплекс економічних інструментів стимулювання розвитку підприємницької активності у сфері поводження з відпрацьованими елементами живлення малої ємності.*

*Ключові слова:* хімічні джерела енергії; небезпечні відходи; поводження з відходами; відпрацьовані батарейки.

*Табл. 1. Літ. 20.*

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ОБРАЩЕНИЕ С ОТРАБОТАННЫМИ БЫТОВЫМИ  
ЭЛЕМЕНТАМИ ПИТАНИЯ В УКРАИНЕ: ПРОБЛЕМЫ  
И НАПРАВЛЕНИЯ ИХ РЕШЕНИЯ

*В статье проанализировано нормативно-правовое обеспечение в сфере обращения с химическими источниками тока в Украине, с точки зрения соответствия требованиям экобезопасного обращения с опасными веществами. Исследована отечественная практика хозяйственной деятельности в сфере утилизации отработанных химических источников тока малой емкости. Определены стратегические ориентиры государственной экологической политики Украины в регулировании исследуемой отрасли. Предложен комплекс экономических инструментов стимулирования развития предпринимательской активности в сфере обращения с отработанными элементами питания малой емкости.*

*Ключевые слова:* химические источники тока; опасные отходы; обращение с отходами; отработанные батарейки.

**Introduction.** Devices and equipment, the proper operation of which is provided by primary or secondary batteries have become usual companions of everyday life. The contemporary market offers to consumers a wide range of low capacity chemical

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current sources, most of which contain hazardous substances such as magnesium, zinc, mercury, lithium, cadmium, silver, nickel, lead. After the end of its useful life, batteries become ecologically hazardous wastes taken to dumps and landfills as well as municipal waste according to the existing in Ukraine practice on the treatment of chemical current sources of low capacity. One spent AA battery while falling into the general waste stream pollutes 400 liters of water or 20 m<sup>2</sup> of soils (Borgun et al., 2012). It is very difficult to estimate reliably the extent of the problem caused by the absence of effective schemes of treatment for spent household batteries, due to the absence of the system of their inventory as such. However, even approximate estimates are impressive: according to the data (Blagoustriy.Info, 2015) around 1 mln of household battery units are thrown away in Ukraine daily, and only 0.1% of them are recycled. According to other estimates (Kravchenko et al., 2013) spent batteries make approximately 0.25% of all municipal wastes.

**Recent researches and publications analysis.** Treatment of hazardous components of municipal wastes attracts more and more attention of scientists, though there are not many researches. The research team under the supervision of T.S. Borgun et al. (2012) developed the draft "Guidelines on the waste collection of the home electrical appliances" that is the basis of the corresponding Order of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine (22.01.2013, # 15). The group of authors (Fesyuk et al., 2011) developed the optimal (in terms of costs) option of the collecting system of spent mercury-containing light bulbs for households of the Volyn region. Yu.M. Makovetska (2011) investigated the opportunities of enterprises on the recycling of a wide range of wastes, including the hazardous ones (mercury-containing, chemical current sources etc.) and emphasized the need for improving the system of these waste collection to increase the production capacity of recycling enterprises. The results of scientific research of the team headed by (Kravchenko et al., 2013) became the basis for "Guidelines on the safe treatment of components of hazardous waste as components of municipal waste".

While viewing positively the contribution of all these scientists to the problem solving regarding treatment of hazardous components of municipal waste, ambiguity and contradictions in the provisions of the developed laws should also be pointed out and regulations on the organization of spent batteries collection systems (Law of Ukraine, 05.03.1998, # 187/98-VR; Law of Ukraine, 23.02.2006, # 3503-IV).

European practice on treatment of spent chemical current sources (Rogulski and Czerwinski, 2006) shows that development of high efficiency schemes on collection and recycling of batteries is possible under clearly determined obligations of all parties involved (producers, importers, distributors, government agencies and population) and under the condition of the implementation of effective economic mechanism stimulating the economic activity in this field. Thus, the study and generalization of European experience on economic and legal regulation must also form the basis for the improvement of domestic state policy in the field.

**The purpose of the research** is to determine the peculiarities of the treatment of spent chemical current sources in Ukraine and the development of recommendations on the improvement of state environmental policy in this field.

**Key research findings.** The main regulatory act on wastes treatment in Ukraine is the Law of Ukraine "On Waste" (5.03.1998, # 187/98-VR). This law defines the

necessity of separate collection of hazardous components of municipal waste, their separation at the stage of collection or sorting and their delivering to specialized enterprises that have licensees for hazardous waste treatment (Art. 35-1). The "State sanitary regulations and rules on the provision of residential areas" (17.03.2011, # 145) imposed on the owners of waste the obligation for separate collection of hazardous waste as a components of municipal waste and also determined the need for their storage, exclusion of their destruction and mixing with each other and with other waste during transportation.

All the above mentioned outlines the general legal framework on the treatment of hazardous waste as components of municipal waste. At the same time, spent chemical current sources (SCCS), which are not suitable to be used according to the consumer's decision because of physical deterioration, obsolescence, irreparable defect or other reasons, irrespective of the place of generating, are the object of the regulation of the Law of Ukraine "On chemical current sources" (23.02.2006, # 3503-IV). In case when spent batteries contain environmentally hazardous substances and their compounds, they are treated as "hazardous spent chemical current sources" and, thus, do not gain the legal status of dangerous waste.

It should be added, that despite the definition of the terms provided by the law "On chemical current sources" the State Waste Classifier DK 005-96 (1.05.2015) provides the inventory of "Damaged or spent batteries" by code 7710.3.1.25 as products waste that were formed during product operation and collected separately. In addition, spent batteries that contain lead, cadmium or mercury (or other substances in the amount that makes them dangerous) are included to the Yellow waste list and other wastes of galvanic cells are included to the Green waste list (Cabinet of Ministers of Ukraine, 13.07.2000). Let us add that from the consumers' point of view spent batteries are waste, i.e. goods that completely or partially lost their consumer properties and cannot be used further, thus owner disposes them by recycling or disposal (Law of Ukraine, 05.03.1998, # 187/98-VR). Taking into account the concentration of hazardous substances in batteries, these wastes can be rightly considered dangerous and European practice of spent electrochemical current sources is based on such principle (Rogulski and Czerwinski, 2006).

Returning to the issue of the collection and recycling of small household batteries it should be noted that the Law of Ukraine "On chemical current sources" (23.02.2006, # 3503-IV) provides the collection and recycling of spent chemical current sources by specialized enterprises (production) directly or through network of collection centers. The law defines the obligation of physical persons (not registered as business entities) to deliver dangerous spent chemical current sources with capacity of 7 A/h and more for recycling to specialized enterprises on recycling at specialized production or to their collection centers (Art. 17). Same is stated for business entities of all forms of ownership. It should be noted that the law provides the latter with economic motivation for such activity, i.e. the obligation to pay the environmental pledge while purchasing chemical current sources with the capacity of 7 A/h and more (Art. 19). Population is stimulated to apply the recycling only through penalties: "if citizens do not the delivering the spent hazardous chemical current sources with the capacity of 7 A/h and more in accordance with the established procedure for recycling to the enterprises carrying out the activity on collection and recy-

cling of spent chemical current sources they will be punished by a fine from one to three personal exemption" (Law of USSR, 07.12.1984, # 8073-X).

However, operations on treatment of hazardous waste chemical current sources with the capacity up to 7 A/h are regulated by the law "On chemical current sources" (23.02.2006, # 3503-IV).

The absence of a clearly defined procedure on collection, transportation and recycling as well as the rights, obligations and responsibilities of the owners of waste and business entities authorized to carry out these operations leads to further aggravation of the problem of treatment of spent chemical current sources of low capacity. Some attempts to solve this problem were made by the Ministry of Regional Development, Construction and Housing and Communal Services by the publication of "Guidelines on the safe treatment of the components of hazardous waste as components of municipal waste" (30.08.2013, # 423). This document determines the procedure on collecting and transporting of hazardous waste as components of municipal, including batteries, and it contains also the references to the "Rules on providing the services on municipal waste removal" (10.12.2008, # 1070).

Provided by different regulatory laws and regulations, provisions on carrying out the operations in the field of treatment of spent batteries to some extent are contrary to the general principles of legislation in this field (Table 1).

According to the data in Table 1, the system of collection of spent household batteries, that was provided by "Guidelines on safe treatment of components of hazardous waste as components of municipal waste" (30.08.2013, # 423), contradicts the provisions of the Law of Ukraine "On chemical current sources" (23.02.2006, # 3503-IV) and mentions the attraction of additional operator to carrying out the operations on hazardous spent current sources treatment, that is the transporter of municipal waste, that, in our opinion, is not justified. Firstly, it does not guarantee the compliance with environmental standards on the collection of hazardous waste in the place for containers of municipal waste and their transportation. Secondly, the issue about the payment of costs on services for removal of hazardous waste on the basis of averaged standards of services providing is debatable due to rather unbalanced use of batteries by households and potentially high costs of transportation as there are special requirements for hazardous cargo. Requirements can be as follows: special equipment, the loading system, cargo insurance, requirements to personnel etc.

Thus, the existing legislative initiatives in the field of regulation of operations on the treatment of hazardous spent chemical current sources generated in households do not cover many issues, such as: can local authorities and transporters of municipal waste provide environmentally safe collection and transportation of hazardous cargo? Can it happen, that red container in the place of municipal waste collection will turn into the source of chemical pollution at the territory of a single yard? Is such system a socially fair one? And finally, it should be noted that "Guidelines" (30.08.2013, # 423) were approved in 2013, but have not still been put in practice.

In order to form the directions on the improvement of national practice on the treatment of hazardous spent chemical current sources generated in households, we consider it necessary to examine the EU legislation on electrochemical current sources treatment.

Table 1. Comparative analysis of the provisions of current laws and regulations on the treatment of spent chemical current sources generated in households, authors' grouping

Stages of the treatment of spent hazardous chemical current sources	The Law of Ukraine «On chemical current sources» (23.02.2006, # 3503-IV)	«Guidelines on safe treatment of the components of hazardous waste as components of municipal waste» (30.08.2013, # 423)
<i>Organizational provision of the system functioning</i>		
Collection	- separate; - carried out by specialized enterprises (production), directly or through the network of collection centers; - compulsory for spent hazardous chemical current sources with the capacity of 7 A/h and more	- separate; - carried out by the relevant arrangement of places for container for municipal waste collection by replaceable hermetic metal (for mercury-containing waste) or red stationary containers
Transportation	- carried out by specialized companies	- carried out in accordance with the «Rules on providing the services on municipal waste removal» (10.12.2008, # 1070) by transporter of municipal waste with special equipment
Recycling	- carried out by specialized enterprises (production)	- carried out by specialized enterprises (production)
<i>Economic provision of the system functioning</i>		
Financing of operations on collection (transportation)	- not specified	- population covers the cost of the services on hazardous waste removal according to the standards of service providing, that is 0.01 kg /person per day
Financing of operations on waste recycling (disposal)	- not specified	- not specified

European legislation on wastes treatment is based on horizontal regulation when laws and regulations deal with all types of wastes, and on vertical regulation when laws and regulations deal with specific types of wastes and regulate the sequence of operations on their treatment.

The aim of the Directive 2006/66/EC "On the disposal of spent batteries and rechargeable batteries" is to regulate the processes of collection, storage and recycling of spent batteries and rechargeable batteries in all EU countries, as well as the limitation of concentration of some heavy metals such as mercury, cadmium and lead. In particular, this document determines the minimum levels of collection and recycling of spent batteries: up to September 26, 2016 45% of all batteries purchased on the territory of the EU should be recycled. At the same time production and sale of batteries and rechargeable batteries with concentration of the most hazardous substances such as mercury (more than 0.0005% by weight) and cadmium (more than 0.002% by weight) is prohibited (European Parliament and Council, 2006).

Financing of operations on collection, treatment and recycling of batteries is performed by producers in the amount necessary for covering the costs on these operations, as well as costs on their information support minus the income received from the sale of recovery materials. Member countries can also use different economic instruments to promote the collection of spent batteries and rechargeable batteries and the use of electrochemical current sources with less concentration of pollutants, for example, differentiated tax rates etc. (European Parliament and Council, 2006).

In Ukraine only one enterprise – SOE "Argentum" – located in Lviv, carries out the economic activity on batteries recycling. This enterprises along with non-governmental organizations, within the framework of the All-Ukrainian Environmental Initiative "Clean Ukraine – Dispose batteries" created a network of collection center of low capacity household chemical current sources (not the collection center for enterprises as in the interpretation of the Law of Ukraine "On chemical power sources"! ). Plastic containers for the collection of batteries are placed at trade centers, educational institutions, enterprises, institutions and organizations of different forms of ownership and industries (Blagoustriy.Info, 2015). According to the data given by (SOE "Argentum", 2015), only during the period of January-February 2015 the enterprise received 5,141 tons of spent chemical current sources. Taking into account that the costs connected with the delivery of waste to the recycling place were covered by customers (or by participating organizations), we can conclude that there exists sufficient motivation for population on separate collection of spent batteries. However, effective long-term implementation of such programs country wide is hardly possible.

Also we cannot but pay attention to the negative circumstances that follow the processes of spent batteries recycling. The information on the amount of chemical current sources received by the enterprise and the amount of the recycled ones (SOE "Argentum", 2015) certifies that during the period from December 2012 to February 2015 the enterprise received 34,732 tons of raw material but only 2,340 tons (i.e. 6.7%) were recycled. The rest 32,392 tons of spent chemical current sources, including those that contain mercury and cadmium, are accumulated at the enterprise, which does not have the technology for their recycling (Melen-Zabramna et al., 2015). Under such conditions, the enterprise is a potential source of increased environmental hazard, and its activity should be regulated under the procedure specified in law. At the same time, according to the information of the Ministry of Ecology and Natural Resources (International public interest organization "Environment-People-Law", 2013) "Argentum" does not have permits to conduct economic activity on hazardous waste treatment and did not go through the procedure specified in law of the assessment of the impact of technological processes of waste recycling on the environment (state environmental expert evaluation).

Taking into account the abovementioned, we consider that the settlement of the problem on the treatment of spent household batteries in Ukraine, first of all, requires the formation of conditions for the development of economic activities on the recycling of spent chemical current sources and should include the following:

- implementation of inventory system of chemical current sources, produced (imported), including the noting of their component composition;

- determination of the maximum permissible concentration of most hazardous substances (mercury, cadmium, lead etc.) in chemical current sources, which are produced (imported);
- financing of scientific research in the field of recycling technologies of spent chemical current sources;
- promotion of the development of economic activity on recycling of chemical current sources and formation of a network of collection centers for specialized enterprises on spent chemical current sources collection;
- elimination of ambiguities in legislation on the interpretation of spent chemical current sources containing hazardous substances (determining them as waste, in particular, hazardous ones);
- review of the provisions of the Law "On chemical current sources" concerning the obligations of consumers and business entities on the treatment of spent chemical current sources of small capacity in the context of the general principles of waste (hazardous) treatment;
- formation of the economic mechanism providing the effective recycling of spent waste chemical current sources;
- implementation of educational activities aimed at informing about the danger of spent chemical current sources, rules and procedures of safe treatment, and educational (pedagogic) activities aimed at increasing environmental awareness on separate collection and sorting of waste, in particular, spent batteries.

We consider it necessary to study in more detail the formation of complex of economic instruments of economic entities motivation on carrying out all operations in the chain of environmentally safe and effective treatment of spent batteries. Among all economic instruments that promote recycling the following ones should be mentioned:

- exemption from the value added tax (VAT) for the transactions on delivery of the equipment for recycling of spent chemical power sources;
- implementation of the recycling fee to be paid by economic entities during the production and import of chemical current sources and accumulated at a special account of the Ministry of Ecology and Natural Resources to be further used to cover the costs of functioning of the collection system for spent chemical current sources;
- the use of economic pledge as an instrument for promotion of separate collection and delivery of batteries for recycling, especially batteries containing toxic substances. In case, when customer fails to fulfill the obligations on delivering the spent current sources for disposal the accumulated funds should be used to finance the measures on collecting spent chemical current sources.

The implementation of these initiatives requires the corresponding improvement of tax legislation in Ukraine, in particular, the following articles of the Tax Code of Ukraine (2.12.2010): Art. 197.16 (the intended purpose of equipment, the import of which into the customs territory of Ukraine is exempt from VAT), Art. 8-9 (the implementation of the recycling fee on operations on the import of chemical current sources as well as their production). It is obvious that the expenses of business entities connected with the payment of recycling fee will cause higher prices of production and will be ultimately paid by consumers. It can lead to shadowing of chemical current sources market (especially in border regions). Thus, while implementing such

instruments it is necessary to provide scientifically grounded rates of recycling fee in the amount sufficient to cover the costs on collecting spent chemical current sources and to intensify the control over the movement of goods across the state border.

**Conclusions.** The results of the conducted research show that contrary to the requirements (declared in the law of 2006) on providing environmentally safe treatment of spent waste chemical current sources, the system of their treatment that would meet the principles of the rule of law and the standards of environmentally safe treatment of hazardous substances is not available today. The major barrier for spent batteries recycling is the absence of specialized recycling enterprises and production. Some steps that were made by central executive authorities on the regulation of operations on spent batteries collection need to be reviewed because of the mismatch with the general principles of legislation in the field of chemical current sources and the inadequate rationale of the provided financing instruments on collection operations. Taking into account the experience of European regulation in the fields of production, consumption and recycling of electrochemical current sources, the corresponding directions on the improving of state policy of Ukraine are described here. There is the necessity for the formation of a complex of following effective economic instruments to promote entrepreneurial activity in the field of spent chemical current sources treatment: tax exemption by means of the value added tax for the operations on the purchase of equipment for the recycling of spent chemical current sources; imposition of recycling fee to cover the costs on the functioning of the collection system of spent chemical current sources; the use of economic pledge as an instrument in promotion of separate collection and delivery of spent chemical current sources for recycling.

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